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Digital Debacle? Lessons from the History of Technical Standards

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Articles

Digital Debacle? Lessons from the History of Technical Standards

Stephen Bates*

On February 11, 2009—just six days before the scheduled February 17 deadline—President Obama signed legislation postponing the nation's changeover to digital television until June 12.[1] In a signing statement, the President said, "Millions of Americans, including those in our most vulnerable communities, would have been left in the dark if the conversion had gone on as planned, and this solution is an important step forward as we work to get the nation ready for digital TV."[2] But many Americans are likely to be left in the dark anyway. To restore their TV service, those people will have to buy digital televisions or digital converters, and perhaps powerful antennas as well; or subscribe to cable or satellite services. They will have to spend time and money to get what was always there at the flick of switch, at no cost. In the words of Federal Communications Commissioner Robert M. McDowell, "this transition will be messy regardless of when it happens."[3]

It could have been otherwise. Had Congress, the Federal Communications Commission, and the rest of the federal

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1. DTV Delay Act, Pub. L. No. 111-4, 123 Stat. 112 (2009).

2. Press Release, President Barack Obama, Statement of President Barack Obama on Signing the DTV Bill (Feb. 11, 2009), *available at* http://www.whitehouse.gov/the_press_office/StatementofPresidentBarackObamaonSigningtheDTVBill/ [hereinafter Obama Statement]. Most stations were given the option of sticking with the original date. Roughly one-quarter did so, as will be discussed below.

3. Robert M. McDowell, Commissioner, Fed. Commc'n Comm'n, Opening Statement in DTV Transition *En Banc* Hearing 2 (Feb. 5, 2009), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-288316A1.pdf.

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government paid heed to the history of technology, in particular the lessons of past changes in standards, they could have avoided many of the problems that will vex TV viewers. Here, as elsewhere, history can teach: although technologies and their standards vary, the theory applicable to them remains the same.[4]

Much has been written about the digital TV transition, including valuable works by federal agencies such as the Government Accountability Office ("GAO"). A sizable amount of literature addresses the development and implementation of standards in TV and video technologies generally. An even larger amount of literature addresses the history, policy, politics, and economics of standard-setting. But relatively few authors apply the lessons of standard-setting to television regulatory policy,[5] and none does so with regard to the shift to digital TV. This article aims to fill the gap.

In Part I, I summarize the upcoming digital changeover. In Part II, I briefly recount eight changes of technical standards, extract a proposition from each one, and weigh these propositions against the government's record in planning the digital TV transition. In some cases, the government acted in accord with history's lessons; in many, it did not. Finally, in Part III, I suggest a policy package that would have reduced the costs and inconveniences that consumers will face. For the sake of space, I do not address many issues related to digital TV, including the different digital formats, the process of allocating spectrum, and the protection of digital programs against copying.

I. BACKGROUND

Economists distinguish between *evolution* and *revolution* in technologies and standards.[6] A new technology compatible with what already exists is evolutionary; an incompatible new technology is revolutionary.[7] Digital television is revolutionary. People will only be able to continue watching over-the-air TV on

4. Carl Shapiro & Hal R. Varian, *The Art of Standards Wars*, CAL. MGMT. REV., Winter 1999, at 8, 9.

5. *But see* STANLEY M. BESEN & LELAND L. JOHNSON, COMPATIBILITY STANDARDS, COMPETITION, AND INNOVATION IN THE BROADCASTING INDUSTRY (1986); Mostafa Hashem Sherif, *A Framework for Standardization in Telecommunications and Information Technology,* IEEE COMM. MAG., April 2001, at 94–100.

6. Shapiro & Varian, *supra* note 4, at 15.

7. *Id.*

their analog sets by purchasing converters.[8] The GAO summarizes the differences between digital and analog broadcasting:

> Terrestrial television service—also known as over-the-air broadcast television—is transmitted from television towers through the radiofrequency spectrum to rooftop antennas or antennas attached directly to television sets inside of homes. With traditional analog technology, pictures and sounds are converted into "waveform" electrical signals for transmission, while digital technology converts these pictures and sounds into a stream of digits consisting of zeros and ones. . . . [T]o implement digital transmission, upgrades to transmission facilities, such as television towers, are necessary, and consumers must purchase a digital television or a set-top box that will convert digital signals into an analog form for viewing on existing analog televisions.[9]

Digital TV produces a sharper picture than analog TV. More importantly, it uses far less bandwidth.[10] As a result, a TV station can use its spectrum allocation, previously adequate for a standard-definition TV channel, to broadcast in high-definition or to broadcast multiple standard-definition channels, potentially along with such text as news and stock quotes.[11] Stations will not lose bandwidth, but the FCC will consolidate channels, in part because digital stations can be positioned more closely on the electromagnetic spectrum than analog channels.[12] As a result, roughly thirty percent of the analog TV band will be freed.[13]

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8. CONG. RESEARCH. SERV., DIGITAL TELEVISION: AN OVERVIEW 3–4 (updated Jan. 11, 2008), http://italy.usembassy.gov/pdf/other/RL31260.pdf. Cable subscribers are not affected, but they may be in 2012 when the FCC will stop requiring cable providers to transmit an analog signal. Erica Gies, *U.S. Switch to Digital TV Raises Specter of Toxic Dumping of Old Sets,* INT'L HERALD TRIB., June 4, 2008, *available at* http://www.iht.com/articles/2008/06/04/business/rbogtv.php.

9. GOV'T ACCOUNTABILITY OFFICE, TELECOMMUNICATIONS: GERMAN DTV TRANSITION DIFFERS FROM U.S. TRANSITION IN MANY RESPECTS, BUT CERTAIN KEY CHALLENGES ARE SIMILAR 4 (2004), http://www.gao.gov/new.items/d04926t.pdf [hereinafter 2004 GAO REPORT].

10. GOV'T ACCOUNTABILITY OFFICE, TELECOMMUNICATIONS: ADDITIONAL FEDERAL EFFORTS COULD HELP ADVANCE DIGITAL TELEVISION TRANSITION 6 (2002), http://www.gao.gov/new.items/d037.pdf [hereinafter 2002 GAO REPORT].

11. *Id.*

12. *Hearing Before the Subcomm. on Telecommunications and the Internet, H. Comm. on Energy and Com.,* Mar. 28, 2007, 2 (statement of K. James Yager), *available at* http://energycommerce.house.gov/cmte_mtgs/110-ti-hrg.032807.Yager-testimony.pdf [hereinafter Yager Statement].

13. *Id.* at 5.

Emergency services will be assigned some of the bandwidth, and the Federal Communications Commission will auction much of it, with most of the proceeds dedicated to reducing the deficit.[14]

The roots of digital television reach far back. The U.S. military began investigating the digital transmission of images in the 1970s.[15] Congress held its first hearing on high-definition television in 1981.[16] The FCC launched proceedings on the next generation of TV in 1987, but lacked the power to mandate any changeover.[17] High-definition TV (HDTV) was first exhibited via analog carriage, but it consumed too much of a spectrum already saturated with signals; so, in 1992, the General Instrument Company developed digital HDTV.[18] The digital signal took up less bandwidth and freed space on the television broadcasting spectrum.[19] Congress required American TV stations to go digital in the Balanced Budget Act of 1997 and imposed a deadline of December 31, 2006.[20] The Deficit Reduction Act of 2005 extended the deadline to February 17, 2009.[21] The DTV Delay Act further extended the deadline to June 12, 2009.[22]

In addition to consumers, the digital TV transition has a large number of stakeholders: among others, television manufacturers, TV broadcasters, cable and satellite providers, emergency responders, cell phone companies, firms that want to provide broadband wi-fi, and proponents of an alert system to warn of

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14. GOV'T ACCOUNTABILITY OFFICE, DIGITAL TELEVISION TRANSITION: INCREASED FEDERAL PLANNING AND RISK MANAGEMENT COULD FURTHER FACILITATE THE DTV TRANSITION 1 (2007), http://www.gao.gov/new.items/d0843.pdf [hereinafter 2007 GAO REPORT]; Marc Ferranti, *FCC Chief: Switch to Digital TV on Track,* PC WORLD, Jan. 8, 2008, *available at* http://www.pcworld.com/article/id,141200-c,broadband/article.html; s*ee* CONG. RESEARCH SERV., DIGITAL TELEVISION, *supra* note 8, at 16–17 (citing other earmarked funds to be taken from auction proceeds).

15. Mari Castañeda, *The Complicated Transition to Broadcast Digital Television in the United States,* 8 TELEVISION AND NEWS MEDIA 91, 93 (2007).

16. Yager Statement, *supra* note 12, at 2.

17. CONG. RESEARCH SERV., DIGITAL TELEVISION, *supra* note 8, at 1–3.

18. Aaron Futch et al., *Digital Television: Has the Revolution Stalled?*, 2001 DUKE L. & TECH. REV. 0014 (2001), http://www.law.duke.edu/journals/dltr/articles/2001dltr0014.html.

19. *Id.*

20. CONG. RESEARCH SERV., DIGITAL TELEVISION, *supra* note 8, at 3.

21. *Id.* at 3–4.

