

GAO

Report to the Ranking Minority
Member, Subcommittee on
Telecommunications and the Internet,
Committee on Energy and Commerce,
House of Representatives

November 2002

TELECOMMUNICATIONS

Additional Federal Efforts Could Help Advance Digital Television Transition



G A O

Accountability * Integrity * Reliability



Highlights of [GAO-03-7](#), a report to the Honorable Edward J. Markey, Ranking Minority Member, Subcommittee on Telecommunications and the Internet, Committee on Energy and Commerce, House of Representatives.

Why GAO Did This Study

The transition to broadcast digital television (DTV) will provide new television services and the improved picture quality of “high definition television.” It will also allow some portions of the radiofrequency spectrum used for broadcasting to be returned for public safety and commercial uses. The Congress set December 2006 as the target date for completing the DTV transition and turning off the analog broadcast signals. However, this date can be extended if fewer than 85 percent of households in a market are able to receive the digital signals. GAO was asked to assess issues related to the DTV transition.

What GAO Recommends

GAO recommends that FCC

- explore options to raise public awareness about the DTV transition and its implications,
- examine the costs and benefits of mandating that all new televisions be digital cable-ready, and
- examine the advantages and disadvantages of setting a fixed date for transferring must-carry rights from broadcasters’ analog signals to digital signals.

FCC noted actions it has taken and proceedings it has under way to address the intent of these recommendations.

<http://www.gao.gov/cgi-bin/getrpt?GAO-03-7>

To view the full report, including the scope and methodology, click on the link above. For more information, contact Peter Guerrero, (202) 512-3841 or guerrerop@gao.gov.

TELECOMMUNICATIONS

Additional Federal Efforts Could Help Advance Digital Television Transition

What GAO Found

Numerous factors are impeding the progress of the DTV transition, making it unlikely that 85 percent of households will be able to receive DTV signals in many markets by December 2006.

- Few consumers own digital television equipment. Only about 1 percent of television equipment sold in 2001 could receive digital signals. This is largely because digital television sets and tuners are expensive and high definition programming is limited.
- Many consumers are unaware of the DTV transition. In a random household survey conducted for GAO, 40 percent of respondents had never heard about the transition; only one in five were “very aware” of it. In addition, the quality of information that consumers receive about DTV products at the retail level may be inconsistent. In visits to 23 DTV retailers, GAO found that sales staff sometimes provided inaccurate or incomplete information about DTV equipment and programming.
- Cable and satellite digital carriage is limited. The great majority of American households receive their television via cable or satellite. However, cable carriage of local digital broadcast channels is very limited. Furthermore, satellite providers currently do not carry any markets’ local digital broadcasts.

To speed the DTV transition, the Federal Communications Commission (FCC) has required that by 2007 most new television sets be capable of receiving digital signals over the air. Another policy option to speed the transition would be to also require that new sets be capable of receiving digital signals via cable. Because many more American households receive television via cable than receive it over the air, mandating that new sets be “digital cable-ready” could effectively speed the transition. However, the cost to consumers of such a policy would first need to be assessed, and outstanding issues related to the compatibility between cable systems and DTV equipment would need to be resolved.

Currently, broadcast stations have the right to require that cable systems in their market carry their analog signals (a right known as “must-carry”). One policy option to facilitate the transition would be to set a fixed date when this must-carry right would transfer from broadcasters’ analog signals to digital signals. This option might speed cable carriage of digital broadcasts without requiring cable systems to carry both analog and digital broadcasts simultaneously. Because such a policy could have both advantages and disadvantages, it needs to be carefully evaluated.

Contents

Letter		1
	Results in Brief	3
	Background	6
	Transition to DTV Will Allow the Return of Valuable Spectrum but Will Require Millions of Americans to Buy New Equipment	8
	Consumer Adoption of DTV Has Been Slow, Partly Because Many Americans Are Unaware of the Transition and Are Not Well Informed about DTV Products	15
	Carriage of Digital Signals by Cable and Satellite Operators Is Insufficient to Help Achieve 85 Percent Threshold Quickly	20
	Availability of Digital Programming Is Increasing but Still Limited, Possibly Due in Part to Copy Protection Concerns	27
	Digital Over-the-Air Tuners Have Been Mandated, but Digital Cable-Ready Capability Has Not	33
	Conclusions	37
	Recommendations for Executive Action	39
	Agency Comments	40
Appendix I	Scope and Methodology	42
Appendix II	Equipment Issues Affecting the DTV Transition	44
	Digital Inputs and Copy Protection Technologies	44
	Digital-to-Analog Converter Boxes	44
	Adequacy of Over-the-Air Reception	45
Appendix III	Analysis of the Consumer Survey	47
Appendix IV	Comments from the Federal Communications Commission	49
	GAO Comments	51
Appendix V	GAO Contacts and Staff Acknowledgments	52
	GAO Contacts	52
	Staff Acknowledgments	52

Table

Table 1: Differences in Familiarity with the Digital Television Transition on the Basis of Household Characteristics

48

Abbreviations

DMCA	Digital Millennium Copyright Act
DTV	digital television
FCC	Federal Communications Commission
HD	high definition
NCTA	National Cable & Telecommunications Association
ORC	Opinion Research Corporation
POD	point of deployment



G A O

Accountability * Integrity * Reliability

United States General Accounting Office
Washington, DC 20548

November 8, 2002

The Honorable Edward J. Markey
Ranking Minority Member
Subcommittee on Telecommunications
and the Internet
Committee on Energy and Commerce
House of Representatives

Dear Mr. Markey:

The transition to broadcast digital television (DTV) offers the promise of more programming options, interactive services, and the high-resolution picture quality provided by “high definition television.” It also will allow some of the valuable radiofrequency spectrum now used for broadcasting to be made available for other uses.¹ To help realize this transition, the Congress and the Federal Communications Commission (FCC) have established requirements for television stations to broadcast digital signals. In an April 2002 report, we discussed the progress that stations are making in rolling out these digital broadcasts.² Although the provision of digital broadcast signals is progressing, many other things must happen before the transition can be successfully completed. These include the adoption of DTV equipment by consumers, cable carriage of digital broadcast channels, and the availability and provision of digital programming.

As FCC Chairman Michael Powell has noted, at the heart of the DTV transition lies a classic chicken-and-egg problem. Until more consumers have purchased digital television sets, there is little incentive for networks to provide and cable systems to carry more digital programming. Yet without much digital programming available, consumers have little incentive to purchase digital television sets. In April 2002, the Chairman issued a proposal for industry actions to speed the DTV transition. The

¹The radiofrequency spectrum is the part of the natural spectrum of electromagnetic radiation lying between the frequency limits of 9 kilohertz and 300 gigahertz. It is the medium that makes possible wireless communications, including cellular and paging services, radio and television broadcasting, radar, and satellite-based services.

²U.S. General Accounting Office, *Telecommunications: Many Broadcasters Will Not Meet May 2002 Digital Television Deadline*, GAO-02-466 (Washington, D.C.: Apr. 23, 2002).

proposal laid out specific—though voluntary—actions that various industries should take to provide an “immediate spur” to the DTV transition. In addition, in August 2002, FCC established a requirement that by July 2007 most new television sets include a tuner capable of receiving over-the-air digital broadcasts.

The DTV transition began in 1987 when, at the request of many broadcasters, FCC began to investigate issues related to the introduction of advanced technologies for improvements to television picture and sound. This process led to a study of the feasibility of transitioning from the conventional analog broadcasting system to a digital broadcasting system. Since that time, regulatory actions by FCC, in conjunction with direction set out by the Congress in the Telecommunications Act of 1996 and the Balanced Budget Act of 1997, have established the framework and timeline for the DTV transition. During the transition, all television stations in the United States have been provided with a second channel on which to operate a digital broadcast in addition to the channel on which they operate their analog broadcast. Once the transition is complete, broadcast stations will operate solely in digital. FCC set 2006 as the target date for the completion of the DTV transition. The Congress later codified this date but also provided for extending the date under certain conditions. The goal is for broadcasters to cease broadcasting the analog signal by the target date so that some of the radiofrequency spectrum needed for analog broadcasting can be made available for other uses. However, many believe that the transition will not be completed by the target date.

We were asked to assess issues related to the DTV transition, including (1) the benefits and implications of turning off the analog broadcast signals, (2) consumer awareness and adoption of DTV, (3) cable and satellite carriage of digital signals, (4) the availability of digital programming and the role of copy protection concerns, and (5) issues related to DTV tuner mandates.

To meet these objectives, we interviewed representatives of companies in several key industry segments, including broadcasters, television producers, cable and satellite companies, and retailers and manufacturers of DTV equipment. We also had several meetings with FCC staff and various industry trade groups. To better understand consumer knowledge of the DTV transition, we contracted with a survey research firm to conduct a random household survey that asked questions designed to ascertain consumers’ level of knowledge about the DTV transition. We also visited a variety of retail stores to obtain anecdotal information on retail

practices in marketing and selling DTV products. A more detailed discussion of our scope and methodology is provided in appendix I.

We performed our review from May 2001 through August 2002 in accordance with generally accepted government auditing standards.

Results in Brief

An important benefit of completing the transition to digital television (DTV) is to recapture portions of the radiofrequency spectrum that are currently used for broadcast television. Some of the valuable spectrum television broadcasters currently use to broadcast analog signals has been reallocated for both public safety needs—such as emergency services—and commercial services. However, under the law, television stations do not have to return their analog channel until 85 percent of households in a market can receive DTV signals; this is not likely to occur by the December 2006 target date in many markets. FCC is still in the process of determining how to interpret the statutory provisions concerning when 85 percent of households can receive DTV. However, even when it has been determined that the 85 percent threshold has been met, questions remain about the impact on the remaining 15 percent of the population, who would not be able to access at least some of their local broadcast channels until they purchased new equipment.

One impediment to the transition is that consumer sales of digital television sets, though increasing, are still relatively small. One barrier to sales is that digital television sets are still expensive compared with analog television sets, but another barrier may be that many Americans have little awareness of the DTV transition and its implications. For example, 40 percent of respondents to a random household survey conducted for us said they had never heard about the DTV transition, and fewer than one in five said they were “very aware” of the transition. In addition, the quality of information that consumers receive about DTV products at the retail level may be inconsistent. During visits to 23 DTV retailers in five states, we found that while much of the information provided by DTV sales staff was correct, many staff were uninformed about important issues, such as the ability to receive DTV over the air and the amount of high definition content currently available. Moreover, few of the screens displayed in the stores allowed customers to actually view a high definition picture. The Chairman of FCC has called upon broadcasters, cable systems, and DTV manufacturers and retailers to do more to market and promote DTV programming and equipment to consumers. However, at this time, FCC does not have significant initiatives of its own under way to raise public

awareness about the DTV transition, apart from information that it provides through its Web site and call center.

Cable and satellite operators are not currently planning to carry significant numbers of local digital broadcast stations, which further hinders the completion of the DTV transition. Because more than two-thirds of Americans receive their television via cable, cable carriage of DTV broadcast signals is important for facilitating the transition. Under one provision in the law, households receiving DTV via cable (but that do not have the equipment to receive DTV over the air) count toward the threshold only if their cable system carries one local DTV broadcast channel from all stations broadcasting such channels in its market. However, because cable systems are reluctant to use scarce channel capacity to carry a broadcast station's digital signal, particularly if it only duplicates what is being shown on the station's analog signal, market forces alone may not result in cable systems carrying all of the local broadcasters' digital signals in a market. Direct broadcast satellite providers, which serve about 17 percent of American television households, are probably even less likely than cable systems to provide all local digital broadcasts; because satellite services are national in scope, these providers face constraints in their ability to carry local broadcasts.

Although broadcasters have the right to demand cable carriage of their analog broadcast channels, FCC has tentatively decided that it would be unconstitutional to require cable systems to carry both analog and digital channels during the transition. However, another option we have identified is to set a "date-certain" when broadcasters would, all at once, switch from having the right to demand carriage of their analog channels to having the right to demand carriage of their digital channels. This policy option could help speed the transition by requiring cable carriage of digital broadcast signals without the need for mandatory dual carriage. Because this option also could have certain disadvantages, it would benefit from further study to determine its viability.

