THE DEVELOPMENT OF HIGH DEFINITION TELEVISION:
AN ECOLOGY OF GAMES

By

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The Development of High Definition Television: An Ecology of Games
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Abstract

This study is an analysis of the forces that shaped the overall character of a new US television system, high definition or HDTV, between the early 1980s and 2010, with a primary focus on the period leading up the Federal Communications Commission decision on the new standard in 1996. The study tries to answer the question: how did we get the system we got? The analysis uses the model of an ecology of games that Norton Long developed and William H. Dutton refined. It shows that two camps, or “games,” competed to define the new system. One game, consisting of the traditional television broadcast industry, saw HDTV as a standalone system, at first using the traditional analog technologies and then, midway through the process, switching to digital technologies. The second game, consisting of a lose group of academics and computer company representatives, saw HDTV as part of the emerging digital network. The result of the analysis shows that although the FCC was the legitimate forum for determining the standard, the technological system that finally emerged was the result of unplanned, uncoordinated political, social, and market forces.

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It is a cliché but still true that I owe more than I can ever put into words to the many people who have helped me with this dissertation. First, I want to thank my committee. Charles Stewart III, the chair, guided me with good humor and great patience, arguably far above and beyond duty’s call. Chappell Lawson provided challenges that took me into new theoretical areas that sharpened my mind, and, I hope, this work. William Uricchio provided precise and thoughtful comments on several generations of this project, all with respect, and in addition, introduced me to entirely new ways of looking at the study of communications. I would also like to thank Henry Jenkins for his serious academic guidance combined with infectious enthusiasm; USC’s gain is MIT’s loss.

I started this project in the midst of a group of scholars who believed that rigorous analysis could inform and learn from involvement in the development of public policy: W. Russell Neuman, my early advisor, provided a solid grounding in communications policy, history and analysis. I would like to thank Nicholas Negroponte for providing a home for our research group in the Media Lab and giving us free rein, even when our findings displeased his sponsors. David Staelin and William F. Schreiber were the best kind of mentors. My colleagues Richard Jay Solomon and Lee McKnight were unending sources of new ideas and high energy.

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Preface

High definition television did not develop the way it was supposed to. It started out as a new version of old television, analog and interlaced, as the engineers described it, and with little room for future refinement. It ended up, digital and progressively scanned as the engineers would say, as only one part of an interoperable system that shows video on a variety of devices - TVs, computers, iPads, and cell phones. What does television mean in this context? The definition of the system is as blurry as the pictures are crystalline.

Why did we end up with the system we got? What were the goals of the developers? Who were the players? What strategies did they use? How did those strategies affect the outcome? Answering these questions is the intent of this study.

The source material for this work draws heavily on emails directly sent or copied to me. Although I have tried my hardest to be even-handed and scrupulously fair, I must note that I was a part of the MIT research group that figures prominently in this study.
Chapter 1

Introduction

The men, tired after a long day of hard negotiations, sat in the darkened room, rapt as they watched rain glisten on cobblestones and the red dress flutter flawlessly on the screen. The setting was Geneva, a conference at the International Telecommunication Union; the time, summer 1985; the message: you are looking at the future of television, such perfection is within grasp. Fast forward eleven years to December 2, 1996, in a conference room at the Federal Communications Commission in Washington, on one of the slowest news days of the year, and watch the Commission with little fanfare and less enthusiasm formally adopt a standard for High Definition Television. The decision put an end to years of technological development and political wrangling, but without resolving major disagreements about the shape of the new system. Fast forward again, to June 2009. In broadcast stations across the country, engineers pulled a switch that ended traditional analog broadcasting and completed the switch-over to a fully digital system. The world in which this switch-over occurred, however, could hardly have been more different from the one those early HDTV researchers had imagined. Now television was part of a virtually seamless web for video displays. Today every single one of the low end HDTV Target offers is progressive scan. The display has a LED LCD\(^1\) screen, “razor thin” says the ad, to describe the 7.85” thick display. Moreover, not only does the set display television shows, but there is also an input device for a PC: “(a)nd when you’re not watching TV, the

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\(^1\) light emitting diode, liquid crystal display
VM230XVT can be used as a digital picture frame to enjoy a slideshow of your family and friends," says the ad. For only twenty dollars more, you can buy a set that is “(r)eady to connect to your home Internet; Wi-Fi capable,” that will allow you to “(e)njoy online content, movies, pictures and music on your TV” and “(a)ccess social-networking sites such as Facebook and MySpace.”