22. DTV Delay Act, Pub. L. No. 111-4, 123 Stat. 112, 112 (2009).

tsunamis and other perils.[23] Diverse players have diverse points of view, and this has produced many conflicts. For example, UHF stations wanted to increase their power so as to match the broadcast reach of VHF stations, but VHF stations opposed it.[24] The WB network wanted the FCC to postpone transferring spectrum to non-broadcast uses, so that fledgling networks might benefit from new TV stations;[25] Motorola wanted the spectrum transfer to occur immediately, so that it could expand its wireless services.[26] Most manufacturers opposed a mandate that they include digital tuners in televisions (more on this shortly), with the exception of Zenith, which owns the patent on the tuner.[27] Late in the process of planning the transition, Hollywood cinematographers came forward and argued that new TVs should have wider screens than the planned sixteen to nine ratio.[28]

The number of people affected by the digital changeover far exceeds those affected by any other standards change in American history. An estimated seventeen to twenty-one percent of American households watch over-the-air programming exclusively.[29] Compared to the national average, these people are more likely to live in urban areas,[30] to be nonwhite[31] or

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23. CONG. RESEARCH SERV., DIGITAL TELEVISION, *supra* note 8, at 17.

24. Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service, FCC 97–115, 16–29 (1997), *available at* http://www.fcc.gov/Bureaus/Engineering_Technology/Orders/1997/fcc97115.pdf.

25. *Id.* at 29.

26. *Id.* at 36–37.

27. Drew Clark, *Spectrum Wars,* 37 NAT'L J. 528, 534 (2005).

28. Richard E. Wiley, Chairman, FCC Advisory Committee on Advanced Television Service, Remarks at the Digital Television Conference (Nov. 12, 1996), http://www.wileyrein.com/publication.cfm?pf=1&publication_id=7872 [hereinafter Wiley Remarks].

29. Mark L. Goldstein, Dir., Physical Infrastructure Issues, Testimony Before the H. Subcomm. on Telecommunications and the Internet, 108th Cong. (2005), *in* GOV'T ACCOUNTABILITY OFFICE, DIGITAL BROADCAST TELEVISION TRANSITION: ESTIMATED COST OF SET-TOP BOXES TO HELP ADVANCE THE DTV TRANSITION (2005), *available at* http://www.gao.gov/new.items/d05258t.pdf [hereinafter 2005 Goldstein Testimony]; U.S. GOV'T ACCOUNTABILITY OFFICE, REPORT TO CONGRESSIONAL REQUESTERS: DIGITAL TELEVISION TRANSITION: IMPLEMENTATION OF THE CONVERTER BOX SUBSIDY PROGRAM IS UNDER WAY, BUT PREPAREDNESS TO MANAGE AN INCREASE IN SUBSIDY DEMAND IS UNCLEAR 3 (2008) [hereinafter GAO SUBSIDY PROGRAM REPORT].

30. Mark L. Goldstein, Dir., Physical Infrastructure Issues, Testimony Before the House Subcommittee on Telecommunications and the Internet, 109th Cong. (2008), *in* GOV'T ACCOUNTABILITY OFFICE, DIGITAL BROADCAST

Hispanic,[32] to have lower incomes,[33] to be over sixty-five,[34] and to have fewer TVs in the house (2.1 compared to 2.7 for cable and satellite households).[35] Approximately twenty percent of other households have at least one over-the-air set, meaning that the transition will affect over one-third of households.[36]

Rather than purchase a digital TV or subscribe to a cable or satellite service, an over-the-air household can retrofit a television with a converter, which changes the digital broadcast signal back to analog before reaching the receiver.[37] The National Telecommunications and Information Administration ("NTIA") offers two coupons per household, worth forty dollars each toward the purchase price of a converter.[38] The coupons can be used at 11,448 stores in the country.[39] Congress allocated $990 million to the program, with $510 million more available if necessary.[40] The NTIA ran out of funds by the beginning of 2009 and started a waiting list pending further funding.[41] The waiting list reached 4 million coupons by mid-February 2009[42]—hence the Obama

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TELEVISION TRANSITION: BROADCASTERS' TRANSITION STATUS, LOW-POWER STATION ISSUES, AND INFORMATION ON CONSUMER AWARENESS OF THE DTV TRANSITION 11–12 (2008), http://www.gao.gov/new.items/d08881t.pdf [hereinafter 2008 Goldstein Testimony].

31. *Id.* at 13.

32. GAO SUBSIDY PROGRAM REPORT, *supra* note 29, at 15 (finding that heavily Hispanic areas requested converter coupons at higher-than-average rates, but redeemed them at below-average rates).

33. 2008 Goldstein Testimony, *supra* note 30, at 11–12.

34. 2007 GAO REPORT, *supra* note 14, at 25.

35. 2005 Goldstein Testimony, *supra* note 29, at 8–9.

36. CONG. RESEARCH SERV., DIGITAL TELEVISION, *supra* note 8, at 11; GAO SUBSIDY PROGRAM REPORT, *supra* note 29, at 3.

37. GAO SUBSIDY PROGRAM REPORT, *supra* note 29, at Summary.

38. Press Release, U.S. Dep't of Commerce, Commerce Secretary Gutierrez Announces Ten Millionth Coupon Requested for TV Converter Box (April 8, 2008), http://www.ntia.doc.gov/ntiahome/press/2008/DTVcoupons_080408.pdf.

39. *Id.*

40. Deficit Reduction Act of 2005, Pub. L. 109-171, §§ 3005(a)(2), 3005(c)(3), 120 Stat. 23 (2006).

41. Press Release, National Telecommunications and Information Administration, Commerce's NTIA Announces New Coupon Applicants Will Be Placed on Waiting List Due to High Demand for TV Converter Box Coupons (Jan. 5, 2009), http://www.ntia.doc.gov/press/2009/DTV_WaitList_090105.html.

42. Peter Svensson, *Digital TV Converter Box Coupons Still Trickling Out; No Priority for Needy Areas,* STAR TRIB., Feb. 13, 2009,

Administration's decisions to delay the switchover and to seek additional funding for coupons.[43] The recovery package provided $650 million.[44]

The digital transition poses many challenges, some of them insuperable even with the extended deadline. Determining whether one's television is digital can be difficult. Analog TVs are rarely labeled as such, and even TVs labeled "digital ready" may in fact require a converter or tuner.[45] Although the FCC first maintained that existing home antennas would prove adequate in almost every instance, the assertion was based on the flawed assumption that most households have "an outdoor antenna thirty feet above the ground with an electric motor that allows the user to point the antenna toward to desired station," according to *Broadcast Engineering,* whereas in truth "75 percent of over-the-air households use indoor antennas on their TVs, and only 13 percent have an outdoor motorized roof-top antenna."[46] Even with an optimal antenna, many households may lose access to some stations because digital signals are more easily blocked by mountains and other obstacles.[47] The FCC estimates that for

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http://www.startribune.com/templates/Print_This_Story?sid=39565792.

43. Obama Statement, *supra* note 2.

44. Adrianne Kroepsch, *Digital Television Switch Confusion Clogs Regulators' Phones,* CONG. Q. TODAY ONLINE NEWS, Feb. 18, 2009, http://www.cqpolitics.com/wmspage.cfm?docID=news-000003055493.

45. DTV.gov, The Digital TV Transition: What You Need to Know About DTV, http://www.dtv.gov/consumercorner_2.html#faq7 (last visited Feb. 25, 2009).

46. *As Analog Shutdown Nears, Antenna Reality Emerges*, BROADCAST ENGINEERING, June 9, 2008, *available at* http://broadcastengineering.com/news/analog-shutdown-nears-antenna-reality-emerges-0609/; *see also* Todd Spangler, *Research Firm Centris Says Millions of Analog Sets Will Be in the Dark*, MULTICHANNEL NEWS, Feb. 12, 2008, *available at* http://www.multichannel.com/article/CA6531546.html (reporting that digital converter boxes may not be enough because of antenna problems); Digital TV Facts, Do I Need a New Antenna to Get Digital TV?, http://dtvfacts.com/102/do-i-need-a-new-antenna-to-get-digital-tv/ (last visited Feb. 13, 2009) (advising consumers that they may need to find a better antenna to ensure reliable digital TV reception); CONSUMER ELECTRONICS RETAILERS COALITION, WHAT CONSUMERS NEED TO KNOW ABOUT THE "DTV TRANSITION" AND THE NTIA "TV CONVERTER BOX PROGRAM" 3, http://www.ceretailers.org/CERC%20Consumer%20Guide%20-%202008.pdf (advising consumers that while most antennas should be fine, there may be some exceptions because the reception patterns for digital broadcasts may differ from a station's analog signal).

47. Roy Furchgott, *Many Obstacles to Digital TV Reception, Study Says*, N.Y. TIMES, Feb. 11, 2008,

eighteen percent of TV stations in the country, at least two percent of analog households will be unable to receive digital broadcasts;[48] the commission is allowing stations to boost their signals or use multiple transmission towers as a way of addressing the problem.[49] In addition, most low-power TV stations and translator stations (which amplify and rebroadcast another station) will continue using analog.[50] To receive those stations, a converter must have "analog pass-through" or be installed with an antenna splitter.[51] These factors, technical and largely unavoidable, will complicate the transition to digital. So may other factors, ones that are policy-related. As history teaches, these factors are largely avoidable. The government ought to have heeded their lessons.

II. HISTORICAL EXAMPLES AND PROPOSITIONS

A. THE "BEST" STANDARD CAN BE DIFFICULT TO IDENTIFY.

It is a common belief today that the standard typewriter keyboard is inefficient by design.[52] The inventor of the most significant typewriter prototype, Christopher Latham Sholes, found that the keys tended to stick en route to and from the platen.[53] By trial and error, he developed an arrangement that slowed the typist and reduced the problem of sticking keys: QWERTY, the keyboard that most people use.[54] In the 1930s, August Dvorak came up with a keyboard designed for speed and accuracy. "[D]uring the 1940s U.S. Navy experiments had shown

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http://www.nytimes.com/2008/02/11/technology/11analog.html.