The limited availability of digital programming, possibly due in part to concerns over copy protection, also is slowing the DTV transition. Digital programming, particularly high definition programming, is important both to encourage consumers to purchase digital television sets and to encourage cable companies to carry digital broadcast signals. The amount of digital programming has increased considerably in the past 2 years, but it still represents only a small portion of total television programming. Broadcast networks and cable networks vary greatly in terms of the amount of high definition programming they are providing. The provision

of more digital content is held back by factors that include the small number of viewers with the equipment to watch DTV; the greater cost and complexity of filming or formatting high definition programming; and, possibly, concerns about unauthorized copying and retransmission of digital content provided over the air. In response to this last factor, FCC recently initiated a rulemaking on digital broadcast copy protection issues.

FCC's August 2002 order requiring that most new broadcast television sets include a tuner capable of receiving digital signals over the air raises several issues. This DTV tuner mandate, which is being phased in over 5 years, will speed the transition by increasing the number of households able to receive over-the-air DTV. However, there is some debate about how much this mandate will increase the price of television sets; FCC argues that the economies of large-scale production will keep the added cost of these tuners relatively low. Still, because fewer than one in five Americans actually get their primary television signal over the air, questions have been raised about the economic efficiency of requiring an over-the-air digital tuner in all new television sets. Moreover, although the DTV tuner mandate will help reach the 85 percent threshold, it will do so largely because cable and satellite households that purchase new television sets that include the digital over-the-air tuner will count toward the threshold even though they may not actually watch their television over the air.

One potential option for addressing this issue would be to mandate that, in addition to having an over-the-air tuner, new television sets also should be digital "cable-ready." A digital cable-ready television would likely include a digital cable tuner as well as a security device to handle encrypted cable programming. The marginal cost of mandating digital cable-ready capability has not yet been studied in depth, and other issues regarding the interoperability of cable systems with DTV equipment are still outstanding. However, because far more American households receive television via cable than receive it over the air, mandating digital cable-ready capability could be an effective policy for speeding the DTV transition if the marginal cost of doing so were found to be reasonable and if the outstanding interoperability issues could be settled.

To address the barriers we identified facing the DTV transition, we recommend that the Chairman of FCC (1) explore options that FCC could take to raise awareness among the public about the DTV transition and the implications it will have; (2) direct the relevant FCC bureaus and offices to examine the costs and benefits of mandating that all new televisions be digital cable-ready, and report its recommendations regarding the actions

it believes FCC or the Congress should take; and (3) direct FCC's Media Bureau to examine the advantages and disadvantages of a policy to set a date-certain to switch from full cable carriage of analog signals to full cable carriage of digital signals.

We provided a draft of this report to FCC for comment. FCC said it agreed that raising public awareness about the DTV transition was important, and it noted actions by Chairman Powell and private industry to help achieve this increased awareness. FCC also said it has been engaged in long-standing efforts to achieve compatibility between digital television sets and cable systems and will address this issue in a forthcoming Report and Order. In addition, FCC said that it sought comment on a wide range of options related to digital must-carry, including an option similar to the one described in this report, and that FCC staff are in the process of drafting an order on this issue.

Background

The nation is currently undergoing a transition from analog to digital television broadcasting. Traditional analog broadcasting uses the radiofrequency spectrum to transmit analog signals—that is, signals in which motion pictures and sounds have been converted into a “wave form” electrical signal. With digital technology, the analog wave form is converted into a stream of digits consisting of zeros and ones. For digital television service, like analog service, broadcast stations have been allotted 6 MHz of radiofrequency spectrum for each television channel. However, because digital video signals can be compressed, the spectrum can be used more efficiently, allowing much more information to be broadcast using the same amount of spectrum.

As a result, digital broadcasting provides greater flexibility in terms of the type of television content that can be provided. Most notably, digital broadcasting makes it easier to offer high definition (HD) television. HD television provides roughly twice as many lines of resolution, creating a television picture that is much sharper than traditional analog television pictures. HD television can also provide CD-quality sound and is in “widescreen” format, with display screen ratios similar to a movie theater. With digital broadcasting, 6 MHz of spectrum can be used for at least one channel of HD programming, or it can be subdivided to allow the simultaneous transmission of as many as six separate TV programs of lower quality standard definition television, a concept known as “multicasting.” A broadcast station can also provide “datacasting”—using digital signals to transmit text or data, such as stock quotes or electronic newspapers. “Broadcast stations,” also known as “broadcasters,” are local

operations that transmit signals over the air from the station's transmission tower to the antennas of television sets. Broadcast stations may get their programming content through an affiliation with a "broadcast network" (such as ABC, NBC, or PBS) or a station may be an independent broadcaster. Most stations also produce some of their own content, such as local news programming.

More than four-fifths of American households do not receive their primary television service over the air via their television set's antenna. Instead, they pay a fee to a subscription television service, such as a cable or satellite service. A "cable system" is a company that runs a localized network of cable lines to deliver television signals to subscribers. Some cable systems are individually owned, while others are owned by companies that own and operate more than one cable system. Direct broadcast satellite is a nationally distributed service that transmits programming from orbiting satellites to a customer's satellite dish. Cable systems carry all of their markets' local analog broadcast stations, while satellite services carry local broadcast stations in select markets. "Cable networks" (such as CNN or MTV) produce or acquire television programming that is delivered to cable systems and satellite operators.

Like broadcasters, cable television systems are also transitioning to digital, although they are under no government mandate to do so. Many cable operators have added "digital tiers" to their programming offerings. Satellite systems have always transmitted their signals in digital. Both cable and satellite systems primarily use digital technology as a way of increasing the number of channels they can offer. References in this report to the "DTV transition" refer to the transition by local broadcast stations to the use of digital broadcast signals; it does not refer to the way that cable or satellite systems transmit their signals.

For the DTV transition to be completed, and analog broadcasting to end, two major things need to happen: (1) television stations must broadcast a digital signal and (2) consumers must be able to view that signal. By May 1, 2002, all full-power commercial television stations across America were to have begun airing a DTV signal. As of October 17, 2002, however, only about 43 percent of these stations were broadcasting digitally; the remainder had filed for extensions with FCC. By May 1, 2003, all public broadcast stations also are to be broadcasting a DTV signal.

For a household to see local digital broadcast signals via cable or satellite service, the household must have the necessary equipment, and its cable or satellite service must also carry local digital signals. For consumers to

see the digital signal over the air via an antenna, they must either have a digital-to-analog converter box that will allow them to watch digital signals on their existing analog set, or they must own a digital television set that includes a tuner capable of receiving and processing a digital signal.³ To speed the DTV transition, FCC adopted in August 2002 a requirement that most new television sets must include an over-the-air tuner that receives digital broadcast signals. FCC set various deadlines for manufacturers to include DTV tuners in new television sets, with all sets over 13 inches required to include the tuners by July 1, 2007.

Transition to DTV Will Allow the Return of Valuable Spectrum but Will Require Millions of Americans to Buy New Equipment

One important goal of the DTV transition is to recapture portions of the radiofrequency spectrum currently used for analog broadcasting so this spectrum can be used for public safety needs and auctioned to private companies. Under the law, the spectrum is due to be reclaimed by December 2006, but this date can be extended if less than 85 percent of households in a given market can receive the DTV signal. FCC is still in the process of determining how to interpret the statutory provisions concerning when the 85 percent threshold has been met. Even when 85 percent of households can receive DTV, concerns remain about the impact on the remaining 15 percent of the population, who would not be able to access some or all broadcast channels until they purchased new equipment.

Recapture of Broadcast Spectrum Is an Important Goal of the DTV Transition

An important motivation for completing the DTV transition is to recapture parts of the broadcast spectrum. One goal is to free up portions of the broadcast spectrum that have been reallocated for public safety needs, such as communications by local police and fire departments. The Public Safety Wireless Advisory Committee, in a 1996 report to the FCC, said that an additional 97.5 MHz of spectrum would be needed for public safety communications uses by 2010. In the Balanced Budget Act of 1997, the Congress directed FCC to reallocate 24 MHz of the spectrum to be reclaimed from broadcasters to public safety uses. After the terrorist attacks of September 11, 2001, the Chairman of FCC said that freeing up spectrum for public safety uses has become an even higher priority.

³There are different types of digital tuners, depending on whether the digital signal is being received over the air, via cable service, or via direct broadcast satellite service.

In addition, the vast expansion of wireless technologies in recent years by mobile telephone, broadband Internet, and wireless companies, has greatly increased these industries' demand for portions of the radiofrequency spectrum currently used for television broadcasting. This demand arises not only because of the general scarcity of spectrum, but also because the spectrum used for broadcasting has qualities that make it ideal for the provision of many wireless mobile services.

The Balanced Budget Act of 1997 directed FCC to auction certain portions of the spectrum freed up by the DTV transition according to certain timelines. The Congressional Budget Office has raised concerns that early auction timing could devalue the spectrum because bidders would have to wait years before being able to use the spectrum. The Auction Reform Act of 2002⁴ modified the statutory deadlines set by the Balanced Budget Act and gave FCC increased flexibility in determining when to complete auctions for the remainder of the spectrum.⁵ The Auction Reform Act noted that delay in the return of portions of the spectrum used for broadcasting reduces both the amount of money that auctions are likely to produce and the probability that the spectrum will be purchased by the entities that will put it to its most productive use.

Date When DTV Transition Will Be Completed and Spectrum Returned Is Uncertain

FCC established 2006 as the target date for completing the DTV transition, and this was later codified by Congress in the Balanced Budget Act of 1997. By December 31, 2006, the goal is for broadcasters no longer to broadcast the analog television signal, and for the spectrum that they vacate to be returned so that it can be made fully available for other uses. However, because the Congress was concerned about leaving substantial numbers of households without the ability to access broadcast television signals, the law specifically provided for extensions in certain circumstances. Under the statute, FCC must grant extensions to requesting stations in a television market where it finds that one of the following three conditions exists:

⁴P.L. 107-195, 116 Stat. 715 (2002).

⁵Various proposals have been made that broadcasters pay a fee for their use of the broadcasting spectrum until they return their analog channels. Although such a policy may have its advantages and disadvantages, it is unclear what its impact would be on the DTV transition. More than likely, all broadcast stations will be transmitting a digital signal by 2006, and most of the other factors affecting the transition—such as cable carriage and consumer adoption of DTV equipment—are largely outside of the broadcast industry's control.

-
1. at least one television station affiliated with the four largest national networks (ABC, CBS, Fox, or NBC) is not broadcasting a DTV signal;
 2. the technology to convert a digital signal for use on an analog television set is not generally available; or
 3. fewer than 85 percent of television households in the television market has the ability to receive DTV—a television household would not count as receiving DTV if it (a) did not subscribe to a “multichannel video programming distributor” (such as a cable or satellite service) that carries a digital broadcast channel from each broadcaster in that market and (b) did not have a television receiver or a digital-to-analog converter capable of receiving digital broadcast signals.⁶

How FCC interprets the third provision—sometimes referred to as the “85 percent rule”—has important implications for when the broadcast spectrum can be returned. Several aspects of this provision are still to be determined. For example:

⁶The Balanced Budget Act of 1997 amended the Communications Act of 1934 by adding Section 309(j)(14), which provides:

“(14) AUCTION OF RECAPTURED BROADCAST TELEVISION SPECTRUM. —

“(A) LIMITATIONS ON TERMS OF TERRESTRIAL TELEVISION BROADCAST LICENSES—A television broadcast license that authorizes analog television service may not be renewed to authorize such service for a period that extends beyond December 31, 2006.

“(B) EXTENSION—The Commission shall extend the date described in subparagraph (A) for any station that requests such extension in any television market if the Commission finds that—

“(i) one or more of the stations in such market that are licensed to or affiliated with one of the four largest national television networks are not broadcasting a digital television service signal, and the Commission finds that each such station has exercised due diligence and satisfies the conditions for an extension of the Commission’s applicable construction deadlines for digital television service in that market;

“(ii) digital-to-analog converter technology is not generally available in such market; or

“(iii) in any market in which an extension is not available under clause (i) or (ii), 15 percent or more of the television households in such market—

“(I) do not subscribe to a multichannel video programming distributor (as defined in section 602) that carries one of the digital television service programming channels of each of the television stations broadcasting such a channel in such market; and

“(II) do not have either—

“(a) at least one television receiver capable of receiving the digital television service signals of the television stations licensed in such market; or

“(b) at least one television receiver of analog television signals equipped with digital-to-analog converter technology capable of receiving the digital television service signals of the television stations licensed in such market.”