For the political scientist, the story of the development of high definition television is a puzzle. In the 1970s and early 1980s, as companies began to develop the next generation of television, it was entirely reasonable to expect that the formal standardization of the new system would take place in the established broadcast organizations. The final decision-making point in the United States would have been the Federal Communications Commission (FCC). Since the FCC had long been a prime example of an agency ruled by the interests of its regulated industry, “captured” as numerous scholars had said, the theory of regulatory capture should have predicted the outcome, but it did not. The FCC was not the only locus of decision-making, and the theory of regulatory capture only explains part of what happened. What circumstances brought change to the established standardization process, and where did the theoretical framework buckle?

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2 www.target.com/Vizio-Class-1080p-60Hz-HDTV
The rest of Chapter One is a brief overview of the HDTV chronology and of two theoretical approaches. The first is the literature on regulatory commission-industry relations, and it seems promising as a way to explain the outcome in this case, but on closer look is not. The second approach is Norton Long’s ecology of games, which goes further to untangle the forces that shaped the new system. Chapters Two through Four explore the phases of HDTV development as an ecology of games. Chapter Five summarizes the analyses in the historical chapters and shows what remains unexplained.

**Early Developments in HDTV**

HDTV began in the 1970s in the laboratories at Sony and at Nippon Hōsō Kyōkai, the Japan Broadcasting Corporation or NHK, whose researchers also worked with CBS, an early HD promoter. By 1977, progress was sufficient to begin formally deciding on a US standard. Simultaneous with that work, RCA, both as a television receiver manufacturer and as the parent of RCA Labs, and ABC were also conducting advanced television research, as were a small number of program producers and directors, most notably David Niles, Barry Rebo, and Francis Ford Coppola. The Society of Motion Picture and Television Engineers, the traditional television standardization body, deliberated possibilities until 1985 and finally decided to recommend NHK’s 1125-line standard (commonly referred to as 1125) to the State Department office that handled international

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4 The RCA Laboratory became the Sarnoff Laboratory.
standardization. Diana Lady Dougan, the Office Director, together with CBS Vice President Joseph Flaherty, pressed the executives at ABC and NBC to agree to support 1125 as a unified worldwide standard at the meeting of the International Telecommunication Union (ITU) Consultative Committee on International Radio (CCIR) that was to decide the issue in 1986. Dougan and Flaherty argued that the US would benefit from a single worldwide production standard strengthening Hollywood’s international TV program sales, but that the window to solidify that advantage was small. They campaigned vigorously for international support, but to no avail. The meeting in Dubrovnik ended with a decision to postpone the question about standards for another four years, snapping shut the window and essentially ensuring competing international standards.

**THE AMERICAN STANDARDIZATION PROCESS OPENS**

The defeat of the US position at Dubrovnik had a two-fold effect on the development of a US standard. The first was to unravel the shaky domestic US consensus on HDTV. NBC, RCA and ABC had gone along with the ATSC decision to support 1125 only very

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5 This competition was reminiscent of the rivalry between CBS and RCA and particularly the battle over color system for television. That battle, which lasted from 1940 to 1953, involved questions of backward compatibility with existing black & white sets and the ever controversial question of allocation of spectrum bands. The RCA system was backwardly compatible with existing black and white sets. The CBS system was by most accounts not. CBS among others wanted to relocate to the UHF bands; RCA, which owned patents in the VHF bands, wanted television broadcasts to retain the VHF allocations. The FCC first seemed to decide on the CBS system and then eventually switched to RCA’s. See William Boddy, *Fifties Television*. Urbana: University of Illinois. 1993. Brian Winston, *Media Technology and Society: A History the Telegraph to the Internet*. London: Routledge. 1998
reluctantly, and in the letter to Diana Dougan signaling RCA's agreement, President and CEO Robert Frederick made clear that RCA would resume work on its own system if no agreement came out of Dubrovnik. The second effect was to widen the broadcast game to include new players using new arguments in new arenas. The new players were (1) new proponents of alternative HDTV systems, (2) cable TV companies, (3) satellite broadcasters, and (4) federal agencies and departments, importantly the FCC and also the Departments of Commerce and Defense. The new arguments concerned the design and purpose of HDTV, and the whole debate moved into US domestic arenas.