48. John Eggerton, *FCC Identifies Hundreds of Stations with DTV Coverage Gaps,* BROADCASTING & CABLE, Dec. 23, 2008, http://www.broadcastingcable.com/article/161281-FCC_Identifies_Hundreds_Of_Stations_With_DTV_Coverage_Gaps.php.

49. John Eggerton, *FCC Approves DTV Coverage Area Fill-In Service,* BROADCASTING & CABLE, Dec. 23, 2008, http://www.broadcastingcable.com/article/161245-FCC_Approves_DTV_Coverage_Area_Fill_In_Service.php.

50. Eggerton, *supra* note 48.

51. 2008 Goldstein Testimony, *supra* note 30, at 9 & n. 6; DTV.gov, The Digital TV Transition: What You Need to Know About DTV, http://www.dtv.gov/consumercorner_5.html#faq22 (last visited Apr. 3, 2009).

52. *See generally* Paul A. David, *Clio and the Economics of QWERTY*, 75 AM. ECON. REV. 332, 332 (1985).

53. *Id.* at 333.

54. *Id.*

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that the increased efficiency obtained with [the Dvorak keyboard] would amortize the cost of retraining a group of typists within the first ten days of their subsequent full-time employment," writes Paul A. David.[55] But the QWERTY keyboard was too deeply entrenched to give way. Economists cite it as the classic example of "lock-in," where an inferior technology prevails because individuals who would prefer to change to the better technology do not do so, out of a misguided belief that others prefer the inferior one.[56]

Much of this conventional wisdom has been debunked. In a scrupulous examination of the historical record, communications scholar Darren Wershler-Henry finds that Sholes did have a problem with sticking keys, and that he probably altered the keyboard so that keys struck in succession would rarely be close to each other.[57] How Sholes did so is unknown, as is whether he also sought to slow down typists.[58] As for those Navy studies, economists S.J. Liebowitz and Stephen E. Margolis note that they were evidently overseen by the Navy's time-and-motion specialist, Lieutenant Commander August Dvorak.[59] In a comprehensive analysis of the factors affecting typing speed, Donald A. Norman and David E. Rumelhart judge the Dvorak keyboard superior to the Sholes keyboard on two criteria: equalizing the loads on left and right hands, and maximizing the load on the middle row of keys.[60] But the Sholes keyboard is superior on two other criteria: minimizing the frequency of same-hand typing sequences, and

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55. *Id.* at 332.

56. *See generally* Joseph Farrell & Garth Saloner, *Standardization, Compatibility, and Innovation,* 16 RAND J. OF ECON. 70 (1985) (discussing how standardization benefits can "trap" an industry in an inferior standard when there is a better alternative available); S.J. Liebowitz & Stephen E. Margolis, *Path Dependence, Lock-In, and History,* 11 J. OF L., ECON., & ORG. 205 (1995) (examining different forms of path dependence and how they "lock-in" certain economic decisions).

57. DARREN WERSHLER-HENRY, THE IRON WHIM: A FRAGMENTED HISTORY OF TYPEWRITING 152–57 (2005).

58. *Id.* at 155–57.

59. S.J. Liebowitz & Stephen E. Margolis, *The Fable of the Keys,* 33 J. OF LAW AND ECON. 1, 12 (Apr. 1990); *see generally* S.J. LIEBOWITZ & STEPHEN E. MARGOLIS, THE ECONOMICS OF QWERTY: HISTORY, THEORY, AND POLICY (2002); Peter Lewin, *The Market Process and Economics of QWERTY: Two Views,* 14 REV. OF AUSTRIAN ECON. 65, 65–96 (2001) (weighing arguments against David, *supra* note 52, and eventually siding with Liebowitz and Margolis).

60. Donald A. Norman & David E. Rumelhart, *Studies of Typing from the LNR Research Group, in* COGNITIVE ASPECTS OF SKILLED TYPEWRITING, at 50–52 (William E. Cooper ed. 1983).

minimizing the frequency of same-finger typing sequences.[61] Many studies find the Dvorak keyboard superior to QWERTY, but the difference is generally around a modest five percent, not worth the expense of retraining typists.[62]

Digital television has a great many advantages over analog TV. But—setting aside transition issues for the moment—digital is inferior in a few respects. A former FCC chair, Richard E. Wiley, said in 1996, "sincere and legitimate objections have been raised about digital television—so it has been . . . with all new technical innovations."[63] Many viewers will lose some channels because of the aforementioned antenna issue.[64] Digital television is (in many senses) a binary affair: a channel comes through perfectly or it does not come through at all.[65] Static-ridden stations that people have long tolerated may vanish. To get them back, viewers will have to buy more powerful antennas. In 2008 Rep. Rick Boucher (D-Va.) argued that the federal government ought to pay to replace people's antennas.[66] Furthermore, the GAO reported in 2002 that a small percentage of TV stations would not convert to digital transmissions without the federal mandate, even when given the additional bandwidth for digital broadcasting.[67] One reason is

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61. *Id.* at 51; Liebowitz & Margolis, *supra* note 59, at 16 (citing Norman & Rumelhart study); *see also* Jan Noyes, *QWERTY—The Immortal Keyboard*, COMPUTING AND CONTROL ENGINEERING J., June 1998, 117–22 (citing more observations on the QWERTY and Dvorak comparison); TORBJÖRN LUNDMARK, QUIRKY QWERTY: A BIOGRAPHY OF THE TYPEWRITER AND ITS MANY CHARACTERS (2003) (recounting a short history of the QWERTY keyboard); Lee Gomes, *QWERTY Spells a Saga of Market Economics*, WALL ST. J., Feb. 25, 1998 at B1 (summarizing the keyboard efficiency debate and studies by Paul A. David and Liebowitz and Margolis while discussing economic and market theories of path dependence—the notion that once you start down a certain path, it is hard to get off).

62. Norman & Rumelhart, *supra* note 60, at 51–52; WERSHLER-HENRY, *supra* note 58, at 162–63.

63. Wiley Remarks, *supra* note 28.

64. *See supra* notes 46–49 and accompanying text.

65. Furchgott, *supra* note 47 (explaining "cliff effect"—where the picture suddenly drops out as soon as signal gets weak).

66. John Eggerton, *Boucher: DTV Transition Needs Technical Assistance Component,* BROADCASTING & CABLE*,* June 20, 2008, *available at* http://www.broadcastingcable.com/article/CA6572000.html?rssid=193 (arguing that the government could take spectrum auction proceeds to pay for the coupon program, technical assistance, hardware, and labor of replacing antennas).

67. U.S. GOV'T ACCOUNTABILITY OFFICE, REPORT TO THE RANKING MINORITY MEMBER, SUBCOMMITTEE ON TELECOMMUNICATIONS AND THE

cost, which, including digital program equipment, can reach $10 million per station.[68] Unable to raise the funds, some owners told the GAO they were considering selling their stations.[69] In addition, consumers are likely to get rid of several million analog TVs—most of them before the end of their lifespan—as the transition approaches.[70] Before the changeover delay, *The Washington Post* estimated that nearly 44 million TVs would be discarded.[71] Some TVs will be donated or recycled, but many will end up in landfills.[72] The discarded TVs contain toxins—lead, mercury, cadmium—that can leach into groundwater.[73] (The EPA urges consumers to buy converter boxes rather than new TVs.[74]) Recycling poses its own hazards. Recycled TVs are often sent to developing countries, where the workers who dismantle them are exposed to the toxic chemicals.[75] The waste is often then dumped in those countries' landfills, which simply transfers the environmental peril.[76] The Basel Convention restricts the export of hazardous waste, but the United States is not a signatory.[77] The antenna, cost, and waste issues present arguments against

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INTERNET, COMMITTEE ON ENERGY AND COMMERCE, HOUSE OF REPRESENTATIVES: TELECOMMUNICATIONS: MANY BROADCASTERS WILL NOT MEET MAY 2002 DIGITAL TELEVISION DEADLINE 29 (2002) [hereinafter MAY 2002 DEADLINE].

68. Yager Statement, *supra* note 12, at 6.

69. MAY 2002 DEADLINE, *supra* note 67, at 5 (citing six percent of owners). Postponing the shift to digital imposes additional costs. PBS estimated that its stations would have to spend $22 million to continue simulcasting beyond the original deadline. Sanjay Talwani, *DTV Delay Promises Complications,* TV TECH.: THE DIGITAL TELEVISION AUTHORITY, Jan. 30, 2009, http://www.tvtechnology.com/article/73894.

70. *See, e.g.,* Kim Hart, *Switching to the Recycling Channel: Area Girds for Digital TV Changeover*, WASH. POST, Apr. 26, 2008, at D1 (concluding that many people will use the digital switch to buy a new TV, especially as digital TV sets continue to drop in price).

71. *Id.* at D3.

72. *See id.* (reporting that surveys indicate that most TVs will be sold, donated, or recycled, but that environmental groups are not convinced they will not just go to landfills).

73. *Id.*

74. U.S. Environmental Protection Agency: Digital Television Transition, http://www.epa.gov/epawaste/conserve/materials/ecycling/tv-convert.htm.

75. Gies, *supra* note 8.

76. *Preventing the Digital Dump: Ending "Re-use Abuse,"* BRIEFING PAPER 10 (Basel Action Network, Seattle, Wash.), June 2008.

77. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Mar. 22, 1989, 1673 U.N.T.S. 57.

shifting to digital TV—not decisive ones, but reasonable ones. Digital TV is not necessarily the best technology for everyone.