-
- Defining a “market”: It has not yet been established what constitutes a television market under the statute. FCC officials told us that they have not yet determined what market definition to use, and that this would likely be established in a formal proceeding.
 - Counting cable subscribers: For a household to count as receiving DTV via cable, its cable service must carry at least one digital programming channel from each broadcaster in its market. But it is not yet clear whether a household subscribing to such a service counts if it does not have the equipment necessary to actually view that programming (i.e., it does not have a digital television set or set-top converter box).
 - Method of measurement: It is not yet clear what method would be used to actually measure how many households in a market can receive DTV signals. Some information may be available from cable and satellite providers, but it is uncertain how FCC will determine how many households in a market have the equipment to receive DTV over the air.

In a January 2001 notice of proposed rulemaking that focused on cable carriage of DTV signals, FCC included a section seeking comment on how to count DTV households for the purpose of reaching the 85 percent threshold.⁷ FCC has not yet issued a ruling on this notice, and FCC officials told us that few of the comments received touched on the 85 percent rule. The officials also noted that because DTV penetration is still very low, clarifying the 85 percent rule does not need to be addressed immediately. We asked FCC in a letter for its interpretation of the statute regarding how cable subscribers will count. In a return letter, FCC said that it has not yet adopted a definitive interpretation of that provision of the statute, but that it may initiate a proceeding in the near future that focuses on soliciting public comment on the issue.⁸

The first and second provisions of the statute cited above—that major network affiliates broadcast the digital signal and that technology be available to allow the signal to be converted for use on an analog television set—are not likely to be an obstacle to the transition. However, there was a consensus among most industry experts we spoke with that the third provision—the 85 percent rule—will probably not be met in most

⁷*In the Matter of Carriage of Digital Television Broadcast Signals*, CS Docket No. 98-120, *First Report and Order and Further Notice of Proposed Rulemaking*, FCC 01-22 (released Jan. 23, 2001) at paragraph 117.

⁸Letter from W. Kenneth Ferree, Media Bureau Chief, FCC, to Alan Belkin, Assistant General Counsel, U.S. General Accounting Office (Aug. 5, 2002).

markets by 2006. To reach 85 percent penetration of DTV signals, a series of interrelated changes need to occur, many of which are largely driven by the market. These changes include the availability of more digital programming, increased carriage of digital signals by cable companies, and increased consumer purchases of DTV receivers or converter boxes. As discussed throughout this report, serious roadblocks still remain to achieving each of these changes.

DTV Transition Will Require Millions of American Households to Buy Additional Equipment to Continue to Access Broadcast Stations

The DTV transition will impose some cost, either directly or indirectly, on all television viewers. To be able to receive DTV signals, a household must take one of several actions. It either must (1) purchase a television set that includes a tuner capable of receiving digital broadcast signals, (2) purchase a converter box that captures the digital broadcast signal and converts it to a format that can be shown on an analog television set, or (3) subscribe to a cable or satellite provider that is carrying the broadcast stations' digital signals as well as have the equipment necessary to receive that provider's digital signals.⁹ All of these options involve some financial cost related to DTV equipment—and digital television sets and tuners are currently relatively expensive. Although the price of these technologies is expected to drop dramatically as more units are produced, the cost still may be a burden to many households, particularly low-income households.

Once the 85 percent threshold has been met in a market and the analog signals are turned off, the remaining 15 percent of households will no longer be able to receive some or all broadcast channels. Households that were receiving their television solely over the air, and had not yet purchased a digital television set or converter box, would lose all television service. These households would need to purchase a new television set or converter box to resume their access to broadcast television. Households that were subscribing to cable or satellite would, depending on their circumstances, need to get the necessary equipment to view their cable or satellite services' digital signals or purchase an over-the-air digital tuner (if they did not have one already) to continue to receive the local broadcast channels not being provided by their cable or satellite service. Nationwide, 15 percent of American television households represents nearly 16 million households, consisting of about

⁹This assumes that cable providers do not downgrade the broadcasters' digital signals to analog before transmitting them to subscribers. If this were done, cable subscribers would not need new equipment but would also not receive most of the benefits of DTV, such as high definition.

40 million people, who would lose access to at least some of their local broadcast channels until they purchased additional equipment.

In addition, many households that are able to receive all DTV signals via their cable system will still face some loss of television service. Many households that have cable or satellite service also have one or more additional television sets that are not hooked up to this service. Any such sets that do not contain an over-the-air digital tuner will no longer function without the purchase and installation of a set-top converter box once analog service ends. Overall, approximately 81 million television sets in 42 million American homes currently receive their television signal solely over the air, according to Consumer Electronics Association estimates.

Policy-makers will likely find it unpalatable to disenfranchise a large number of American households from the ability to receive broadcast television signals. The importance that many Americans attach to having television access was illustrated a few years ago in a series of lawsuits involving several broadcasters and a satellite video distribution company named PrimeTime 24.¹⁰ As a result of court rulings, the satellite distributor was ordered to stop providing certain broadcast signals to about 2 million satellite subscribers. This potential loss of service engendered an enormous amount of correspondence from affected satellite subscribers to Members of Congress, resulting in considerable pressure for a solution before the signals were to be shut off. The PrimeTime 24 case is not a perfect analogy to the DTV transition: that case had the potential to completely turn off certain television signals to certain consumers, whereas at the completion of the DTV transition, households can choose to maintain their television service by purchasing additional equipment. But the PrimeTime 24 case does serve to illustrate how the public may react to any disruption in their television service. As with the PrimeTime 24 case, political pressure will likely develop among those American

¹⁰Several broadcast television stations sued a satellite video distributor for copyright infringement for providing certain broadcast signals to some households. Specifically, broadcasters charged that PrimeTime 24 was illegally providing broadcast signals from “distant” markets to viewers who were close enough to the local broadcast towers in their own markets to adequately receive the stations’ signal through an over-the-air antenna. Two courts ruled against PrimeTime 24 and required that it cease distribution of distant station signals to about 2 million households. The case was ultimately resolved when the Congress passed the Satellite Home Viewer Improvement Act of 1999, which allowed (1) direct broadcast satellite providers to include local broadcast signals as part of their programming packages and (2) some of the households specifically affected by the PrimeTime 24 case to continue receiving distant broadcast signals.

households faced with an impending loss of television service due to termination of the analog signals.

Many other countries also are wrestling with how to complete their DTV transition without stranding substantial numbers of consumers who have not yet adopted DTV equipment when the analog signals are shut off. For example:

- The government of the United Kingdom has said that its broadcasters will turn off the analog signals when at least 95 percent of households can receive the digital signals. In addition, United Kingdom officials have noted that their decision about a turn-off date will also factor in the affordability of DTV equipment.¹¹
- The Canadian government's recent policy statement on DTV states that "consumers will be able to upgrade their equipment at their own pace and convenience" and that the transition will be "market-driven." Canadian officials told us that industry interests opposed any strict deadlines for turning off analog signals.
- In setting the date for turning off analog signals, the Japanese government factored in the average life cycle of a television set in Japan (8 years) and the expected cost of digital television sets after the economies of mass production are realized. On the basis of that analysis, government officials told us that consumer adoption of digital television sets will be sufficient to turn off the analog signals without serious adverse effect to consumers by 2011.

¹¹Officials told us that converter boxes that convert broadcasters' digital signals to analog for display on a traditional television set are currently selling for about the equivalent of \$150. The DTV transition in the United Kingdom generally involves less expensive equipment than in the United States because the transition in the United Kingdom is to a digital, but not high definition, platform.

Consumer Adoption of DTV Has Been Slow, Partly Because Many Americans Are Unaware of the Transition and Are Not Well Informed about DTV Products

In a telephone survey of 1,000 randomly selected American households, we found that many people have little understanding of the DTV transition and its implications. In addition, consumer electronics sales data suggest that consumers have not been purchasing digital television sets at a pace rapid enough to make it likely that 85 percent market penetration will be reached by the end of 2006. When we posed as consumers during visits to 23 DTV retailers, we found that much of the information provided by sales staff about DTV equipment was correct. However, many staff were uninformed about important issues and few of the screen displays in the stores allowed consumers to actually view a high definition picture.

Knowledge about the DTV Transition Is Limited

More than 98 percent of American homes have a television set and the average number of televisions per home is 2.5. Moreover, television has become an important part of American life; it is how we share news, entertainment, and public safety information. In addition, the Congress has repeatedly noted the importance of maintaining the nation's free, over-the-air system of local broadcasting, which provides local news and community programming.

The DTV transition will greatly change how television is received in the United States; every household will need to make choices about what type of equipment or service to purchase to continue to receive television programming. However, it appears that relatively few Americans are familiar with the DTV transition and what it entails. To gauge consumer understanding of the DTV transition, we contracted with a survey research firm to conduct a telephone survey of 1,000 randomly selected American households. The consumers were asked questions that were designed to ascertain their level of familiarity with and knowledge about the DTV transition.

Overall, we found that many people have a low level of understanding of the DTV transition and its implications. For example:

- Forty percent of respondents said they had never heard about the transition to digital broadcast television, and another 43 percent said they were only "somewhat aware" of the transition. Fewer than one in five said they were "very aware."

-
- Nearly half of respondents said they were not familiar at all with the difference between an analog television set and a digital, high definition television set. Only 14 percent were “very familiar” with the difference between the two products.¹²
 - Sixty-eight percent of respondents did not know that most television sets currently in use will require a converter box to continue to receive over-the-air broadcasts when the transition is complete.

We also found some differences in the characteristics of people who were more likely to know about the transition versus those who were less likely to know. For example, we found that men were considerably more likely to know about the transition than women, and those who were college-educated were more knowledgeable than those without advanced education. Also, we found some evidence that respondents who received television over the air were less likely than cable or satellite subscribers to know about the transition to DTV. (See app. III for more detailed information about the survey results.)

This lack of familiarity about the DTV transition among American consumers could be problematic. If consumers are unfamiliar with DTV—particularly with benefits such as high definition television—they are less likely to purchase digital television sets. Yet, if few consumers purchase digital television sets, producers have little incentive to provide much digital content and cable systems have little incentive to carry the digital signal. Thus, consumer awareness of the transition—and subsequent consumer adoption of DTV equipment—is a key element in facilitating the transition.

Chairman Powell’s April 2002 proposal for voluntary industry actions to speed the DTV transition suggested several actions that sought to increase consumer awareness. The Chairman called on broadcast stations to use their analog channel to promote the content on their digital channel. He also called on cable systems to market their DTV products and programming on the air and in customers’ monthly bills. In addition, he asked DTV equipment manufacturers and retailers to market broadcast,

¹²It is possible that respondents overreported their familiarity with the difference between analog and digital television sets. For example, we also asked respondents whether they currently own a digital, high definition television set. Nine percent said they did, even though the Consumer Electronics Association estimates that only 1 percent of households owned such a set at the time the survey was conducted. Consumers may be confusing a digital television service (such as digital cable or satellite) with a digital television set.

cable, and satellite DTV options to consumers at the point-of-sale. In response to this proposal, the 10 largest cable operators said they would do more to advertise and market their value-added DTV programming, and consumer electronics makers said they would use point-of-sale promotions and a national public awareness campaign to promote DTV set-top boxes. In addition, in January 2002, the broadcast and consumer electronics industries formed a joint initiative to increase awareness and understanding of DTV through promotional activities in select cities.

FCC itself has not undertaken any significant activities to raise public awareness about the DTV transition and its implications. An FCC official told us that the agency provides information about DTV in several places on its Web site and through the call center of its Consumer & Governmental Affairs Bureau. However, although the Powell plan addresses actions that industry should take, FCC has no specific initiatives of its own under way regarding public education on DTV or the transition. FCC officials told us that the bulk of consumer education that is related to DTV will likely be provided by the private sector, such as through advertisements and point-of-sale discussions, rather than by the government. However, because DTV sales and programming are still relatively limited, consumer electronics makers and other industries may not have sufficient market incentives to provide a high-profile DTV marketing campaign in the short term. Because the public will accrue some of the benefits from recovering portions of the broadcast spectrum, a publicly funded information campaign may be justified if it would hasten the end of the DTV transition.