The period from 1987 to 1991 was the most active and complex of all the periods of HDTV development, on multiple fronts. Initial activity centered around the traditional television standardization process. The FCC agreed to open an Inquiry into Advanced Television Services and then formed the Advisory Committee on Advanced Television Systems (ACATS) to recommend to the Commission a new HDTV standard. In addition, the Advanced Television Systems Committee (ATSC), a newly established private standardization organization, was to help develop the new standard and then shepherd it through the national and international standardization bodies. Last, the Advanced Television Testing Center (ATTC) and the associated cable testing organization, CableLabs, were to test the proposed systems.

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6 Correspondence from Robert R. Frederick to the Honorable Diana Lady Dougan, March 1985
While this activity was going on in the traditional standardization process, two other clusters of (interconnected) activities were also occurring. One was the attempt to steer the traditional standardization process from an analog standard appropriate only for television to developing standards compatible with evolving digital technologies. The other was the involvement of HDTV in the larger debate about the roles of government in fostering technological innovation, protecting our national security as it depended on high technologies, and industrial policy.

While researchers had returned to their labs and conference rooms to work on their own systems – some interlace, some progressive scan\(^7\) – HDTV fell out of the public eye until in February 1987. At that point, concerned that the Land Mobile providers\(^8\) would expand into unused broadcast spectrum, the association for television station owners\(^9\) petitioned the Federal Communications Commission to open an Inquiry into the future of advanced television. The petition also requested that the Commission freeze spectrum reallocation until the future television needs were clearer. In September 1988, the Commission issued the Notice of Inquiry into Advanced Television Services, docket 87-268. It asked for assessments of current system shortcomings, ways to overcome them, alternate spectrum needs, and the state of advanced television research.

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\(^7\) Traditional television uses a method of composing pictures called interlace scan. The next refinement on interlace is a system called progressive scan and is the basis of computer and some television pictures now. For more information, see Appendix I.

\(^8\) Land mobile systems provided two-way communications for police, fire, ambulance and other local groups.

\(^9\) The formal name is the Association of Maximum Service Telecasters, and the acronym is MST.
The following month, Dennis Patrick, the current FCC Chair, appointed an Advisory Committee on Advanced Television Services to assist the Commission. The Committee, known as ACATS, consisted largely of broadcasters and was under the leadership of Richard Wiley, an FCC Chair under Nixon and Ford and a prominent Washington communications lawyer. ACATS’ assignment was to study the requirements for a successful new television system and recommend a standard to the FCC.

A number of new organizations assisted in this work. The Advanced Television Systems Committee (ATSC) was a standards body and also consisted largely of broadcasters. It had already been part of the 1125 standards activities at the ITU meetings, and as of 1987, it remained a strong proponent of that standard. The Advanced Television Testing Center (ATTC) was a brand new organization that the broadcasters established and initially funded to test the competing new HDTV systems. CableLabs was the parallel organization for the cable industry, also new and industry-funded.

With the creation of these groups, the stage was set for the development and technical testing of proponent systems. Autumn of 1988 marked the beginning of a two-year period in which HDTV was a highly visible and contentious issue in other arenas as well. On September first, the FCC released its first decisions in docket 87-268. Existing broadcasters only would have the right to deliver the new system, which would either have to be compatible with the existing television system, NTSC, or would have to fit into the
same size channel. Viewers would have to be able to use their old televisions during any transition period, and cable and satellite companies could offer any advanced services as they wanted. This decision meant that broadcasters would end up with no more – and no less – spectrum than they currently had. On September 2, 1988, Representative Edward Markey, Chair of the House Telecommunications Sub-Committee, opened HDTV demonstrations in the capitol building and held several days of hearings on the new technology, casting it as an important part of the country’s international trade and technological security. On September 7, 1988, broadcasters, system proponents, and researchers all presented their positions at a major broadcaster conference.10

The immediate result of this activity was that economists, political scientists, and corporate strategists began to assess HDTV in broader terms. The American Electronics Association (AEA), the Electronics Industries Association (EIA), and the Department of Commerce National Telecommunications and Information Administration (NTIA) all studied potential diffusion of HDTV. HBO and Russell Neuman (MIT) studied mass audience reactions to HDTV. Robert Cohen (Economic Policy Institute) compared US and Japanese models of developing new technologies. The economic studies all predicted a large market for receivers and VCRs, ranging from $4 to $12 billion in 1988 dollars, figures made even larger in comparison with 1987 US consumer electronics factory sales total of $30 billion.