B. THE MARKETPLACE WILL CHANGE STANDARDS ONLY IF THE BENEFITS ARE CLEAR.

In 1869 *Scribner's Monthly* spoke of a "revolution in the humble matter of weighing and measuring . . . [that] is now making quiet progress."[78] In the 1970s, adoption of the metric system was "Held 'Inevitable'"[79] and "coming very soon,"[80] and the *Wall Street Journal Guide to the Metric System* declared, in 1977, it was "about to become a fact of life."[81] The Federal Highway Administration proclaimed in 1995: "The Long Wait for Metric is Nearly Over."[82] American competitiveness in international markets is said to be hindered by the nation's refusal to go metric.[83] The latest survey by the United States Metric Association finds the only non-metric nations to be the United States, Myanmar, and Liberia.[84] Inertia, however, is not the only force thwarting the United States' adoption of the metric system. One critic contends, "Every carpenter will need new tapes and squares, steel fabricators will need to retool shops, millions of dollars' worth of technical libraries will become obsolete and millions of dollars' worth of surveying equipment will need replacement (primarily from overseas manufacturers). . . ."[85] Some consumers fear being shortchanged, too. When wine and liquor bottles

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78. *The Metric Reform*, SCRIBNER'S MONTHLY, July 1879, at 408.

79. John Noble Wilford, *New Sizes in U.S. Held "Inevitable,"* N.Y. TIMES, Dec. 29, 1970, at 14.

80. *Nation Going Metric; Shift Seen in Boating: It's Coming Very Soon*, CHI. TRIB., Mar. 21, 1975, at C7.

81. Mark Feeney, *Inching Along: Thirty Years Later, We're Still Taking Measure the Old English Way,* B. GLOBE, May 2, 2005, at B12.

82. David Smith, *Metric Conversion: How Soon?*, PUB. ROADS, Summer 1995, at 18.

83. Ralph Blumenthal, *Is Metrics U.S.A. Just a Silly Little Millimeter Away?*, N.Y. TIMES, July 21, 1978, at B1.

84. U.S. Metric Association: Metric Usage and Metrication in Other Countries, http://lamar.colostate.edu/~hillger/internat.htm; *see also* Jeanette C. Smith, *Take Me to Your Liter: A History of Metrification in the United States*, 25 J. OF GOV'T INFO. 419, 425 (1998) (using 1981 data, also listing Brunei and Yemen).

85. Joel Rosenblatt, *Metrication: Billion-Dollar Boondoggle?* CIV. ENGINEERING, Apr. 1995, at 6; *see also* Smith, *supra* note 84, at 424–25; *Metric Reform, supra* note 78, at 413–14 (citing an earlier discussion of the changeover hassle).

switched to 1.75 liters from half gallons in 1975, the bottles held eight percent less but the prices generally remained the same.[86]

Where consumers and other players must act, roughly simultaneously, to effect a transition, it is unlikely to occur without strong consumer demand. For DVD players to succeed, for example, studios needed to license their films for DVDs; companies needed to produce and distribute the DVDs; stores needed to stock them; and consumers needed to buy players and buy or rent DVDs. All of these developments happened. Nielsen Media reports that DVD penetration rose from forty-one percent in the third quarter of 2002 to eighty-one percent four years later.[87] By contrast, Jeannette C. Smith remarks that "[m]etric conversion will continue at a snail's pace" if, among other things, "it is voluntary, not mandatory."[88] For consumers, DVDs offered mainly benefits; the metric system, mainly costs.

Digital TV has proved more like the metric system than like DVD technology. In a 1996 FCC hearing, economist Jeffrey H. Rohlfs explained: "No viewer has the incentive to buy an ATV [advanced TV] set because if they got one there is nothing they could receive over it. Since there is no demand for the sets, no manufacturer has the incentive to produce any. And given that no sets are being produced, no station has any incentive to broadcast in ATV."[89] Even after the FCC mandated the digital conversion in 1997, the public's interest in digital TV remained minimal. "For stations, it was a lonely and expensive experience," National Association of Broadcasters board member K. James Yager said.[90] In 2002 nearly two-thirds of TV stations surveyed by the GAO reported little or no interest in digital programming in their markets.[91] "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

86. Blumenthal, *supra* note 83.

87. *Table 2: Penetration of Media Devices in U.S. Homes*, *in* NIELSEN MEDIA RESEARCH HOME TECH. REP., *available at* http://www.nielsenmedia.com/nc/nmr_static/docs/HomeTech_chartsQ3.pdf.

88. Smith, *supra* note 82, at 430.

89. *Economic Considerations for Alternative Digital Television Standards*, *Digital TV Forum Before the Federal Communications Commission*, http://www.fcc.gov/Reports/ec961101.txt (transcript of Jeffrey H. Rohlfs, Strategy Policy Research).

90. Yager Statement, *supra* note 12, at 5.

91. MAY 2002 DEADLINE, *supra* note 67, at 14.

within the originally anticipated time frame,"[92] the GAO said in 2002.

Left to the marketplace, it seems that digital-television adoption might have taken decades, or, as with the metric system to date, never occurred at all. Consumer demand for a somewhat sharper picture (much sharper in HDTV) appears to be relatively modest.[93] In order to benefit from digital TV, including HDTV, and the newly-available spectrum space for emergency services, the government imposed a mandate, learning from the metric system's failure to transition. But for years, the FCC believed that consumers would begin buying digital TVs on their own. They did not, and manufacturers and retailers continued making and selling analog TVs. Only in 2002 did the FCC conclude that market forces were inadequate and mandate retailers to solely stock digital TVs by early 2007.[94] (Only beginning in May 2007 did the FCC require retailers to place warning labels on analog TVs in stock, which still can be sold.[95] The FCC has fined Best Buy and other companies for violating the label requirement.[96]) The digital transition's years of delay are a result of the FCC's misguided reliance on the marketplace.

C. COMPROMISE IS NOT ALWAYS THE BEST SOLUTION.

Early trains ran on a variety of gauges, partly because the first rail lines did not interconnect and company officials never

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92. 2002 GAO REPORT, *supra* note 10, at 37–38.

93. *See supra* text accompanying note 68.

94. Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television, 17 F.C.C.R. 15978, 15996 (2002) (second report and order).

95. Second Periodic Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television, 22 F.C.C.R. 8776, 8783 (2007) (second report and order).

96. *E.g.,* Best Buy Co., Inc., 23 F.C.C.R. 6249 (2008) (finding that Best Buy apparently willfully and repeatedly violated FCC's rules by failing to place the required Consumer Alert label immediately adjacent to and clearly associated with analog television). *See generally* U.S. PUB. INTEREST RESEARCH GROUPS EDUCATION FUND, MIXED SIGNALS: HOW TV RETAILERS MISLEAD CONSUMERS ON THE DIGITAL TELEVISION (DTV) TRANSITION (2008), *available at* http://uspirg.org/uploads/eP/B7/ePB7dh1zQV1RZV-2vsqhxA/Mixed_Signals.pdf (showing that the majority of retailers provide inaccurate or misleading information about the digital transition to persuade customers to buy new, expensive digital televisions instead of the cheaper converter box alternative).

intended to interconnect the lines.[97] In the 1840s Ireland had three dominant gauges: four feet, eight and a half inches; five feet, two inches; and six feet, two inches. The British Board of Trade chose a compromise: five feet, three inches, "a gauge which at that time fitted no existing line in Ireland or England or, for that matter, anywhere else in the world."[98] Companies had to re-lay track and order specially made rolling stock, which in turn could be sold to no other country.[99]

The byzantine story of digital television is full of compromises, some wise, some neutral, and some as ill-advised as the British Board of Trade's track gauge. An example of an ill-advised compromise is the transition period for television sets—that is, how long before the changeover (initially February 17, 2009, and now June 12, 2009) when all TVs sold in the United States must be digital, creating a period in which consumers will not buy a set that will soon require a converter. The longer digital TVs are exclusively sold, the fewer converters will be needed. During the debate on the topic in 2005, TV manufacturers argued that digital tuners ought to be optional because only a minority of Americans watch over-the-air TV, a position that the Consumer Federation of America also supported.[100] Broadcasters wanted digital tuners to be mandatory right away.[101] Both positions are reasonable. TV manufacturers and the Consumer Federation opposed a change that would raise the cost of a TV by some $200, an unnecessary expense for the majority of buyers.[102] Broadcasters, on the other hand, claimed that the cost would be under $100, perhaps as low as $16,[103] and wanted consumers to be confident that a new set would work with all transmission modes—over-the-air, cable, and satellite.[104] Even if consumers did not use terrestrial TV at the

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97. William R. Siddall, *Railroad Gauges and Spatial Interaction,* 59 GEOGRAPHICAL REV. 29, 30 (1969).

98. *Id.* at 43.

99. *Id.*

100. MARK COOPER, CONSUMER FED'N OF AMERICA, A CONSUMER-FRIENDLY INDUSTRIAL POLICY FOR THE TRANSITION TO DIGITAL TV 1–2 (2002), *available at* http://www.consumerfed.org/pdfs/dtvtransition.pdf.

101. Ted Hearn, *NAB Wants Sooner DTV-Tuner Mandate*, MULTICHANNEL NEWS, Aug. 10, 2005, http://www.multichannel.com/index.asp?layout=article&articleid=CA634076&display=Breaking+News&referral=SUPP.

102. COOPER, *supra* note 100, at 4.

103. Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television, 17 F.C.C.R. 15978, 15997 (2002).