Quality of Information That DTV Retailers Provide to Consumers Varies

Although sales of digital television sets have been increasing steadily, the overall level of adoption remains low. Sales have grown from approximately 14,000 units in 1998 to approximately 1.5 million units in 2001, according to the Consumer Electronics Association.¹³ However, despite this sales growth, in 2001 digital television units still represented less than 5 percent of the 28 million television sets sold in the United States. Moreover, the majority of these units were DTV monitors, which lacked a DTV tuner that can receive DTV signals. Sales of television sets

¹³Digital television “units” include digital television monitors, integrated digital television sets (monitors that also include a digital tuner), and stand-alone set-top boxes that serve as digital tuners. Sales figures cited here represent factory-to-dealer sales, rather than sales to consumers. Because they include products still in inventory in retail stores, actual consumer sales may be lower.

that included a tuner capable of receiving digital broadcast signals, when combined with sales of set-top DTV tuners, still represented less than 1 percent of all television sets sold. Sales of digital television sets with DTV tuners will increase due to FCC's recent requirement that all new sets include a DTV tuner, but this requirement is being phased in, with virtually all new televisions to have a DTV tuner by 2007.

There also are roughly an additional 250 million existing television sets in the United States, nearly all of them analog. Because the average life span of a television set is about 10 years, large numbers of households will have analog television sets for the foreseeable future. As a result, even the DTV tuner mandate—which affects only new television sets—is unlikely to result in 85 percent DTV market penetration by the end of 2006, or several years thereafter.

Perhaps the most significant barrier to greater consumer adoption of DTV equipment is its cost. In 2001, the average price of a digital television set was more than \$1,800. Still, digital television set prices have steadily dropped in the past few years. Whereas the average price for a digital television set was more than \$3,000 in 1998, by mid-2002 some units were available for as little as \$1,000, according to the Consumer Electronics Association.

Many analysts believe that many more consumers would be willing to purchase DTV equipment if they were more familiar with DTV and had more exposure to high definition television's picture and sound. For many consumers, retail sales outlets provide the best opportunity for viewing and learning about DTV products. To gather anecdotal information on consumers' experiences at DTV retail outlets, we visited 23 consumer electronics stores in California, Maryland, Massachusetts, Nevada, and Virginia. We visited each store as a consumer "shopping" for DTV products and asked several standard questions to a member of the store's sales staff.

The accuracy of the information provided by the sales staff with whom we spoke was mixed. Nearly all of the staff were correctly able to explain the "platforms" available for receiving digital and HD channels (i.e., over the air, cable, and satellite). They also were generally accurate in explaining what equipment would be needed to receive digital signals. In addition, most staff had some knowledge about which channels and programs were available in high definition.

However, there was also a fair amount of inaccurate information provided. Overall, 18 of the 23 sales staff provided inaccurate information about at least one significant aspect regarding DTV. For example:

- Eight of the 23 sales staff significantly overstated the amount of HD content currently available. For instance, 1 said that all cable channels are in HD; a few incorrectly said that Fox and WB were currently broadcasting in HD.
- Four of the staff incorrectly said local broadcasters in their market were not broadcasting a digital signal.
- Four of the staff told us DTV is not available over the air at all. Other staff misstated what equipment would be needed to receive DTV over the air.

In addition, we noted that the majority of stores we visited were not showing an actual high definition picture on the high definition television sets being displayed on the showroom floor. Instead, many stores showed prerecorded movies or non-HD satellite programming. Sales of DTV products may be slowed because many consumers have never actually experienced true high definition television, with its superior audio and video qualities.

In addition to visiting individual retail stores, we also interviewed executives at the corporate offices of four major retailers of DTV products. They acknowledged that there is a lot of confusion among consumers about DTV equipment due to the complexities involved. Because digital television sets represent a tremendous growth opportunity for consumer electronics retailers, they said they are eager to ensure that their stores provide consumers with exposure to DTV, including high definition, and that their sales staff are highly knowledgeable about DTV products. Some companies told us that they provide their floor staff with specialized training on DTV, and that they are using innovative methods, such as on-line training tools, to do so.

Carriage of Digital Signals by Cable and Satellite Operators Is Insufficient to Help Achieve 85 Percent Threshold Quickly

On the basis of current plans for digital carriage by cable and satellite companies, it appears unlikely that many households will have access to all of their local digital channels via cable or satellite by December 2006. FCC has tentatively decided against mandating that cable systems carry analog and digital channels simultaneously during the transition. In lieu of dual carriage, however, another option we have identified is to set a “date-certain” when cable systems would, all at once, switch from carrying analog channels to carrying digital channels.

Cable Carriage of Digital Signals Is Limited

Because more than two-thirds of Americans receive their primary television service via cable, cable carriage of digital broadcast signals is an important element in encouraging consumer adoption of digital television sets and in encouraging producers, networks, and broadcasters to provide more original digital and HD programming. Without carriage of the digital broadcast signals by their carrier, cable customers—even those who own digital television sets—are unable to watch via cable the digital channel provided by most local broadcast stations in large cities.¹⁴ Presently, for a cable customer to watch local digital broadcast stations in digital format over a cable system, several factors must be in place: that customer must (1) own a DTV monitor; (2) live in a market with stations that are broadcasting digitally; (3) subscribe to a cable system that has chosen to carry those local digital broadcast signals; and (4) get from the cable system a special set-top box and the necessary cable subscription package needed to view HDTV.¹⁵

Currently, most cable companies do not offer their customers local digital broadcast signals. As of August 2002, only 3 of the 10 largest cable companies—Time Warner, Comcast, and Cox, which together serve more than 25 million cable customers—carried local digital broadcast stations in some of their markets. In his April 2002 proposal for voluntary industry action, the FCC Chairman called on cable systems with at least 750 MHz channel capacity to carry up to five channels that provide substantial HD

¹⁴Cable customers with digital television sets and a digital tuner can still receive DTV signals over the air. However, few consumers have such a tuner, and those who do must switch back and forth between cable and antenna reception to receive local digital broadcasts.

¹⁵Cable systems offer different subscription packages or “tiers.” The basic tier typically consists, at a minimum, of local analog broadcast signals, while an expanded tier includes additional cable network channels. In the past several years, cable systems have been offering a “digital cable” tier, which can have 100 or more channels.

programming or other value-added digital programming during at least 50 percent of their prime-time schedule by January 1, 2003. The nation's top 10 cable companies have all agreed to do so in the top 100 markets. However, these five channels may include a mix of both local digital broadcast channels and national cable networks that provide HD programming. As a result, it is unclear how much cable carriage there will be of digital local broadcast channels in the near future. These companies also have agreed to provide consumers who request them with set-top boxes that include digital inputs and can display HD.

We spoke with representatives from 5 large companies that own multiple cable systems and 10 broadcast stations, and we reviewed comments submitted by the cable industry in FCC proceedings. We asked the representatives about the incentives and disincentives that cable systems face in choosing to carry local digital broadcast channels as well as to carry high definition channels provided by national cable networks. Cable companies said they are willing in some cases to carry local digital broadcast stations, but they are reluctant to use their limited channel capacity to provide a local digital signal that (1) very few consumers are able to watch and (2) often merely duplicates what appears on the broadcaster's analog channel. The cable companies said they are far more likely to carry a station's digital signal if it offers "compelling" content that is in demand by their customers. In particular, they said they are most interested in carrying digital channels that offer substantial amounts of high definition programming, as opposed to standard definition digital or multicasting.

Cable companies also told us that their most important incentive for providing more digital carriage is competition with direct broadcast satellite. Satellite service has rapidly increased its market share: it grew from about 7 percent of television households in 1999 to more than 17 percent by mid-2002. The two major national satellite companies generally do not provide local digital broadcast channels, but they do offer their customers several high definition cable networks, such as HBO HD and Discovery HD Theater. Cable companies told us that they want to increase the amount of digital programming they offer—including local digital broadcasts—to stay competitive with satellite.

Some cable systems would have great difficulty carrying digital signals even if they wanted to do so. Many smaller cable systems have not installed fiber optic cable lines or made other upgrades to their cable network that allow for the carriage of digital signals. As a result, these

systems are highly limited in their channel capacity and are unable to carry local digital broadcast channels in a digital format.

Cable Carriage Is Unlikely to Be Sufficient to Help Reach the 85 Percent Threshold by December 2006

As previously discussed, the analog broadcast signals are not likely to be turned off after December 2006 unless 85 percent of households in a given market can receive DTV. More than two-thirds of American households subscribe to cable television, and thus cable carriage of DTV signals may play a large role in determining when that 85 percent threshold has been reached. The law says that households receiving DTV via cable count toward the 85 percent threshold only when their cable system carries a digital broadcast channel from all stations broadcasting digitally in their television market. Yet, while most large cable companies are planning to provide a digital broadcast channels from some broadcast stations in many markets, none currently plan to carry a digital broadcast channel from all digital broadcast stations. As a result, it appears highly unlikely that cable carriage of local digital broadcast signals will be sufficient to substantially contribute to reaching an 85 percent market penetration by 2006. To some extent, this problem is mitigated by FCC's recent DTV tuner mandate. In the future, as cable customers purchase new television sets that contain a DTV tuner, they will be able to receive digital signals over the air even if their cable system is not carrying those signals. However, this will require some cable households to take actions that many are resistant to: install a rooftop or set-top antenna and switch back and forth between cable service and over-the-air reception to access local digital channels not carried on their cable system.

Direct Broadcast Satellite Providers Offer No Local Digital Channels

As of mid-2002, about 17 percent of American television households subscribed to direct broadcast satellite service, and subscribership has been increasing rapidly in recent years.¹⁶ The two primary satellite television services available in the United States are DirecTV and EchoStar's DISH Network. All satellite subscribers need a satellite dish and a satellite receiver, but subscribers who want to access HD programming via their service are given a special dish and receiver that can process HD signals.

¹⁶Companies that provide television delivery for a fee (as opposed to free, over-the-air television) are known as "multichannel video programming distributors." In addition to cable and direct broadcast satellite, which are by far the most common, these distributors include multichannel multipoint distribution systems (wireless cable), local multipoint distribution systems, satellite master antenna television, and open video systems.

DirecTV and DISH each offers subscribers the option of receiving their local analog broadcast channels in about 45 television markets. However, neither service offers any local digital broadcast channels in any market.¹⁷ Both satellite providers do, however, offer several options for HD programming from cable or satellite networks. For example, both providers offer HBO HD and Showtime HD, while DirecTV also offers HDNet, and DISH also offers Discovery HD Theater.

Because satellite is a national service, it faces inherent constraints in providing local broadcast channels: carrying a local channel in a few markets uses the same channel capacity as carrying one cable network to customers nationwide. Representatives of the two satellite services have said it is therefore not feasible for them to carry local digital channels and analog channels at the same time on a widespread scale. Lack of local digital carriage during the transition by satellite providers may increase the difficulty of reaching the necessary 85 percent DTV penetration threshold in many markets, particularly if satellite service continues to grow in market share.

This problem is somewhat mitigated by the fact that satellite equipment can be adapted fairly easily to have the additional capability of receiving local digital channels through an over-the-air antenna. DISH already offers subscribers equipment that serves the dual purpose of receiving and decoding both satellite signals (which can include HD) and over-the-air broadcast signals (which can include both analog and digital). The over-the-air antenna automatically picks up the signal when the television is tuned to a local broadcast channel, and the satellite dish picks up the signal when the television is tuned to other channels.

FCC Has Tentatively Decided Against Mandatory Dual Cable Carriage

Under the Cable Television Consumer Protection and Competition Act of 1992, local commercial broadcast stations have the right to require that cable systems in their market carry their analog signal. Once the DTV transition is complete, and analog broadcasting ends, this right, commonly known as “must-carry,” will transfer to broadcasters’ digital signals. Most stations, including the great majority of those affiliated with a major broadcasting network, do not need to invoke “must-carry” because cable

¹⁷DISH allows subscribers under certain circumstances to access the digital signal of CBS’s New York or Los Angeles affiliate. However, this option is not available to subscribers in the New York or Los Angeles markets, and thus no DISH subscribers receive local digital broadcasts in their own market location.

systems desire to carry them. These stations sign what is called a “retransmission consent agreement” with the cable system, which lays out the terms under which the cable system will carry the station.