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A major question in these studies was the role of government in supporting HDTV. Representatives Levine and Ritter formed an HDTV Congressional caucus. George Brown created the Advanced Technology program as part of the Omnibus Trade and Competitiveness Act. NTIA appointed a Blue-Ribbon panel. In late December, Representatives Levine, Markey and Brown, head of the House Science Committee, along with Craig Fields from DARPA, and others met in Cambridge with researchers and scholars at the MIT Media Lab to develop alternative strategies. One result was a series of HDTV Ad Hoc meetings which brought together representatives of the administration, Congress, the bureaucracy, and the private sector. Another was an agreement to develop recommendations for private-public sector collaboration that resulted in a series of workshops under the auspices of the National Research Council. Last, DARPA took the concrete step in late December with its Broad Area Announcement of $30 million for advanced video components.

The HDTV developments in 1989 took place within the context of the Bush administration’s science and technology policies. The Reagan years had been lean ones for scientists not working in the few high-profile endeavors such as the Strategic Defense Initiative, but the incoming administration looked as though it would be more open to cooperative ventures. Robert Mosbacher, the new Secretary of Commerce, sounded particularly supportive at his confirmation hearings, saying that HDTV was not just
television but a part of "...a whole other generation of electronics," perhaps appropriate
for a government-industry consortium such as Sematech.12

This view found resonance within Congress, US electronics manufacturers, and among
computer researchers, though it met with a warier response with both broadcasters and
computer manufacturers. Congressman Ritter proposed legislation that would create an
HDTV consortium like Sematech, and Congressmen Markey and Levine also introduced
HDTV legislation.13 The National Research Council and the Institute of Electrical and
Electronics Engineers (IEEE) Committee on Competitiveness co-sponsored workshops to
develop a possible Technology Corporation of America (in February 1989) or a DRAM
memory chip consortium (in June 1989), both of which would build on US HDTV
production. Mosbacher's support also spurred the American Electronics Association
(AEA) to commission the Boston Consulting Group to develop a proposal for an HDTV
consortium that would use government as well as private funding. AEA unveiled the plan
during a week of great interest in HDTV in Congress. Representatives Markey, Ritter, and
Levine and then-Senator Gore all proposed legislation providing government support for

12 SEMATECH was a consortium of fourteen companies formed in 1987 to develop and manufacture
semiconductors and compete more effectively with the Japanese. SEMATECH received DARPA funding
13 "Markey's HDTV Bill Stalls in Jurisdictional Squabble," Communications Daily, Vol. 10, No. 187,
Communications Daily, February 23, 1989, Thursday, Vol. 9, No. 36; Pg. 8, "Brown Offers Bill; DARPA
Narrows HDTV Projects to 49," Communications Daily, Vol. 9, No. 56; Pg. 1, Communications Daily,
October 26, 1989, Thursday, Vol. 9, No. 207; Pg. 4

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HDTV to keep pressure on the Bush administration, particularly the Commerce Department. 14

The AEA proposed forming a consortium of private companies with $1.35 billion in seed money that the government would provide over ten years and that the consortium would repay. Despite that promise, the amount of money was striking, and the administration's position on industry-government relations had began to crystallize away from such partnerships. In particular, opposition to anything that seemed to be "industrial policy" was an anathema, an opposition that centered around John Sununu, the White House Chief of Staff, Michael Boskin, chair of the Council of Economic Advisers, and Office of Management and Budget Director Richard Darman. Mosbacher quickly backed away from the AEA proposal, saying "We cannot approach HDTV by asking 'Uncle Sugar' ... to put up the money, tempting as that may be." 15 The administration would only be willing to provide other forms of support such as some antitrust relaxation and R&D tax credits.