104. 17 F.C.C.R. at 15998.

time of purchase, they might do so in the future.[105] The FCC compromised by letting retailers sell analog TVs until early 2007[106] (and thereafter for TVs already in stock, as long as they were labeled).[107] During the year before the digital-only deadline, nearly ten million analog TVs were shipped to dealers.[108] Many of those are being used for cable or satellite, but given the estimated number of over-the-air households, most likely two million are being used for broadcast TV.[109] Those consumers will discover that their relatively new sets stop working on June 12, 2009. For reasons set forth below, this ill-advised compromise ranks among the FCC's major blunders.

D. EDUCATION CAN AID A TRANSITION.

For decades during the twentieth century, Sweden was one of few countries in continental Europe in which people drove on the left side of the road. After Hungary switched to driving on the right side of the road in 1941, Sweden was the only one.[110] In the early 1960s, the Swedish government decided to change to driving on the right side of the road as of September 3, 1967.[111] A road, of course, is not a technology in the traditional sense. But the rule for driving is a standard, one that "reduces the 'transaction' costs of ascertaining the intentions of each oncoming driver, not to

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105. *Cf.* Second Periodic Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television, 22 F.C.C.R. 8776, 8782 (2007) ("[E]ven cable and satellite subscribers might be surprised to find that they cannot receive television broadcasts over-the-air on an analog-only television purchased today if they choose to discontinue subscription service or their cable or satellite service is terminated by a disaster, service disruption or for non-payment of their bills.").

106. Federal Communications Commission, "DTV" Is Coming (and Sooner Than You Think!), http://www.fcc.gov/cgb/consumerfacts/digitaltv.html [hereinafter "DTV" Is Coming]; s*ee generally* Consumer Electronics Ass'n v. FCC, 347 F.3d 291 (D.C. Cir. 2003) (denying Consumer Electronics Association's petition arguing the FCC lacked the statutory authority to require digital tuners).

107. "DTV" Is Coming, *supra* note 106.

108. Deborah D. McAdams, *NTIA Issues D2A Specs,* Apr. 2, 2007, http://www.tvtechnology.com/pages/s.0082/t.4382.html.

109. 2005 Goldstein Testimony, *supra* note 29; GAO SUBSIDY PROGRAM REPORT, *supra* note 29.

110. *See* Paul J. C. Friedlander, *H-Day Is Coming in Sweden,* N.Y. TIMES, Aug. 20, 1967, at XX–31 (reporting that when Sweden switches to the right side of the road, all of the continent of Europe will be on the right side of the road).

111. *Id.* at XX–1.

mention the resource costs of failed coordination."[112] And for the user, the results of the change were similar to those impending for digital television: to continue using something, one had to change behavior. One difference should be kept in mind: the equivalent of "simulcasting"—in which TV stations broadcast (and consumers receive) in both analog and digital, as they now are doing—is impossible on the road. People cannot drive on whichever side they prefer during a transition period.

A standards change that affects millions of people with no transition time must be meticulously planned. Sweden sent a thirty-two page instruction manual to every household in the country[113] and provided pamphlets in nine languages.[114] The changeover was preceded, *The New York Times* said, by "one year of continuous indoctrination in the press and over television and radio."[115] *Time* magazine reported, "In the final, frenetic days . . . the new system was explained in the press, demonstrated on film, discussed on radio and TV, and extolled by singing commercials."[116] During the hours before the Swedish changeover, only emergency vehicles, taxis, buses, and newspaper delivery trucks were permitted on the roads.[117] Workers uncovered previously positioned traffic signs and road stripes and covered up old ones.[118] Following well-publicized directions, at 4:50 a.m., all traffic stopped on the left side of the road and then cautiously moved to the right curb and remained there.[119] At five a.m., traffic moved again and Sweden became a right-hand-drive country.[120] The short-term cost was considerable, but relatively few citizens objected in the end (many did in the beginning).[121] By matching Norway and Finland's right-hand driving, Sweden

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112. RAGHU GARUD et al., *Introduction* to MANAGING IN THE MODULAR AGE: ARCHITECTURES, NETWORKS, AND ORGANIZATIONS 6 (Raghu Garud et al. eds., 2003).

113. PETER KINCAID, THE RULE OF THE ROAD: AN INTERNATIONAL GUIDE TO HISTORY AND PRACTICE 160 (1986).

114. *Switch to the Right,* TIME, Sept. 15, 1967, at 39–40 [hereinafter *Switch*].

115. *All Goes Right as Sweden Shifts Her Traffic Pattern,* N.Y. TIMES, Sept. 4, 1967, at 26.

116. *Switch, supra* note 114, at 40.

117. Friedlander, *supra* note 110, at XX–31.

118. *Id.* at XX–1.

119. *Id.* at XX–31.

120. *Id.*; *Swedes Adjust, Some Grumpily, to Switching Traffic to the Right,* N.Y. TIMES, Sept. 5, 1967, at L-24 [hereinafter *Swedes*].

121. *Swedes*, *supra* note 120.

reduced the number of accidents at the borders.[122] The overall accident rate declined for months after the changeover, seemingly because drivers became more cautious.[123]

With the United States' digital transition, however, the government only reluctantly concluded that it needed to educate the public.[124] As late as 2002, the FCC had no plans for education campaigns.[125] According to the GAO, "FCC officials told us that the bulk of consumer education that is related to DTV will likely be provided by the private sector."[126] Over time, the federal role in digital education did increase somewhat. A 2006 law provided that of the $990 million converter fund, the NTIA could devote $5 million, maximum, to consumer education.[127] By 2007 the FCC acknowledged its role in education, yet the GAO found that nobody in the government had created a comprehensive plan.[128] One FCC strategy document verged on self-parody:

> The Americans who will be most directly affected by the DTV transition are, of course, those who watch television, particularly over-the-air television. Consumer education efforts that specifically target this group are the best way to get information about the transition and its benefits into the hands of the people who need it.[129]

Berlin shifted to digital television in 2003, with a relatively speedy nine-month transition during which broadcasters simulcasted in digital and analog.[130] The education campaign included a rolling scroll on TV stations, "a direct mailing to every household, a consumer hotline, flyers and newsletters, an Internet Web site, and advertisements on buses and subways."[131] The month-long

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122. Friedlander, *supra* note 110, at XX–31.

123. Werner Wiskari, *Swedish Auto Deaths Down Since Change-Over,* N.Y. TIMES, Nov. 12, 1967, at K–27.

124. 2002 GAO REPORT, *supra* note 10, at 17.

125. *Id.*

126. *Id.*

127. Deficit Reduction Act of 2005, Pub. L. No. 109-171, Title III, sec. 3005(c)(2)(A), 120 Stat. 4, 23 (2006).

128. 2007 GAO REPORT, *supra* note 14, at 3.

129. Fed. Commc'ns Comm'n, Draft Document on the Digital Television (DTV) Transition 50 (Oct. 29, 2007), *available at* http://www.gao.gov/fccdraft.pdf. The FCC, remarkably, gave the unlabeled document to the GAO to demonstrate its preparedness for the changeover.

130. 2004 GAO REPORT, *supra* note 9, at 15–16.

131. *Id.* at 18.

campaign cost roughly one million U.S. dollars.[132] For Berlin's 3.4 million people, that works out to about twenty-nine cents per person, whereas $5 million to educate 301 million Americans comes to 1.7 cents per person.

To be sure, word is getting out, thanks in large part to a $1.4 billion educational campaign sponsored by the National Association of Broadcasters and the National Cable and Telecommunications Association.[133] Some eighty-three percent of Americans knew little or nothing about the transition in 2002, with greater ignorance among people who watch over-the-air TV, the ones who must take action to continue receiving broadcasts.[134] As of early 2008, the GAO found that eighty-four percent of Americans had heard about the transition, with higher levels of awareness among those who watch over-the-air TV.[135] But the GAO also found that many people who needed to act did not intend to do so: forty-five percent of people who watched terrestrial TV planned to take no action or inadequate action to retain reception.[136] Moreover, some people who needed to do nothing planned to act anyway: fifteen percent of people who watched cable or satellite said they would buy a converter.[137] The GAO recommends that educational campaigns include a message to them *not* to do anything.[138] Noting the need for material in other languages and in Braille, it also observes that "a challenge of consumer education is that those households in need of taking action may be the least likely to be aware of the transition."[139]

E. A CONVERTER IS LESS EXPENSIVE THAN THE NEW TECHNOLOGY, BUT ALSO LESS EFFECTIVE.

Fire hoses were the subject of one of the earliest standardization efforts in the United States.[140] Catastrophic fires

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132. *Id.*
133. GAO SUBSIDY PROGRAM REPORT, *supra* note 29, at 2.
134. 2002 GAO REPORT, *supra* note 10, at 16.
135. 2008 Goldstein Testimony, *supra* note 30, at 10–11, 15.
136. *Id.* at 11.
137. *Id.* at 14.
138. U.S. GOV'T ACCOUNTABILITY OFFICE, TESTIMONY BEFORE THE HOUSE SUBCOMMITTEE ON TELECOMMUNICATIONS AND THE INTERNET: DIGITAL TELEVISION TRANSITION: PRELIMINARY INFORMATION ON PROGRESS OF THE DTV TRANSITION 7–8 (2007).
139. *Id.* at 8.
140. *See To Help Stop Big Fires,* N.Y. TIMES, Mar. 8, 1904, at 5 [hereinafter *To Help Stop Fires*].