Currently, these must-carry rules apply only to broadcasters’ analog channels.¹⁸ In July 1998, FCC initiated a proceeding on DTV cable carriage, which included a discussion of whether must-carry rules should be modified so that they apply both to a station’s analog channel and its digital channel during the DTV transition.^{19,20} In the proceeding, broadcasters argued that few cable systems currently offer local digital broadcast channels, which means that cable customers have little incentive to purchase digital television sets. With few viewers owning digital television sets, networks have little incentive to provide more value-added digital programming, such as HDTV. This completes a circle: with few consumers owning digital television sets, and little digital programming available, few cable systems have any incentive to carry local digital signals. Broadcasters have argued that mandating cable carriage of both analog signals and digital signals, often known as “dual must-carry,” would break this circle and greatly improve the speed with which 85 percent DTV market penetration is reached.

The cable industry has strongly opposed a dual must-carry requirement, arguing that it would greatly limit the number of channels that cable providers are able to offer their customers. The industry contends that the DTV transition has been slow largely because broadcasters have failed to provide enough original digital and HD programming; it also says that cable systems will carry local digital broadcasts as soon as consumer demand warrants it. In addition, the industry argues that dual must-carry would represent a violation of its free speech rights and an unlawful “taking” of its property.

¹⁸During the DTV transition, a station may invoke must-carry for its digital signal only if that station has no analog signal and broadcasts only a digital signal.

¹⁹*Notice of Proposed Rule Making on Carriage of Transmissions of Digital Television Broadcast Stations*, CS Docket No. 98-120, released July 10, 1998.

²⁰Direct broadcast satellite companies have a requirement somewhat analogous to cable’s must-carry. The Satellite Home Viewer Improvement Act of 1999 (P.L. 106-113) allows direct broadcast satellite companies to provide local broadcast signals, but requires in most circumstances that if they carry any local channels in a market, they are required to carry all of that market’s channels.

In January 2001, FCC tentatively decided that it would be unconstitutional to require dual must-carry. FCC concluded that requiring simultaneous carriage of both analog and digital broadcast signals appeared to burden cable operators' First Amendment interests more than was necessary to further a substantial government interest. FCC also issued a Further Notice of Proposed Rulemaking to collect public comment and gather more information before a final ruling is made on the issue.²¹

Setting a Date-Certain for Cable Switchover from Analog to Digital Carriage Might Be a Way to Facilitate DTV Transition

Under the current legal and regulatory environment, it may be a long time before cable carriage of broadcast DTV signals is sufficient to help substantially contribute to the 85 percent threshold. Market forces are unlikely to engender full dual carriage because cable systems do not want to use scarce channel capacity to simultaneously carry two channels of each broadcast station. At the same time, cable systems have little incentive to switch from solely analog to solely digital carriage of local broadcast stations until the end of the transition. The resulting situation is something of a "catch-22." Once the transition is completed, and the analog signals are turned off, all cable systems will be carrying local broadcasters' digital signals. However, it is likely that the transition will not be completed until 85 percent of households in a market can receive those digital signals. Yet, because cable systems are generally unwilling to carry the analog and digital signals simultaneously, it is more difficult to reach that 85 percent threshold in the first place.

Rather than wait for cable systems to carry all local broadcast digital signals through voluntary dual carriage, one option we have identified is for FCC to adopt rules under which a specific date is set for cable systems to switch from full carriage of analog signals to full carriage of digital signals. Imposing a date-certain for a cable carriage switchover from analog to digital signals could have two specific advantages. First, it could facilitate the transition by requiring cable carriage of digital broadcast signals—and would do so without the need for dual carriage. Second, cable systems and their customers would know a date-certain for which they could plan to be ready for the switchover and have the necessary equipment in place.

²¹*In the Matter of Carriage of Digital Television Broadcast Signals*, CS Docket No. 98-120, *First Report and Order and Further Notice of Proposed Rulemaking*, FCC 01-22, released Jan. 23, 2001.

Procedurally, this policy might best be carried out by setting a date when broadcast stations' right to invoke must-carry for their stations' signal would transfer from their analog signal to their digital signal. Because cable systems and broadcast stations routinely renegotiate carriage agreements every 3 years, a logical time frame for implementing this switchover would be when these agreements are set to be renegotiated. Those negotiations are set to be take place in 2005 and again in 2008.

A policy of a "date-certain" switchover may have drawbacks as well as advantages. If many cable customers do not have DTV equipment by the "date-certain," cable systems may elect to continue to carry analog signals as well as digital signals after the switchover date. FCC officials told us that such a scenario could have two unintended outcomes. First, it could create a *de facto* policy of dual must-carry. Second, the policy could inadvertently harm smaller broadcast stations and their viewers. Once the analog must-carry requirement were to end, many cable systems might choose to continue carrying the analog signals of large stations (which have a large market share) but not of small stations. Thus, some smaller stations would no longer be seen by households that did not have a set-top box or digital television set for processing digital signals.²²

Officials at the National Cable & Telecommunications Association (NCTA) expressed concern that equipment issues could make preparing for a date-certain switchover an enormous and costly task. To continue to receive local broadcast channels via cable once the switchover occurred, consumers whose cable system was no longer providing any analog signals would require either a digital cable-ready television set or some form of cable set-top box. Digital cable-ready television sets are not yet available on the market, and some consumers are resistant to using set-top boxes. NCTA officials also said that smaller cable systems with no digital capability at all may need some kind of exemption. These officials also noted that a date-certain switchover policy would place much of the burden of the DTV transition on the cable industry and its customers, even though the DTV transition was promoted by and pertains to broadcast television stations.

²²Although these problems could be alleviated by prohibiting cable systems from carrying analog broadcast signals once must-carry rights transfer from analog signals to digital signals, such a prohibition would likely be challenged in court.

The concern expressed by NCTA officials regarding the focus of a policy on cable subscribers is understandable. However, given that more than two-thirds of Americans get their television via cable, and given that the DTV tuner mandate will not take full effect for several more years, policies targeted at cable households could be important to meeting the 85 percent threshold in a timely fashion. NCTA officials' concern about ensuring that consumers have the necessary equipment for a date-certain switchover is also understandable: the rollout of DTV-compatible cable equipment will likely be costly, cumbersome, and confusing. However, it is important to note that for the DTV transition to occur, this rollout will occur with or without a date-certain switchover. Setting a date-certain would simply help to ensure that cable customers transition within a certain time frame, but it may not necessarily increase the cost or complication of readying cable subscribers for the transition to DTV.

Availability of Digital Programming Is Increasing but Still Limited, Possibly Due in Part to Copy Protection Concerns

DTV allows for a variety of new forms of content, including HD, and an increased supply of true digital content is an important element in encouraging consumer adoption and cable carriage of DTV. Both broadcast networks and cable networks have greatly increased the amount of digital content they provide, although this still represents a relatively small portion of all television programming. Disincentives to the provision of more digital content include the small market share of viewers able to watch DTV, the cost and complexity—relative to this small market share—of filming or formatting HD programming, and possibly concerns about unauthorized copying and retransmission of digital content provided over the air.

DTV Allows for High Definition and Other New Forms of Content

The creation and delivery of digital programming is a key element in speeding the DTV transition. Consumers have little incentive to purchase costly digital television sets when little digital programming is available. Likewise, cable systems are not likely to use their limited channel capacity to carry broadcasters' digital signals if those signals simply duplicate what is already on the broadcasters' analog signals.

DTV allows for a number of different programming options. True digital programming has actually been filmed in digital or has been converted from a high-resolution format (such as 35 mm film) to a standard definition or high definition digital format. Alternately, a broadcast station can simply duplicate the programming shown on its analog channel by scanning it and "converting" it to digital. FCC gave broadcasters flexibility in determining how to use their digital signals and did not specifically

require that broadcasters provide any programming in high definition. Indeed, many broadcasters have already said that they intend to use their digital channel to multicast several channels of standard definition at once, rather than to provide HD.

The camera, editing, and production equipment that most broadcast stations and networks currently use to film and produce live programming—such as sports or news—cannot be used for HD broadcasts, which require special equipment. By contrast, most recorded programming, such as scheduled dramas and situation comedies, has been shot in the past few years using 35 mm film or high-resolution videotape that can be converted into a variety of formats. These formats can include standard definition analog, standard definition digital, and high definition digital as well as either a traditional aspect ratio or “widescreen.”²³

Amount of Digital Programming Is Increasing but Still Relatively Limited

As of August 28, 2002, 460 broadcast stations in 136 markets were broadcasting a digital channel. However, much of the programming on those channels is not true digital content, but rather programming that has been duplicated from a station’s analog channel and converted to a single stream of standard definition digital. In a survey of broadcast stations that we conducted in the fall of 2001,²⁴ 74 percent of the stations that had begun broadcasting a digital signal and that responded to our survey said they were providing at least some HD content—an average of 23 hours per week. In subsequent interviews, broadcast stations told us that the amount of HD content they provide on their digital channel generally depends on the programming feed provided to them by their affiliated network. HD content (as opposed to content in standard definition digital or merely converted from analog) is generally believed to be the most important factor in encouraging consumer adoption and cable carriage of DTV.

The national broadcast networks are mixed in terms of the amount of HD programming they provide, as follows:

²³An “aspect ratio” refers to the shape of the picture on the screen. A traditional analog television has an aspect ratio of 4:3, meaning that the screen is 4 units wide and 3 units high. DTV is often in a “widescreen” format, which has an aspect ratio of 16:9, similar to a movie theater.

²⁴For a more detailed discussion of the survey results, see [GAO-02-466](#).

-
- CBS was the first commercial network to provide substantial HD programming. Nearly all of its scripted prime-time situation comedies and dramas are available in HD, as are many national sports broadcasts, certain movies, and one daytime soap opera.
 - ABC began providing nearly all of its scripted prime-time programs in HD during the 2001-02 television season. It also provides some sports programming in HD.
 - NBC, until recently, has provided relatively little HD programming, primarily *The Tonight Show*, one prime-time drama, and certain sports broadcasts. NBC has said it will be providing several more hours-per-week HD programming in the 2002-03 television season.
 - Fox network provides virtually no HD content. It does provide more than two-thirds of its prime-time programming in “Fox Widescreen,” a digital, standard definition format.
 - PBS provides several programs per month in HD, mostly in the form of special programs and series.
 - WB, UPN, and PAX—the three smaller national networks—have provided virtually no HD or other true digital content. WB has announced it will begin providing about 5 hours per week of prime-time HD during the 2002-03 television season.

Among cable networks, HBO, Showtime, and Discovery each has a channel that provides programming that is either exclusively or primarily in HD. Other cable networks, including Madison Square Garden and A&E, have occasional special programming in HD. HDNet shows programming that is exclusively in HD; it is currently available only via DirecTV, although the network is expected to offer a channel on cable systems in the near future. ESPN has said it will begin an HD channel next year. Most other major cable networks, including CNN and MTV, are not currently offering any HD programming.

Networks Face Incentives and Disincentives to Providing More Digital Content

Chairman Powell’s proposal for voluntary industry actions to speed the DTV transition called on the top four broadcast networks, as well as HBO and Showtime, to provide HD or other “value-added DTV programming” during at least 50 percent of their prime-time schedule beginning with the 2002-03 season. We spoke with executives of four national broadcast networks, three major television studios, three cable networks, and other industry representatives to learn their incentives and disincentives for producing or delivering more HD and other true digital programming. Broadcast networks said the main disincentive to providing more HD content is the small number of viewers currently able to watch HD. Because the market share for HD content is small, HD programming

provides little in the way of significant additional revenue opportunities. In addition, there is relatively little demand or pressure from viewers to provide more HD content.

Networks and studios told us that in absolute terms, the cost of converting most recorded programming—such as films, situation comedies, and dramas—to HD is relatively low, adding perhaps \$8,000 to \$10,000 for a 1-hour show. In addition, the cost of transmitting a high definition signal to broadcast stations is not significantly higher than that of transmitting a standard definition digital signal. However, industry representatives noted that given the small market share for HD, in relative terms these costs are not insignificant. In addition, the cost and complexity of providing live programming, such as sporting events, in HD can be substantial because of the need for separate cameras and production facilities.

Broadcast networks that are providing HD content say they are doing so not for any short-term profit but rather for long-term benefit. For example, they want their programming to be available in HD when it is sold for syndication years from now. Cable networks providing HD told us they want to be forward-looking and provide innovative, state-of-the-art programming that adds value and distinguishes them from other networks.