That negative posture continued: in November Washington was abuzz with rumors that the administration would cut off funding for Sematech and the DARPA HDTV grants, though Darman denied the charges, and that the Pentagon would fold the Defense Manufacturing Board and possibly DARPA as well, into the less political Defense Science Board. The HDTV supporters in Congress reacted loudly. Markey held hearings. Gore

14 "Pressure on Bush Administration; Gore Proposes HDTV Bill in Senate," Communications Daily, Vol. 9, No. 95, May 12, 1989
15 "Mosbacher Opposes Govt. Financial Aid For HDTV Development," Communications Policy, Vol. 9, No. 97, May 19, 1989
wrote the president and delivered a Senate speech that focused on the "inevitable demise" of US consumer electronics.

Simultaneous with the political developments, the State Department, with strong support from CBS and Sony/America, were still backing attempts to get agreement on 1125 as an international standard through the ITU standards process. As Sonia Landau, Diana Dougan's replacement, testified at a Markey hearing in early March, there had been no agreement on a new standard. The Congressmen were not pleased, and four days later Representatives Markey and Dingell wrote to Secretary of State James Baker stating that Landau had exceeded her authority in supporting 1125 and requesting that the Department refrain from any further decisions until the domestic ATV standardization was more settled. 16

The 1125 supporters had argued that their standard would be only a transmission standard and that countries could decide on a production standard as each wished. The problem according to the dissenters 17 was that the characteristics of a transmission standard would greatly limit the options in a production standard and that this effort was really just another attempt to make 1125 the US standard. Moreover, the Europeans stood behind

the 1250/50 standard they had proposed to counter the American-Japanese proposal in Dubrovnik, and it was clear that neither side could achieve worldwide acceptance.

To achieve some sort of movement towards standardization, the Canadian and Australian delegations to the ITU CCIR meeting recommended breaking the proposed standards into thirty-four smaller parts and building agreement on the common components. They called this system Common Image Format (CIF). Given the lack of a US domestic consensus on a standard, the American delegation to the CCIR agreed to back CIF at the May and October 1989 ITU meetings, opening the door to a US standard that was both more flexible and the product of American industry.

By the end of 1989, then, there were two clear camps concerned with HDTV. The television industry saw it in terms of enhanced pictures and spectrum needs. Although industry executives certainly testified at Congressional hearings and took part in State Department/ITU standards activities, the focus of their HDTV activities was the FCC, ACATS, and the testing labs. The second camp was less defined in membership but came together around their vision of HDTV as compatible with computers. They were largely representatives of the computer and film industries and academics from computer and social sciences. They all spoke in terms of high resolution systems, for there was broad agreement that advanced television would be flexible and capable of evolving over time in unforeseeable ways.
In testimony before the Markey Subcommittee in September 1989, Barry Whalen, Senior Vice-President of the Microelectronics and Computer Technology Corporation (MCC), defined high resolution systems as

"...the production, distribution, reception, processing, and display of high quality, high definition, broadband video and data for consumer, business, scientific, and military applications...The view of high definition systems merely as passive signal receptors that will give consumer a better picture on their television sets is much too limiting – high definition systems represent key, generic technology. We must expand the view of this technology to routinely include advanced software programming." 18

In a similar vein, Russell Neuman from MIT said,

"We must cease thinking of brighter colors and wider pictures and begin thinking instead of television as a mechanism for displaying a developing and evolving variety of video information on a television screen. We must think of television as a box with a computer inside." 19

Despite the administration opposition, HDTV remained in the public eye as 1990 began. The House Science Committee unanimously (49-0) voted to fund commercial R&D of HDTV and other advanced imaging systems at $350 million over two years through an office in the Commerce Department. 20

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18 Barry H. Whalen, Testimony before the Subcommittee on Telecommunications and Finance of the Committee on Energy and Commerce of the US House of Representatives, September 13, 1989, p. 1

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The question of US backing for 1125 in the ITU arose again. The ITU standards cycle that had begun after the Dubrovnik meeting, the meeting at which the US had failed to make 1125 a worldwide standard, was drawing to its quadrennial close. The attempt in May 1989 to get agreement on a Common Image Format had not succeeded. The Europeans continued to support their 1250 standard and made clear they would not compromise. Nonetheless, the State Department and the US National CCIR Committee were again endorsing 1125.

This continued support of the State Department and the US National CCIR Committee angered a group of senior level media and computer company executives and academics, who wrote the Secretary of State James Baker insisting that the US give the domestic FCC standardization process a chance to finish its work before agreeing to an international standard. The signers included senior vice-presidents from Viacom, Fox, Paramount, and IBM among others, and they backed up their position by sending representatives to US CCIR meetings. They were ultimately successful, and the CCIR postponed deciding on an HDTV standard for another four years. In addition, they formed a loose group to monitor the CCIR and FCC processes and to push their agenda of flexible standards. This group became the Committee on Open High Resolution Systems (COHRS), the coordinating point for developing HDTV as part of a broader digital video system.