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in Baltimore, Toronto, and Rochester, New York, occurred around 1900, and firefighters from elsewhere came but could not render aid.[141] "[N]o two cities or towns were equipped with apparatus of like gage as to diameters or number of threads to the inch on hose or hydrant couplings and practically all efforts to help in these times of dire emergency were therefore rendered nugatory."[142] In 1913 the National Fire Protection Association recommended a standard coupling, which was gradually adopted.[143] Converters covered the transition. "[A] sufficient number of adapters should be carried on each hose wagon, so that the unconverted hose can be coupled up with the standard outlets of hydrants or fire engines," said the American Society of Mechanical Engineers.[144] The organization characterized the adapter as "an interim measure," which would be "discarded as the hose wears out, and all new hose purchased to be fitted with the standard couplings, thus securing a gradual and inexpensive method of standardizing the whole equipment. . . ."[145] These converters, said the American Society of Municipal Improvements, would make the transition "gradual, easy and inexpensive."[146]

Converters can diminish the danger of "stranding users who have invested in the losing technology," Joseph Farrell and Garth Saloner observe, adding that these "black boxes" can make it "unnecessary to standardize" by creating "*compatibility ex post*—i.e., after a variety of products has been introduced, without the constraints of *ex ante standardization.*"[147] But converters tend to have problems. Carl Shapiro and Hal R. Varian write, "Converting files from WordStar to WordPerfect, and now from WordPerfect to Word, is notoriously buggy . . . in part because of raw

141. *Id.*

142. PROCS. OF THE 13TH ANN. CONVENTION OF THE AM. SOC'Y OF MUN. IMPROVEMENTS, Birmingham, AL, October 1906, 30 [hereinafter PROCS.]; *see also To Help Stop Fires*, *supra* note 140 (citing Rochester and Baltimore fires and the trouble visiting fire companies had).

143. Sub-Committee on Fire Protection, Am. Soc'y of Mech. Eng'rs, *No. 1398: Standard Threads for Hose Couplings,* 35 TRANSACTIONS 301, 301 (1914); F.M. Griswold, *Recent Progress in the Standardization of Threads for Fire-hose Couplings and Fittings,* 35 J. OF THE NEW ENG. WATER WORKS ASS'N 43, 43 (1921).

144. Sub-Committee on Fire Protection, *supra* note 143, at 305.

145. *Id.* at 304–05.

146. PROCS., *supra* note 142, at 31.

147. Joseph Farrell & Garth Saloner, *Converters, Compatibility, and the Control of Interfaces,* 40 J. OF INDUS. ECON. 9, 10–11 (1992).

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performance concerns and in part because of lurking concerns over just how compatible the conversion really is . . . ."[148] More generally, they note: "The biggest problem with adapters, when they are technically and legally possible, is performance degradation . . . . Tasks become more complex."[149] With fire hoses, converters required money to buy, time to install before each fire, and doubled the leakage and pressure problems that can arise in every hose connection.

For digital TV, converters do enable consumers to benefit from the new service while holding on to the old technology. But they come at a cost—from forty to one hundred dollars, of which the NTIA coupon pays forty dollars.[150] Getting the coupon and finding a store to accept it can take time and effort. The NTIA provides two coupons per household; households with more than two TVs must pay full price for additional converters. Nationally, the average household had 2.6 sets in 2005.[151] Furthermore, households need another converter in order to watch one program while recording a different one on analog equipment.[152] It seems likely, then, that a majority of over-the-air households will have to purchase at least one full-price converter. Instead of the coupon program, the government might have directly subsidized the manufacture of converters. That way, consumers would not have to await arrival of coupons, and they could buy as many discounted converters as their homes require. Installation of the converter, further, can demand more know-how than a consumer possesses. The FCC shut off analog broadcasting in Wilmington, North Carolina, in September 2008 as a pilot program; the National Association of Broadcasters found that a quarter of converter buyers there had trouble installing the equipment, and eleven percent were unable to resolve the problem.[153] Wilmington

148. Shapiro & Varian, *supra* note 4, at 29.

149. *Id.* at 28.

150. Jacques Steinberg, *Digital TV Beckons, But Many Miss the Call,* N.Y. TIMES, Jan. 29, 2009, at C8.

151. U.S. CENSUS BUREAU, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES (2008), 2008 704 tbl.1099 (127th ed. 2007).

152. Federal Communications Commission, Setting Up Your Digital-to-Analog Converter Box With a VCR, http://www.fcc.gov/cgb/consumerfacts/converterbox_vcr.html (last visited Mar. 14, 2009).

153. Letter from Marsha J. MacBride, Nat'l Ass'n of Broadcasters et al., to Marlene H. Dortch, Sec'y, Fed. Commc'ns Comm'n 11 (Oct. 10, 2008), *available at*

firefighters helped housebound people purchase and install the converters.[154] Emergency service providers elsewhere are unlikely to provide the same aid. The remote control for the converter poses problems too. A room with a TV may already have separate remotes for the television and the DVD player, and, sometimes, TiVo, the VCR, the stereo, and other devices. Universal remotes can replace the different remotes, but they cost money and take some effort to program. A homeowner without a universal remote must grow accustomed to turning on the TV with the TV remote, changing channels with the converter remote, and adjusting volume with the TV remote or, with some converters, with the converter remote. And recording a program while watching one requires different-model converters with different remotes—otherwise changing the channel on the viewing TV will also change the channel on the recording TV—which introduces one more remote and an even steeper learning curve. What once was simple or at least familiar becomes complicated or at least unfamiliar. A converter costs much less money than a digital TV, but seems likely to require more time, inconvenience, and money than is being advertised.

F. TIME AND SPACE CAN EASE A TRANSITION.

Transitions can be simpler when they occur gradually. One approach is to convert region by region over time. During much of the nineteenth century, as noted earlier, trains operated on a variety of gauges.[155] A half-dozen different lines might run into a city—Richmond, Virginia, among others—with no connection between them.[156] What is known as the English gauge, four feet, eight and a half inches from the inner side of one rail to the inner side of the other, gradually came to dominate, especially after Congress chose it for the Transcontinental Railroad in 1863.[157]

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http://www.nab.org/AM/Template.cfm?Section=resources&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=13231.

154. Lewis Beale, *World Watches as Wilmington Goes Digital,* WILMINGTON STAR-NEWS ONLINE, Sept. 8, 2008, http://www.starnewsonline.com/article/20080908/ARTICLES/809080263/1004&title=World_watches_as_Wilmington_goes_digital.

155. *See supra* text accompanying notes 97–99.

156. CHRISTOPHER R. GABEL, RAILS TO OBLIVION: THE BATTLE OF CONFEDERATE RAILROADS IN THE CIVIL WAR 3–4 (2002).

157. W.F. BAILEY, THE STORY OF THE FIRST TRANS-CONTINENTAL RAILROAD 28–29 (1906).

Lines with gauges of different widths converted over time, region by region, often as their owners' finances permitted.[158]

Many countries are making the digital conversion region by region. England, for example, is shifting gradually between 2008 and 2012, with London converting in the final year.[159] Germany plans to make the transition by "islands," because, according to the GAO, "officials thought that a nationwide DTV transition would be too big to manage at one time."[160] Berlin was the first to switch, in 2003.[161] Austria shifted on a seven-month schedule.[162]

The digital transition in the United States began with the aforementioned pilot program in Wilmington, North Carolina, on September 8, 2008.[163] Though the early switch went relatively smoothly, it did uncover problems. Some consumers knew of the September 8 deadline but did not believe broadcasters would go through with it, thinking the changeover date would be extended (just as the February 17, 2009, deadline has been extended).[164] The FCC's help line received some 800 calls from Wilmington on the day of the changeover, half of which concerned reception problems, including an inability to pick up stations that had been available by analog signal.[165] Rather than Wilmington's small and late partial roll-out, something akin to the British approach might

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158. *See, e.g.,* EDWARD HAROLD MOTT, THE STORY OF ERIE: BETWEEN THE OCEAN AND THE LAKES 44–46, 338 (1908) (citing the millions of dollars it cost the Erie Railroad Company in New York to make the standard gauge change and to maintain, equip, and supply the new railroad width).

159. Digitaluk.co.uk, When Do I Switch?, http://www.digitaluk.co.uk/when_do_i_switch (last visited July 3, 2008).

160. 2004 GAO REPORT, *supra* note 9, at 12.

161. *Id.* (reviewing the Berlin transition).

162. Peter Svensson, *US Analog TV Shutdown Bolder, Riskier Than Most*, CNBC, Feb. 6, 2009, http://www.cnbc.com/id/29055489.

163. Beale, *supra* note 154; *see also* Stephen Lawson, *DTV Transition Gains Steam as Qualcomm Pushes Back,* PC WORLD, Jan. 21, 2009, http://www.pcworld.com/article/158096/dtv_transition_gains_steam_as_qualcomm_pushes_back.html (reporting an earlier milestone when Hawaiian stations went all-digital on January 15, 2009; few problems were reported, but Hawaii has a higher-than-average cable TV penetration).

164. Glen Dickson, *Martin: Don't Move DTV Date—Fix Coupon Program,* BROADCASTING & CABLE, Jan. 10, 2009, http://www.broadcastingcable.com/article/161964-Martin_Don_t_Move_DTV_Date_Fix_Coupon_Program.php.

165. Press Release, Fed. Commc'ns Comm'n, Vast Majority of Wilmington, NC Residents Were Aware of the Early Digital Television Transition in Their Viewing Area 3 (Sept. 10, 2008), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-285330A1.pdf.

have proved wiser. A gradual conversion would have certainly made last-minute coupon requests more manageable for NTIA. The FCC could have also tried a regional transition a year or so before the national one, to detect and work out kinks. Even more, several weeks before each regional transition, the FCC could have ordered analog TV shut off for several days or a week to get people's attention.