We asked officials at two major broadcast networks, NBC and Fox, why they were providing relatively little HD content. NBC officials said that the studios that produce some of their programming have not been able to provide it in HD format in a timely enough manner. They also said that conversion to HD format was costly relative to the small number of viewers able to watch HD programming. They noted that other networks were doing more HD in part because those networks had agreements with consumer electronics companies to underwrite some of their HD production costs. Fox officials said they provide the great majority of their prime-time programming in “Fox Widescreen,” which, while not HD, provides a widescreen aspect ratio and a better picture quality than the traditional analog signal. In addition, they said that their standard definition digital format allows them to provide more live programming, such as sports, in a digital format because separate HD cameras and production facilities are not required.

Because television advertising ultimately funds most network programming, we spoke with three major television advertisers and reviewed the trade literature, to assess advertising’s role in affecting network decision-making regarding digital content. Overall, we found that advertising revenues are not a significant driver in the DTV transition.

Almost no advertising is produced in HD. In addition, due to low viewership, few advertisers are currently expressing special interest in placing ads on programs shown in HD. Advertisers also told us that networks and broadcasters are not making significant efforts to get them excited about DTV and any possibilities it holds with regard to advertising. However, with an eye to the future, two large advertisers said they have actively begun exploring the possibilities of DTV advertising to be ready when DTV becomes more widespread.

Copy Protection Concerns Are Still Being Addressed

Many content providers say they are reluctant to provide high-value digital content over the air via DTV because they are concerned about consumers making unauthorized copies as well as redistributing the content over the Internet. DTV raises special concerns about copy protection primarily for two reasons. First, in the digital world, each copy is an exact replica of the original, whereas in the analog world, each successive copy degrades in quality. Second, digital content can be easily and widely transmitted on the Internet, whereas analog copies must typically be physically transferred from user to user.

In October 1998, the Digital Millennium Copyright Act (DMCA) was signed into law.²⁵ The DMCA amended and updated the Copyright Act of 1976²⁶ with respect to the use of copyrighted works in digital contexts. Most relevant to DTV, the DMCA makes it a crime to circumvent copyright protection (“antipiracy”) technologies, such as encryption and scrambling. In other words, the DMCA makes it a crime to intentionally create hardware or software to bypass technology designed to prevent unauthorized copying.

At the same time, the DMCA does not require that consumer electronics manufacturers actually include in their consumer products technology to protect against piracy of DTV broadcasts. In 1998, five consumer electronics manufacturing companies began working together to develop a standard for copy protection, resulting in the Digital Transmission Content Protection technology, commonly known as “5C.” This technology is designed to protect DTV content from unauthorized copying or redistribution by DTV home consumers. The seven major studios that

²⁵P.L. 105-304, 112 Stat. 2860 (1998).

²⁶17 U.S.C. §101 *et seq.*

produce television content, as well as the cable industry, have agreed that 5C meets most of their key requirements for adequate copy protection.

However, as initially developed, 5C protects content delivered over cable or satellite service, but not content delivered over the air. All of the studios, as well as major broadcast networks, have expressed concern about this, and five of the studios have refused to sign licensing agreements using 5C technology until it covers over-the-air broadcasts. Broadcast networks in particular are concerned that without protection for over-the-air content on DTV, content providers will move their programming to cable and satellite channels where copyright protection is stronger.

To address copy protection for over-the-air content, studios want the use of a “broadcast flag,” which would identify rules for how particular content could be used. The flag would be recognized by technology embedded in digital television sets and other devices that receive DTV broadcast signals. For example, the flag might signal to a copy device that the user is allowed to make personal copies of a particular television program but would prevent that user from distributing those copies on the Internet. For a broadcast flag to be effective, a government mandate may be required to prohibit electronics makers from manufacturing products that did not follow the instructions of the flag.²⁷

In August 2002, FCC initiated a rulemaking exploring whether it can and should mandate the use of a copy protection mechanism for DTV. FCC is seeking public comment on several issues, including the need for a broadcast flag, the appropriate implementation of various copy protection technologies, and the extent to which FCC has jurisdiction regarding DTV copy protection issues.

Much of the debate over copy protection centers on finding the correct balance between the consumer’s right to view and copy material and the intellectual property rights of copyright holders. In the 1984 Supreme

²⁷ Another copy protection problem is what is commonly referred to as the “analog hole.” Consumers with analog television sets can watch digital signals using a set-top converter box that converts the signal from digital to analog. However, this process currently strips the signal of any copy protection, meaning it would be possible to convert the content back into an unprotected digital form that could be illegally copied and redistributed. A technology similar to a broadcast flag could be developed to “plug” the analog hole, but this is still being negotiated by content providers and consumer electronics manufacturers.

Court case *Sony Corporation of America v. Universal City Studios*,²⁸ the court ruled that “fair use” doctrine²⁹ gives consumers broad latitude to record television programs for noncommercial use in the home. The Consumer Electronics Association argues that copy protection technologies should not be allowed to impinge on fair use rights, which would deprive the public of equal and fair access to information, entertainment, and education. Content producers, represented by organizations such as the Motion Picture Association of America, argue that mandated copy protection is essential in the digital era if intellectual property rights are to be preserved. Without sufficient protection, they say, content providers will not be willing to provide high-value content via digital broadcast television.

Copy protection issues are very important to the content and consumer electronics industries, and the debate has been contentious. However, DTV is only one part of a larger debate about copy protection in the digital era; the issue also encompasses recorded music, films, and other media. Many observers with whom we spoke in the content, consumer electronics, and broadcast industries said that DTV copy protection is an important hurdle that needs to be resolved. At the same time, many believed that copy protection issues were ultimately less of a roadblock to the DTV transition than other key challenges.

Digital Over-the-Air Tuners Have Been Mandated, but Digital Cable-Ready Capability Has Not

To speed the DTV transition, FCC has adopted an order requiring that by 2007 most new broadcast television sets include a tuner capable of receiving digital signals over the air. Another policy option would be to pair the over-the-air mandate with a requirement that new television sets also be digital cable-ready. Because many more American households receive television via cable than receive it over the air, mandating digital cable-ready capability could be an effective policy for speeding the DTV transition if the marginal cost of this requirement were found to be reasonable. (See app. II for a discussion of other equipment issues that are affecting the DTV transition.)

²⁸464 U.S.C. 417 (1984).

²⁹The fair use doctrine permits copying of copyrighted works for such purposes as criticism, commentary, news reporting, teaching, scholarship, or research. 17 U.S.C. §107.

Over-the-Air DTV Tuner Mandate Will Spur the Transition, but Standing Alone May Be Inefficient

On August 8, 2002, FCC adopted an order requiring that most new broadcast television sets, as well as other equipment like VCRs that may contain broadcast receivers, include the capability to receive DTV signals.³⁰ This DTV tuner mandate is being phased in over time on the basis of the size of the television set. For example, all new sets of 36 inches and above must have DTV tuners by July 1, 2005, while sets of 13 inches and above must have the tuner by July 1, 2007. FCC said that its jurisdiction to impose a DTV tuner mandate is established by the All Channel Receiver Act of 1962, as amended, which gives FCC the authority to require that television sets be capable of adequately receiving all frequencies allocated by FCC for television broadcasting.

Currently, very few television sets sold in the United States are capable of receiving digital broadcasts. FCC said it adopted the DTV tuner mandate to ensure that consumers are provided with the capability to receive broadcasters' digital signals and to move more rapidly toward completion of the DTV transition. FCC also noted that the additional cost per television set will be minimized by the large manufacturing volumes that will result from the mandate. The National Association of Broadcasters, which strongly supported the mandate, has cited estimates that the cost of imposing a DTV tuner mandate may be as low as \$16 per set by 2006.

Opponents of the DTV tuner mandate, which include the Consumer Electronics Association, cite different estimates, saying that the mandate could raise the price of a television set by as much as \$250. Moreover, opponents say it is an inefficient policy, given that more than four-fifths of American households subscribe to a cable or satellite service for their primary television set and may not need or use a digital broadcast tuner. They argue that consumer demand, rather than a government mandate, should drive whether digital tuners are offered in television sets.

Both sides of the tuner mandate issue raise valid points. Because more than 25 million new television sets are sold each year, the DTV tuner mandate will undoubtedly allow the 85 percent DTV penetration rate to be reached more quickly. In addition, most experts believe that the per-unit cost of the mandate, while hard to predict, is not likely to be very high once the economies of large-scale production are achieved. At the same

³⁰*In the Matter of Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television*, MM Docket No. 00-39, *Second Report and Order and Second Memorandum Opinion and Order*, FCC 02-230, released Aug. 9, 2002.

time, the tuner mandate raises questions of economic efficiency: all consumers purchasing sets of 13 inches or over will be paying for a DTV tuner that the majority of them (those who receive their primary television via cable or satellite) may be unlikely to use.

Moreover, although the DTV mandate will help reach the 85 percent threshold more quickly, it will do so largely because cable and satellite households that purchase new television sets that include the digital over-the-air tuner will count toward the threshold even though they may not actually watch their television over the air. To watch local digital broadcasts over cable or satellite—presuming those broadcasts were being carried by their cable or satellite operator—many of these households would need additional equipment. The tuner mandate thus could result in a scenario where analog signals are turned off in a market because 85 percent of households are capable of receiving local DTV channels over the air—but the majority of those households are cable or satellite customers who, in practice, are not actually using their set for over-the-air reception.

Mandate for All Televisions to Be Digital Cable-Ready Might Have Benefits

Cable and over-the-air television each uses a different digital format and thus each requires a different type of tuner to decode digital signals. Although a digital over-the-air tuner has been mandated, another option would be to additionally mandate that new television sets be digital “cable-ready.” With a digital cable-ready television set, the cable line would plug directly into the set and digital signals could be viewed without need of a cable set-top box. Cable-ready analog television sets have been available for many years, but there are no cable-ready digital television sets currently on the market. Digital cable-ready sets could be important to the DTV transition because consumers may be more likely to purchase digital television sets if the set does not require a set-top box to access cable service.

Digital cable-ready capability is more complicated than analog cable-ready capability, and there is no one definition for what constitutes a digital cable-ready television set. FCC and television manufacturers generally consider a digital cable-ready set to include, at a minimum, a digital cable tuner (to receive and process digital signals) and a slot for a “point of

deployment” (POD) security device (to handle encrypted cable programming).³¹

In February 2000, after much negotiation, the Consumer Electronics Association and the National Cable & Telecommunications Association submitted to FCC an agreement of basic technical standards for a digital cable-ready television set. However, since that time, the two industries have been unable to resolve details related to that agreement, including licensing and programming guide issues. Television manufacturers say they are reluctant to roll out digital cable-ready sets until all cable systems implement the agreed-upon technical standards, and they have requested that FCC implement a timetable for national cable standards. FCC and the Congress are monitoring the negotiations but so far have left the issues to the industries to resolve on their own and, to date, have not imposed any significant requirements regarding digital cable-ready television sets.

Because far more households receive local broadcast signals via cable than via over the air, pairing a digital cable-ready mandate with the existing over-the-air tuner mandate might be an efficient policy for ensuring that households are able to receive and watch DTV signals. It is not clear what the additional manufacturing cost would be of incorporating digital cable tuners and POD slots into television sets that already include digital over-the-air tuners. The Consumer Electronics Association has stated that because the electronic components for digital cable tuners are almost identical to those for digital broadcast tuners, “manufacturers could include combination broadcast and cable tuners in their products at a cost that would be little greater than the cost of either a broadcast-only tuner or a cable-only tuner.”³² Nonetheless, a more detailed cost-benefit analysis would need to be undertaken before such a policy was implemented, particularly in light of the probable requirement for a POD slot to make the set digital cable-ready.

³¹FCC has adopted three definitions to designate a digital television set as digital cable-ready. Under all three definitions, the set includes a digital cable tuner and a POD slot. Under two of the definitions, the set also includes other functionalities, such as digital inputs and support for interactivity. See *In the Matter of Compatibility Between Cable Systems and Consumer Electronics Equipment*, PP Docket No. 00-67, *Report and Order*, FCC 00-342 (released Sept. 15, 2000).