The mandatory-changeover postponement has provided something of a rollout, with about one-quarter of stations, mainly in smaller markets, going all-digital on February 17, 2009.[166] The FCC's digital TV helpline received about 28,000 calls the day of the transition and 25,000 the next day.[167] According to the FCC and TV stations, most consumers knew of the transition.[168] Many had trouble installing their converters.[169] Others called to complain about losing reception of some stations due to the antenna problem.[170] In effect, this has served as an early detection.

Another way of orchestrating a transition is to have it occur over much or all of a system at once with a period of overlap, like the current TV digital-and-analog simulcasting but unlike the Swedish road rules. New York City Transit installed fare-card readers in subways between 1994 and 1997.[171] Tokens kept

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166. Brian Stelter, *With Four More Months to Switch, Hundreds of Television Stations Are All Digital,* N.Y. TIMES, Feb. 18, 2009, at B3; Ira Teinowitz, *DTV Switch: Early Reports Encouraging But Look Out . . . ,* TELEVISION WEEK, Feb. 18, 2009, http://www.tvweek.com/news/2009/02/dtv_switch_early_reports_encou.php.

167. Ira Teinowitz, *DTV Switch: Help Calls to FCC Decreasing,* TELEVISION WEEK, Feb. 19, 2009, http://www.tvweek.com/news/2009/02/dtv_switch_help_calls_to_fcc_d.php.

168. Michael Malone, *DTV Switch: Reports Indicate Smooth Early Analog Shutoff,* BROADCASTING & CABLE ONLINE, Feb. 18, 2009, http://www.broadcastingcable.com/article/174437-DTV_Switch_Reports_Indicate_Smooth_Early_Analog_Shutoff.php?rssid=20099&q=malone.

169. Kim Hart, *Some Markets Pull Plug on Analog TV,* WASH. POST., Feb. 19, 2009, at D02, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2009/02/18/AR2009021803131.html.

170. Todd Shields, *Viewers Lose Channels, Call Help in Digital TV Switch,* BLOOMBERG NEWS, Feb. 18, 2009, http://www.bloomberg.com/apps/news?pid=20601103&sid=aWTTgVtUsrzI&refer=us.

171. Metro. Transit Auth., N.Y. City, New York City Transit—History

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working until 2003, when the system went all-fare-card.[172] Similarly, New Zealand created new, lightweight versions of its 10-, 20-, and 50-cent coins in 2006.[173] For three months, residents could use old or new coins.[174] Subsequently, the old coins could be redeemed only at the Reserve Bank.[175] New York City Transit absorbed the inconvenience of a dual system. On the other hand, with New Zealand currency, the burden fell on private individuals and companies. New Zealand consumers faced the inconvenience of ridding themselves quickly of all their old coins or of having to go to the Reserve Bank to do so, whereas merchants faced the inconvenience of having to keep track of dual currencies. The three-month transition was a compromise, chosen to balance the burdens.

In 1997 the FCC decided on a multi-year transition, "so that consumers would not have to immediately purchase new digital television sets or converters."[176] The decision was half right. The FCC wisely kept consumers from having to rush out and buy digital sets, but it unwisely let them avoid buying digital sets at all for a decade. Only in 2007, as noted, did the FCC require retailers to sell digital TVs (or analog ones with warning labels). In this regard, the transition to the revised June 2009 analog shutoff was just over two years. That is not enough time. Between twenty-five and thirty million new TVs, on average, are shipped to dealers yearly in the United States (in the year before the 2007 deadline, ten million of them were analog).[177] Every additional year's delay in the analog shutoff would get another twenty-five to thirty million digital TVs into Americans' hands. The average lifespan of

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and Chronology, http://www.mta.info/nyct/facts/ffhist.htm (last visited Feb. 13, 2009).

172. *Id.*

173. *Id.*

174. *Id.*

175. Press Release, Reserve Bank of N. Z., Introducing . . . Smaller, Lighter Coins (July 31, 2006), *available at* http://www.rbnz.govt.nz/news/2006/2684589.html; Reserve Bank of N. Z., Change for the Better, http://www.newcoins.govt.nz/ (last visited Feb. 13, 2009); *see also* RESERVE BANK OF N.Z., EXPLAINING NEW ZEALAND'S CURRENCY 2, http://www.rbnz.govt.nz/currency/money/explaining_currency.pdf (explaining that the Reserve Bank is the only organization in New Zealand that can issue banknotes and coins).

176. CONG. RESEARCH SERV., DIGITAL TELEVISION REPORT, *supra* note 8, at 3.

177. 2005 Goldstein Testimony, *supra* note 29, at 11; McAdams, *supra* note 108.

an American TV is in the range of ten to twelve years.[178] So, every additional year's delay reduces the number of people who will need converters by roughly a tenth. Japan took the average lifespan of a TV (in Japan, eight years) into account in planning the digital transition, with the three major metropolitan areas—Tokyo, Osaka, and Nagoya—going digital in 2003 and analog broadcasting shutting down in 2011.[179] The United States should have considered a similar approach.

G. ON TECHNICAL MATTERS, THE VOICE OF THE PEOPLE IS OFTEN A WHISPER.

"It is long past time for the American public to hear about the problems they will experience in the rollout of digital TV," Senator John McCain (R-AZ) said in 1998.[180] Unfortunately, people tend to pay attention to an issue only when it affects them directly, by which time it may be too late to affect the policy. People are often not well organized and have little incentive to participate in the policymaking process.[181] Even if they did want to participate, lay persons are rarely welcome at meetings over setting standards. Members of standard-setting organizations prefer to work with others who are familiar with the technical matters.[182]

The press, and to some extent the public, are beginning to protest one mandate comparable to digital TV, the federal energy-saving requirements that will largely phase out the use of incandescent bulbs in favor of compact fluorescent light bulbs

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178. 2002 GAO REPORT, *supra* note 10, at 18 (citing ten years as the average life span of a television); W.A. KELLY HUFF, REGULATING THE FUTURE: BROADCASTING TECHNOLOGY AND GOVERNMENTAL CONTROL 170 (2001) (Contributions to the Study of Mass Media & Commc'ns, No. 61, 2001) (citing twelve years as the average life span of a television).

179. 2002 GAO REPORT, *supra* note 10, at 14; Kiyoshi Nakamura & Nobuyuki Tajiri, *A Perspective on Digital Terrestrial Broadcasting in Japan, in* DIGITAL BROADCASTING: POLICY AND PRACTICE IN THE AMERICAS, EUROPE, AND JAPAN 120, 121 (Martin Cave & Kihoshi Nakamura eds. 2006).

180. Jeannine Aversa, *Hard Road Ahead Before TV Reaches Digital Future*, AUGUSTA CHRON., Jul. 10, 1998, http://chronicle.augusta.com/stories/1998/07/10/tec_233057.shtml.

181. *See, e.g.*, JESSICA LITMAN, DIGITAL COPYRIGHT 176 (2001) ("Congress did not incorporate specific [copyright] exemptions for the general population in most of these enactments because nobody showed up to ask for them.").

182. *See* Kai Jakobs et al., *The Making of Standards: Looking Inside the Work Groups*, IEEE COMM. MAG., Apr. 2001, at 102–23.

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("CFLs") by 2012.[183] A CFL, like digital TV, is far more efficient than its predecessor technology. According to Energy Star, a joint program of the U.S. Department of Energy and the U.S. Environmental Protection Agency, they use up to seventy-five percent less electricity than incandescent bulbs and last up to ten times longer.[184] But they also contain toxic mercury. When a bulb burns out, Energy Star urges consumers to recycle it. If recycling is not an option and local garbage is incinerated, the consumer should take the bulb elsewhere for disposal; "[n]ever send a fluorescent light bulb . . . to an incinerator."[185] If a CFL breaks, as light bulbs sometimes do, the clean-up process is elaborate: "Have people and pets leave the room. . . . Open a window and leave the room for 15 minutes or more. Shut off the central forced-air heating/air conditioning system . . . ."[186] Energy Star's instructions proceed in this biohazard tone, including this admonition: "[i]f clothing or bedding materials come in direct contact with broken glass or mercury-containing powder from inside the bulb . . . the clothing or bedding should be thrown away."[187] If presented with full information in a referendum, one doubts that the American public would vote to adopt CFLs. The energy savings and longevity are certainly advantages, but the requirements for cleaning up a broken bulb—the difficulty, risk, and cost, in time if not in clothing or bedding—are disproportionate. The technology may improve so as to ease the cleanup process, of course,[188] but for now, the cost-benefit balance seems to argue for leaving the choice up to the consumer.

The public has likewise been the forgotten stakeholder in the digital transition. Scores of difficult issues involving broadcasters dominated the regulatory discussion for years, including whether broadcasters would begin paying for spectrum given the greater

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183. CONG. RESEARCH SERV., ENERGY INDEPENDENCE AND SECURITY ACT OF 2007: A SUMMARY OF MAJOR PROVISIONS 7 (2007).

184. ENERGY STAR, U.S. DEP'T OF ENERGY, FREQUENTLY ASKED QUESTIONS: INFORMATION ON COMPACT FLUORESCENT BULBS (CFLS) AND MERCURY 1 (2008), *available at* http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf.