³²Letter to W. Kenneth Ferree, Federal Communications Commission, from Michael Petricone, Consumer Electronics Association, filed in CS Docket No. 97-80, *Implementation of Section 304 of the Telecommunications Act of 1996; Commercial Availability of Navigation Devices*, and PP Docket No. 00-67, *Compatibility Between Cable Systems and Consumer Electronics Equipment*, Sept. 11, 2002.

The idea previously discussed in this report for a “date-certain” cable switchover from analog signals to digital signals might be especially effective if paired with a mandate that all new television sets sold be digital cable-ready. Because about 25 million new television sets are sold each year, significant numbers of households would own a television set capable of receiving digital signals via cable without the need for a set-top box by the date-certain cable switchover, thereby lessening the need of cable subscribers to obtain set-top boxes when the switchover occurs.

Direct broadcast satellite service, like cable and over the air, requires a digital tuner to decode the digital signal and turn it into the picture that appears on the television screen. Satellite uses a third format for transmission of digital signals. Some digital television sets on the market are digital “satellite-ready” in that they incorporate a satellite tuner and do not require a set-top box to receive satellite service. However, a satellite DTV tuner mandate would not help reach the 85 percent threshold to the extent that a cable DTV tuner mandate would. First, there are many more cable subscribers than satellite subscribers in the United States. In addition, unlike cable operators, satellite operators are not required to carry local broadcast channels (although if they choose to carry any local channels in a market they are required to carry all of that market’s channels). Satellite companies are uncertain about their plans for offering local broadcasts once the DTV transition is complete. This is partly because the HD programming that many local stations will be providing requires greater bandwidth than current analog programming, and this will impact the satellite systems’ capacity to carry local broadcast stations.

Conclusions

The DTV transition will affect nearly all Americans by changing the nature of television—a main source of news and entertainment—and requiring nearly every household to obtain new equipment. Despite this, few Americans seem aware of the DTV transition and the implications it will have for them. This lack of knowledge is, in and of itself, a barrier to the transition’s timely completion. It is likely a factor in the sluggish sales for DTV equipment and the lack of pressure by viewers for networks to provide more HD programming and for cable systems to carry local digital broadcasts. To date, FCC has made recommendations to the private sector but has not undertaken significant initiatives of its own to increase public awareness about DTV and the transition.

Until recently, laws passed by the Congress and rules implemented by FCC regarding the DTV transition have been focused largely on the rollout of DTV signals by broadcast stations. But factors driving consumer adoption

also are important because the transition cannot be completed until sufficient numbers of households can view the digital broadcasts. The realization of most of these factors has largely been left to market forces. Generally, market-driven adoption of new technologies is considered best, but the current circumstances in the DTV transition suggest that it is unrealistic to anticipate that market forces will bring about the completion of the transition within the originally anticipated time frame. Thus, it would be helpful for policy-makers to better understand the various options that could be implemented to advance the timeliness of the DTV transition.

FCC's recent DTV tuner mandate serves as a notable exception to the transition's market-driven approach. However, that mandate alone—which will not take full effect until mid-2007—may not be enough to complete the transition in a timely and reasonably seamless manner. An additional option would be to require digital cable-ready capability in addition to the over-the-air digital tuner. Because more than two-thirds of households receive cable, mandating that televisions be digital cable-ready may prove a cost-effective policy option for hastening the DTV transition, particularly when paired with the existing over-the-air mandate. While the additional cost of the digital cable tuner is likely small, it is less clear what the incremental cost of the POD slot would be. In addition, outstanding cable compatibility issues would need to be resolved before a digital cable-ready mandate could be implemented.

Another policy option related to DTV that we have identified is to set a date-certain when broadcast stations' right to invoke a must-carry status for their stations' signals would transfer from their analog signals to their digital signals. This option could have the advantage of speeding up cable carriage of digital signals while avoiding problems inherent in requiring dual carriage. Pairing this date-certain switchover with a digital cable-ready mandate has the potential to be especially effective. The digital cable mandate would ensure that when the switchover did occur, a significant portion of households would both receive local digital broadcast signals and have the equipment in place to view those signals. However, the switchover policy could have disadvantages as well, such as possible adverse effects on smaller stations. As such, this policy would need to be evaluated more closely.

One of the most important goals for completing the DTV transition is the recapture of the broadcast spectrum that television stations will be returning. There is significant economic value embodied in this spectrum, and it has been allocated for both public safety needs as well as for new

commercial services. Delays in completing the DTV transition would compromise for some time the ability to fully utilize this spectrum. Understanding the relative time frames for the transition—that is, the time frame with and without certain policy changes—is key to understanding the implicit cost to society of allowing the transition to move at its current pace. Ultimately, decisions about implementing further legal or regulatory changes to speed the DTV transition require balancing the costs and burdens of those changes with the benefits of returning the broadcast spectrum in a timely fashion.

Recommendations for Executive Action

Some issues affecting the DTV transition, such as the production of HD television programming, are largely outside of traditional federal legislative or regulatory control. Other issues, such as inclusion of an over-the-air tuner, have already been addressed by FCC or are the subject of ongoing proceedings. Our recommendations are in areas over which FCC or the Congress have authority, and that have not been widely discussed but could have an important impact on the success of the DTV transition and the speed with which spectrum used for broadcasting can be returned for other uses.

We recommend that the Chairman of the Federal Communications Commission take the following actions:

1. Explore options to raise public awareness about the DTV transition and the implications it will have. For example, FCC might consider a public education campaign of its own, or it might consider partnering with the affected industries to provide consumers with more information about DTV products and the DTV transition. Such actions could help speed consumer adoption of DTV equipment as well as inform the public about a transition that will affect nearly all Americans.
2. Direct the relevant FCC bureaus and offices to examine the costs and benefits of mandating that all new televisions be digital cable-ready in addition to the existing mandate for a digital over-the-air tuner. As part of this process, FCC should conduct an independent analysis that estimates (1) the additional cost to consumers of adding a digital cable tuner and POD slot and (2) the timetable of the DTV transition with and without such a mandate. FCC should then report its recommendations as to the actions it believes the Commission or the Congress should take regarding a digital cable-ready mandate.

-
3. Direct FCC's Media Bureau to examine the advantages and disadvantages of a policy that would set a date-certain for cable carriage to switch from full carriage of analog signals to full carriage of digital signals. Such a policy could be implemented by transferring broadcasters' must-carry rights from analog to digital on that date, or through some other means. The Chairman also should direct the Media Bureau to examine the possibility of combining such a policy with a digital cable-ready mandate. As part of this examination, FCC should estimate the amount of time it will take for the DTV transition to be completed with and without implementation of these policy options.

Agency Comments

We provided a draft of this report to FCC for review and comment. In its comments, which are reprinted in appendix IV, FCC said the report analyzes some of the difficult challenges facing the DTV transition and should add useful input to the policy-making process. FCC agreed that it is important to explore options for raising public awareness, and emphasized that Chairman Powell has called on industries involved in the transition to take concrete measures to educate the public about the DTV transition and its implications. Regarding our recommendation on cable-ready DTV equipment, FCC noted that it has been engaged in a long-term effort to achieve compatibility between digital television sets and cable systems, and that many of the technical standards for digital cable-ready sets were not finalized until recently. FCC said it will be addressing these issues in a forthcoming Report and Order. Regarding our recommendation related to a date-certain for transfer of must-carry rights from analog signals to digital signals, FCC noted that its digital carriage proceeding sought comment on a wide range of options regarding must-carry, including an option similar to the one we described in our draft. FCC said that the record is now closed in that proceeding, and that its staff is preparing a draft order for the Commission's consideration. The actions described by FCC in their response are positive steps; however, we believe the Commission should also adopt our specific recommendations. FCC also provided us with technical changes to the report, which we incorporated where appropriate.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 14 days after the date of this letter. At that time, we will send copies to interested congressional committees; the Chairman, FCC; and other interested parties. We also will make copies available to others upon request. In addition, this report will be available at no cost on the GAO Web site at

<http://www.gao.gov>. If you have any questions about this report, please contact me at 202-512-2834 or guerrerop@gao.gov. Key contacts and major contributors to this report are listed in appendix V.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'P. Guerrero', with a long horizontal flourish extending to the right.

Peter Guerrero
Director, Physical Infrastructure Issues

Appendix I: Scope and Methodology

To understand the benefits and implications of turning off the analog broadcast signals, we reviewed relevant studies, statutes, and Federal Communications Commission (FCC) proceedings on the topic, and we spoke with officials at FCC and the National Telecommunications and Information Administration as well as officials in the United Kingdom, Canada, and Japan who are addressing their nations' digital television (DTV) transitions.

To understand consumer adoption of DTV, we reviewed and analyzed data from the consumer electronics industry and other sources on DTV equipment sales and projected trends. To obtain anecdotal information on retail practices in marketing and selling DTV products, we visited 23 retail consumer electronic stores that sell DTV equipment in several locations: Boston and Worcester, Massachusetts; Las Vegas, Nevada; Los Angeles, California; and the Virginia and Maryland suburbs of Washington, D.C. During our visits, we posed as shoppers and asked sales staff a standard set of questions designed to gauge their knowledge of information that would be important to a potential consumer of DTV equipment. We also interviewed senior executives at the corporate offices of 4 consumer electronics retailers.

In addition, to gauge consumer awareness and understanding of the DTV transition, we contracted with Opinion Research Corporation (ORC), a national market research firm, to include questions regarding the DTV transition in one of the national telephone surveys conducted by ORC on a regular basis. The survey contained a set of 10 questions that asked respondents general questions about their television use (such as how they receive their television signal) and some questions specifically designed to gauge their knowledge and familiarity with the DTV transition. The questions were closed-ended, with response options read to the respondents. A total of 1,009 adults in the continental United States were interviewed between November 29 and December 2, 2001. The contractor's survey was made up of a random-digit-dialing sample of households with telephones, stratified by region.

To use the survey results to make estimates about the entire adult population 18 years and older in the continental United States, ORC weighted the responses from the survey to represent the characteristics of all adults in the general public according to four variables: age, gender, geographic region, and race. Because our results are from a sample of the population, the resulting estimates have some sampling error associated with them. Sampling errors are often presented as a 95 percent confidence interval. The percentage estimates we present in this report have a 95

percent confidence interval of about plus or minus 3 percentage points or less. The practical difficulties of conducting any survey may introduce nonsampling errors. As in any survey, differences in the wording of questions, the sources of information available to respondents, or the types of people who do not respond can lead to somewhat different results. We took steps to minimize nonsampling errors. For example, we developed our survey questions with the aid of a survey specialist and pretested the questions before submitting them to ORC.

To understand the role of cable and satellite carriage in the DTV transition, we spoke with representatives from 5 large companies that own multiple cable systems; 10 broadcast stations, including those with and without cable carriage of their digital signals; and the 2 national providers of direct broadcast satellite service. We also discussed these issues with representatives of the National Cable & Telecommunications Association, the National Association of Broadcasters, FCC, and other relevant parties. We also reviewed relevant documents, including FCC proceedings related to cable carriage.

To review issues related to the availability of digital programming, we spoke with representatives of television broadcast networks; cable networks; studios that produce and format television programming; television advertisers; and trade associations that represent these interests, including the Motion Picture Association of America and the National Association of Broadcasters. We also conducted a literature review to determine what digital programming is currently available. In addition, we reviewed and analyzed data related to programming from our survey of U.S. commercial broadcast stations that we conducted in the fall of 2001. To review the status of DTV copy protection issues, we spoke with representatives of broadcast networks and television producers as well as representatives of consumer electronics manufacturers. We also spoke with representatives of trade associations and other organizations that are concerned about copy protection issues, including the Electronic Frontier Foundation. In addition, we reviewed relevant legislation and court proceedings.

To review issues related to DTV tuner mandates, as well as other equipment issues, we spoke with representatives of four consumer electronics manufacturers, two industry standards organizations, three industry trade associations, and a consumer advocacy organization. We also toured the facility of a large DTV manufacturer. In addition, we reviewed documents from FCC proceedings involving technical issues related to the DTV transition.

Appendix II: Equipment Issues Affecting the DTV Transition

FCC has mandated that most new television sets include a DTV tuner. However, several other equipment issues that could affect the pace of the DTV transition are still being resolved.