185. *Id.*

186. *Id.*

187. *Id.*

188. *See, e.g.*, Peter B. Lord, *Solution Offered for Mercury Disposal*, PROVIDENCE J., July 1, 2008, http://www.projo.com/news/environment/content/BZ_get_mercury_07-01-08_SEAN594_v8.31a2a07.html.

capacity of digital broadcasting, what benchmark to use for deciding when to shut off analog broadcasting, and whether cable systems should be required to carry a TV station's digital as well as its analog channels during the period of simulcasting. Broadcasters and makers of receivers were given leisurely timetables for the transition. Only the public was rushed into the transition, with just over two years between the sale of the last unlabeled analog TV and the June 2009 conversion to digital.

H. A DISCONTENTED PUBLIC CAN BE AN UGLY THING.

A lesson may be learned from the history of railroad gauges. In the early 1850s, before the English gauge became the railroad standard, the Erie and Northeast Company announced plans to change a twenty-mile stretch of track between the New York-Pennsylvania border and Erie, Pennsylvania.[189] The twenty miles had a six-foot gauge, whereas the rest of the line between Buffalo and Cleveland had a gauge of four feet, ten inches.[190] By changing the twenty miles of track, the railroad could send trains straight through, rather than having to transfer passengers and cargo from one train to another twice, at each point where the gauge shifted.[191] But just as the status quo imposed cost and inconvenience on the railroad and its passengers, it benefited Erie. Passengers and workers stopped to eat and drink in the town, and local draymen hauled freight from one train to the other.[192] When railroad workers started changing the gauge in December 1853, a mob of some seven hundred, led by the mayor, tore up the track running through the town and burned the railroad bridges.[193] During the month after the first destruction of the line, the railroad rebuilt it seven times, and the people of Erie demolished it each time.[194] A few miles east of Erie, residents of the town of Harbor Creek tore up the track and burned bridges there, in a gesture of solidarity.[195] The result was that passengers

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189. CHARLES FREDERICK CARTER, WHEN RAILROADS WERE NEW 214–20 (Centenary ed. 1926).

190. *Id.*

191. *Id.*

192. *Id.* at 216.

193. *The Railroad Gange* [sic] *at Erie*, N.Y. TIMES, Dec. 8, 1853, at 1.

194. *The Troubles at Erie*, N.Y. TIMES, Jan. 9, 1854, at 3.

195. 3 JAMES FORD RHODES, HISTORY OF THE UNITED STATES FROM THE COMPROMISE OF 1850 TO THE MCKINLEY-BRYAN CAMPAIGN OF 1896, at 21–22 (Norwood Press 1906) (1895).

had to traverse a seven-mile stretch between the two breaks in the track.[196] The railroad provided carriages and, during the frequent snowstorms, sleds.[197] The ride took two hours; some passengers suffered frostbite and even came close to death.[198] Chief Justice Roger B. Taney issued an order enjoining the people of Erie from hindering railroad workers; the Erie justice of the peace declared the injunction void.[199] At a meeting, the people of Erie voted to find the president of the railroad and hang him.[200] Sporadic violence continued for two and a half years, until state authorities, grudgingly, intervened.[201]

Will the digital transition lead to rioting in the streets? No. But it is worth remembering that people can respond heatedly when actions by faraway authorities threaten their interests.

III. THE DIGITAL TELEVISION TRANSITION

The FCC said in 2007:

> The government has a strong interest in ensuring a timely conclusion of the digital transition, reducing consumer disruption and confusion, and limiting the number of consumers who are left without over-the-air television service on some or all of their television equipment when the analog broadcast service ends in less than two years.[202]

Notwithstanding the extension of the changeover until June, pursuit of that interest has fallen short.

Had Congress, the FCC, and the rest of the federal government heeded some lessons of history, the result would have been better all around. These are among the pertinent lessons:

- Realize that the virtues of the digital transition will be unapparent to many consumers—for them, the best technology is the one they have, not the one that requires a converter and perhaps a new antenna and that, even

196. CARTER, *supra* note 189, at 216.

197. *The Troubles at Erie*, N.Y. TIMES, Jan. 5, 1854, at 1.

198. *Id.*; *The Troubles at Erie*, *supra* note 194.

199. *The Railroad Troubles at Erie*, N.Y. WKLY. HERALD, Dec. 24, 1853; *The Railroad Troubles at Erie*, N.Y. TIMES, Dec. 31, 1853, at 4.

200. *The Railroad Troubles at Erie–Farther* [sic] *Details*, N.Y. TIMES, Dec. 31, 1853, at 8.

201. Uzal W. Ent, *The Great Erie Gauge War—A City Fights the Railroads in the 1850s*, PA. MAG., Winter 1985, at 44, 47–48.

202. Second Periodic Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television, 22 F.C.C.R. 8776, 8782 (2007) (second report and order).

with those add-ons, may no longer receive all their former channels. (The costs of conversion for TV stations and the environmental hazards of discarded TVs raise problems too.) As with the Dvorak keyboard, "better" is a relative term.

- Do not count on the marketplace to coordinate many different players unless the incentive is great enough. In a key part, the digital transition falls into the metric system category: much of the delay in the transition is the result of the FCC's misguided reliance on the market to get digital receivers into the hands of consumers.
- On behalf of the neglected consumer, strive to minimize the need for cumbersome and imperfect converters. Fire hose converters in the early twentieth century were unavoidable; with proper planning, most digital TV converters could be avoidable.
- To reduce the need for converters, substantially extend the duration of the transition—"transition" in the sense that only digital TVs are sold during a period of simulcasting. Ideally the transition's duration would approach the average life of a TV, ten or twelve years. The FCC bungled by choosing a short transition, barely two years, as a result of a flawed compromise between the desires of broadcasters (digital tuner mandate now) and those of TV manufacturers (digital tuner mandate never). The New York City fare card example is partly analogous, though the cost of incompatibility there was perhaps a few dollars, whereas here it will be the loss of TV reception. The Obama Administration's four-month extension helps only modestly.
- Avoid converter coupons if possible by subsidizing the store or the manufacturer rather than the consumer—that is, eliminate the necessity for consumers to apply for the two coupons, await their arrival, bring them to the store, and potentially have to purchase at least one converter at full price. Such an approach would anticipate consumers' interests and treat them seriously.
- Consider a region-by-region changeover, as with the conversion of railroad tracks to the standard gauge, both to detect problems and to simplify the process of providing converter coupons if they are necessary. The February shift to digital by some TV stations partially

fulfilled this criterion, though that was not the reason underlying the policy.

- To get consumers' attention, consider an analog shut-down of several days or a week well before the regional or national shut-down.
- Consider, as Rep. Rick Boucher has urged, subsidizing new antennas for people who need them.
- Launch a far more robust education program, along the lines of the Swedish road campaign, rather than the anemic one that the federal government has funded.

CONCLUSION

What will happen? First, expect a rush on digital TVs and converters as the June 12 deadline approaches. A Nielsen study released in February 2009 reported that 5.1 percent of American households would lose all TV service if the transition took place immediately, which is roughly a third of households that get TV solely over-the-air.[203] Upon discovering that their TVs no longer work after the analog shutoff, many Americans will buy new TVs or converters, leaving some stores out of TVs, or, especially, converters. (As the GAO has observed, demand for converters will plummet after the changeover, so stores have an incentive to stock too few rather than too many.[204]) TV sales rose in 2008, suggesting that those who knew of the then-scheduled February 2009 transition were buying digital sets.[205] If converters are necessary, some people, especially the elderly, will have to hire helpers to install them. Many will find that they no longer receive channels that they had received by analog. When some TV

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203. *DTV Readiness Update: 5.1% of U.S. Households Still Unprepared*, Feb. 5, 2009, NIELSEN WIRE, http://blog.nielsen.com/nielsenwire/media_entertainment/dtv-readiness-update-51-of-us-households-still-unprepared/. Unpreparedness was substantially higher among African-Americans (8.7 percent), Hispanics (8.5 percent), and those under age 35 (8.6 percent). *Id.*

204. 2007 GAO REPORT, *supra* note 14, at 31; *see also* Austin Bogues, *Some Press for More Notice of Transition in TV*, N.Y. TIMES, July 7, 2008, at C2 ("[L]ast-minute demand for digital converter boxes could be so overwhelming that millions of people—many of them elderly, low-income or disabled—will lose service.").

205. Danny King, *TV Sales Fueled by Digital Switch*, TV WEEK, Jan. 12, 2008, http://www.tvweek.com/news/2008/06/tv_sales_fueled_by_digital_swi.php. A Consumer Electronics Association study found that about fourteen percent of terrestrial-TV households plan to buy a digital TV before the transition. Hart, *supra* note 70, at D–1.

stations converted to digital on the original date, as noted, loss of channels was a major complaint on the part of consumers. Some people will give up on terrestrial TV and subscribe to cable or satellite services—this occurred with between a third and half of broadcast households in Berlin when the digital changeover took place.[206]

The result will not be a catastrophe, but for many Americans it will be a major inconvenience—and a needless one. Television is "among the most ubiquitous consumer durables in our society," according to the Consumer Federation of America.[207] We will be reminded just how ubiquitous on June 12, 2009.

206. 2004 GAO REPORT, *supra* note 9, at 19. When Hawaii converted to digital programming in January 2009, cable and satellite companies offered specials to attract new customers. Erika Engle, *Hawaii Makes DTV Switch Tomorrow,* HONOLULU STAR-BULLETIN, Jan. 14, 2009, *available at* http://www.starbulletin.com/business/businessnews/20090114_Hawaii_makes_DTV_switch_tomorrow.html.

207. COOPER, *supra* note 100, at 2.