Digital Inputs and Copy Protection Technologies

“Digital inputs” are connections that allow digital information to flow into the digital television set. Digital inputs facilitate the use of copy protection technologies and the connection of digital television sets to set-top boxes or other devices. Most digital television sets manufactured thus far have included only “component analog” inputs rather than digital inputs. This is problematic because these digital television sets may not be compatible with future devices or technologies, including those designed to provide copy protection. The consumer electronics industry appears to be settling on two types of digital inputs, and the FCC Chairman Michael Powell has called for one or more of these inputs to be included in all new HD monitors and digital receivers by January 1, 2004. A representative of one manufacturer with whom we spoke told us that his company plans to include both types of digital inputs in its DTV equipment in the near future.

Digital-to-Analog Converter Boxes

Eventually, each of the more than 250 million analog television sets currently in use in the United States will need to be retired, replaced, or attached to a “digital-to-analog converter box.” A digital-to-analog converter box will allow consumers to keep their analog television sets once the DTV transition is complete by (1) converting digital signals to analog signals and (2) when necessary, converting high definition signals to standard definition. It is not yet known how much digital-to-analog converter boxes will cost once they become widely available. One expert with whom we spoke suggested that these converter boxes would need to cost about \$50 or less before large numbers of consumers would be willing to purchase them for their analog television sets.

There are different types of digital-to-analog converter boxes for television signals received over the air, via cable, and via satellite because each of these three platforms uses a different digital transmission format.¹ Converter boxes for over-the-air signals are essentially digital receivers that are intended for use with an analog television set.² The issue of digital-to-analog converter boxes could present the DTV transition with another “catch-22.” Consumers currently receiving analog television signals over the air have little incentive to purchase a converter box for their television set until the analog signals are shut off. However, the analog signals cannot be shut off until enough consumers are able to see the DTV signals—such as through the purchase of a converter box.³

Adequacy of Over-the-Air Reception

There are some concerns that digital television sets in locations with a weak signal will have difficulty receiving over-the-air broadcasts. This issue is important for the DTV transition because with a digital signal, unlike an analog signal, the picture is lost completely when the signal is inadequate. Over-the-air viewers who may currently tolerate a weak, snowy analog signal could find themselves without any signal at all when they try to receive the digital broadcast signal. FCC has declined to impose minimum performance thresholds for over-the-air digital tuners (or “receivers”). In its August 8, 2002, Report and Order, FCC said that it believed that competitive forces were the best approach for ensuring that DTV receivers perform adequately and meet consumer needs.⁴ Efforts are under way by the broadcast and consumer electronics industries to improve the effectiveness of over-the-air digital tuners. One expert with

¹Manufacturers can also combine more than one of these capabilities into a single box.

²A digital receiver currently on the market for use with a digital monitor could also, in theory, be used as a digital-to-analog converter box with an analog television set. However, because these receivers currently retail for about \$600, few if any consumers use them for this purpose.

³To some extent, this may be mitigated by some consumers purchasing digital-to-analog converter boxes before the termination of the analog signals. Consumers may do this because a converter box will give them access to the content on digital broadcast channels (although not in digital format), provide a clearer picture, and provide access to “multicasting”—that is, multiple programs on a single channel.

⁴*In the Matter of Review of the Commission’s Rules and Policies Affecting the Conversion to Digital Television*, MM Docket No. 00-39, *Second Report and Order and Second Memorandum Opinion and Order*, FCC 02-230, released Aug. 9, 2002, para. 60-67.

whom we spoke noted that DTV tuner technology is now in its fourth generation and has improved significantly over earlier generations.

Appendix III: Analysis of the Consumer Survey

To gauge consumer understanding of the DTV transition, we contracted with a survey research firm to conduct a random survey of 1,000 American households. The consumers were asked questions that were designed to ascertain their level of familiarity with and knowledge about the DTV transition.

The survey collected basic demographic information about the respondent (such as race, gender, income, education level, and age) and asked questions related to television use, such as how the respondent's household receives its television signals. There were also three key questions asking respondents about their awareness or familiarity with

(1) the transition from analog to digital broadcast television,

(2) the difference between a traditional analog and a digital television set, and

(3) the fact that analog sets will require a special converter box to continue to receive over-the-air broadcasts at the completion of the transition.

Forty percent of respondents were unaware of the transition from analog to digital television and 48 percent were "not at all familiar" with the difference between traditional analog television sets and digital, high definition television sets. In addition, nearly 70 percent of respondents did not know that after the transition, analog television sets will require a converter box to continue receiving broadcasts.

We combined the answers to these three questions to create a scale of knowledgeable ability about the DTV transition and used multivariate models to see if there are relationships between demographic and other household characteristics and knowledgeable ability of the transition. We included as explanatory variables in the model contrasting groups of households. Specifically, we included the following variables in the model:

- whether the respondent lived in 1 of the 30 largest television markets,
- whether the respondent was male,
- whether the respondent lived in an urban area,
- whether the respondent had a white-collar job,
- whether the respondent had at least a college education,
- whether the respondent was between 30 and 55 years old (this was contrasted with age under 30),

- whether the respondent was over 55 years old (this was also contrasted with age under 30),
- whether the respondent’s reported race was white,
- whether there was more than one telephone line in the respondent’s household,
- whether the respondent reported having satellite television as the primary television viewing method in the household (this was contrasted with reporting cable as the primary television method),
- whether the respondent reported having over-the-air television as the primary television viewing method in the household (this was contrasted with reporting cable as the primary television method), and
- whether the respondent reported owning a DVD player.

Table 1 shows that males and white-collar and more educated households are significantly more familiar with the DTV transition. Households that own a DVD are also significantly more familiar with the transition. However, households still receiving their television over the air, rather than via cable or satellite service, were significantly less likely to be familiar with the DTV transition. Age, race, and urbanicity did not have any effect on respondents’ familiarity with the transition.

Table 1: Differences in Familiarity with the Digital Television Transition on the Basis of Household Characteristics

Household/Respondent characteristics	Regression coefficient
Reside in 1 of the 30 largest TV markets	0.06
Male	0.79^a
Urban	0.17
White-collar	0.29^a
College or more education	0.45^a
30 to 55 years old (relative to under 30 years old)	0.17
Over 55 years old (relative to under 30 years old)	0.17
White	0.06
More than one telephone line	0.21
Receive TV via satellite (compared with receive TV via cable)	-0.14
Receive TV over the air (compared with receive TV via cable)	-0.34^a
Own a DVD player	0.56^a

^aBolding denotes statistical significance, p< 0.05.

Source: GAO analysis of data collected by Opinion Research Corporation.

Appendix IV: Comments from the Federal Communications Commission

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Federal Communications Commission
Washington, D.C. 20554

October 10, 2002

Mr. Peter F. Guerrero
Director, Physical Infrastructure Issues
United States General Accounting Office
Washington, D.C. 20548

Re: GAO-03-7

Dear Mr. Guerrero:

Chairman Powell asked me to respond to your request for comment on a draft copy of GAO-03-7, "Additional Federal Efforts Could Help Advance Digital Television Transition." The report analyzes some of the difficult challenges facing the digital television transition; it should provide useful input into the policy-making process.

Many of our staff comments were incorporated in the draft report itself, and I will not repeat them here. I would, however, like to emphasize some of the steps the Commission has already taken with respect to the areas covered by the report's specific recommendations.

First, the report recommends that Chairman Powell explore options to raise public awareness about the DTV transition. We agree this is a critical goal. That is why earlier this year Chairman Powell called on the industries involved in the transition to take concrete measures to educate the public about what the digital transition is and what it means for them. Although the report refers to Chairman Powell's proposal, it fails to note that the ten largest cable operators, which serve more than 85% of all cable subscribers, responded to the proposal by agreeing to advertise and market HDTV and other new digital services using a broad variety of promotional tools. In addition, in an effort predating Chairman Powell's proposal, the National Association of Broadcasters and the Consumer Electronics Association have joined together to launch outreach efforts in various "DTV Zones" around the country to increase public awareness and understanding of digital television. Nevertheless, as your report indicates, we have a big job in front of us.

Second, the report recommends that the Commission study the benefits of mandating that all digital televisions be "cable ready." The Commission has been engaged in a long-standing effort to achieve compatibility between digital television sets and cable systems. Since 2000, for instance, the Commission has required the National Cable & Telecommunications Association and the Consumer Electronics Association to file progress reports every six months on compatibility issues. We have also held a series of meetings in which the parties have been called together for face-to-face discussions on these issues. Much progress has been made, particularly on the completion of the technical standards for digital "cable ready" sets.

See comment 1.

See comment 2.

**Appendix IV: Comments from the Federal
Communications Commission**

See comment 3.

Nonetheless, contentious and complex business and policy issues remain. The Commission has stated that it will address these issues in a forthcoming Second Report and Order in conjunction with our proceeding on Commercial Availability of Navigation Devices.

Finally, the report recommends that the Commission consider setting a date certain for broadcasters' mandatory carriage rights to switch from their analog to their digital signals. Without commenting on the merits of such a proposal, I would note that the Commission has sought comment in our digital carriage proceeding on a wide range of options regarding digital must-carry, including an option similar to the one you describe. The record now is closed in that proceeding and the staff is preparing a draft Order for the Commission's consideration.

Thank you for the opportunity to comment on the draft report.

Sincerely,



W. Kenneth Ferree
Chief, Media Bureau

The following are GAO's comments on the Federal Communications Commission's letter dated October 10, 2002.

GAO Comments

1. We added text on industry actions being undertaken to raise public awareness about the DTV transition, including those taken in response to Chairman Powell's proposal. However, we believe that FCC should not rely almost exclusively on private industry initiatives, but also should explore initiatives that the agency itself might undertake to improve public awareness about the DTV transition and its implications for the American people.
2. This report acknowledges FCC's efforts to resolve issues related to the compatibility between digital television sets and cable systems. Resolving these issues is a prerequisite to making digital cable-ready television sets widely available. However, we believe that in addition to resolving compatibility issues, FCC should, as we recommended, undertake an independent examination of the costs and benefits of mandating digital cable-ready capability. We look forward to seeing how the Commission addresses these issues in its forthcoming Report and Order.
3. We also look forward to the Commission's upcoming order on digital cable carriage. The Commission did seek comment in its digital carriage proceeding on a variety of options, including one similar to our "switchover" option. However, FCC told us that few if any comments were submitted regarding this option, and it is unclear the extent to which it has been given full consideration. Assuming this is not addressed in the Commission's upcoming order, we believe the agency should conduct a more thorough examination of the advantages and disadvantages of the switchover option.

Appendix V: GAO Contacts and Staff Acknowledgments

GAO Contacts

Amy Abramowitz, (202) 512-4936
Jason Bromberg, (617) 565-8863

Staff Acknowledgments

In addition to those named above, Wendy Ahmed, Carol Bray, Aaron Casey, Michael Clements, Michele Fejfar, Chris Miller, Faye Morrison, Madhav Panwar, Emma Quach, Mindi Weisenbloom, and Alwynne Wilbur made key contributions to this report.

GAO's Mission

The General Accounting Office, the investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through the Internet. GAO's Web site (www.gao.gov) contains abstracts and full-text files of current reports and testimony and an expanding archive of older products. The Web site features a search engine to help you locate documents using key words and phrases. You can print these documents in their entirety, including charts and other graphics.

Each day, GAO issues a list of newly released reports, testimony, and correspondence. GAO posts this list, known as "Today's Reports," on its Web site daily. The list contains links to the full-text document files. To have GAO e-mail this list to you every afternoon, go to www.gao.gov and select "Subscribe to daily E-mail alert for newly released products" under the GAO Reports heading.

Order by Mail or Phone

The first copy of each printed report is free. Additional copies are \$2 each. A check or money order should be made out to the Superintendent of Documents. GAO also accepts VISA and Mastercard. Orders for 100 or more copies mailed to a single address are discounted 25 percent. Orders should be sent to:

U.S. General Accounting Office
441 G Street NW, Room LM
Washington, D.C. 20548

To order by Phone: Voice: (202) 512-6000
 TDD: (202) 512-2537
 Fax: (202) 512-6061

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm

E-mail: fraudnet@gao.gov

Automated answering system: (800) 424-5454 or (202) 512-7470

Public Affairs

Jeff Nelligan, managing director, NelliganJ@gao.gov (202) 512-4800
U.S. General Accounting Office, 441 G Street NW, Room 7149
Washington, D.C. 20548