April 1990 was a bleak month for supporters of industry-government partnerships in high technology and HDTV in particular. Craig Fields, the director of DARPA, was fired.
Technically he was reassigned within DARPA, but the media and all concerned with high technology understood the administration’s message: industry would have to find ways other than the Sematech model for developing new technologies. Fields’ misstep had been to take an equity position in a Silicon Valley company experimenting with gallium arsenide, and that involvement was too close.

With Craig Fields’ removal and the demise of the AEA HDTV initiative, plans for industry-government consortia receded. At the IEEE Workshop on Architectures for High Resolution Systems, those who a year previously had developed the blueprint for a Technology Corporation of America now settled down to the hard work of figuring out extensible systems. Out of that workshop came working groups that would design headers and descriptors to make video systems interoperable.

Congressional attempts to support innovation in information and communications technologies did continue through the year. There were hearings, an HDTV demo in the Capitol building, as well as legislation, but the legislation never made it through both houses and to the president. The Bush administration had backed away from anything that looked like industrial policy and would not pick “winners and losers.”

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Behind all of this political maneuvering, the companies and groups competing to develop the system the FCC would approve had winnowed down from twenty-three to five. However, on Friday afternoon, June 1, 1990, the very last day to submit system proposals to ACATS, General Instruments proposed DigiCipher as an HDTV standard. GI’s submission was unexpected, but its real import was that it was, at least on paper, a digital system. With that submission, the FCC/ACATS process opened up, potentially, to the digital revolution swirling around it; indeed within six months, all proposed systems but the latest version of 1125, Narrow MUSE, were digital. The ground rules for the new system had also become clearer. In August, the FCC announced that HDTV would be simulcast, that is, it would not have to be compatible with existing NTSC television; it would have to fit into a 6 MHz channel; and each broadcaster would receive a new spectrum allocation of 6 MHz to use during the transition, which would last ten years.

**HDTV Comes of (Digital) Age**

For the next three years, ACATS concerned itself with testing proponent systems to see which was best. In addition to General Instruments, the digital proponents were the Advanced Television Research Consortium (ATRC), AT&T/Zenith, and MIT. The

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22 The proposal was sketchy, an extrapolation of GI’s digital satellite system, but it was good enough for ACATS to accept it.


process was difficult – all of the systems were cutting edge – but most frustrating to all was the obvious absence of a clear winner. Each system had flaws, and in February 1993, Richard Wiley announced that none of the systems was good enough to recommend as the new HDTV standard. The choice was either to give the proponents more time to refine their systems and retest them, expensive both in time and money, or convince them to combine their efforts and develop one system – the “shake and bake” or “bakeoff” approach. The whole ACATS process was way behind schedule, some of the early FCC timelines had had the system rolling out and broadcasting to real viewers by 1993, so the retesting option was unattractive. Moreover, it was widely known that Wiley preferred the latter option, and according to Brinkley, he pressured the proponents until on March 24, 1993, the remaining proponents announced that they had formed a Grand Alliance.26

During the time the proponents were testing their system, there was still outside pressure on ACATS and the FCC to make HDTV interoperable with a high-resolution system. In January 1991, COHRS coordinated the submission to the US National CCIR Committee of defining interoperability, scalability, and extensibility in an HDTV system, the first of many submissions. In March, the ATSC, the committee formally responsible for recommending a standard to ACATS, co-sponsored one of the workshops, an off-the-record two-day meeting attended by a number of broadcasters as well as film, program

25 For an excellent blow-by-blow account, see Brinkley, Defining Vision.
26 David Brinkley, Defining Vision
producers, and computer company executives. In April, Craig Fields, Mike Dertouzos, and Richard Solomon were the subject of a “60 Minutes” story and made their case to Mike Wallace that HDTV was a means to recapture the technology lead from Japan. In May, Michael Liebhold of Apple testified as part of the FCC’s Networks of the Future inquiry, and his presentation also was an opportunity to explain the importance and usefulness of interoperability, extensibility, and scalability. He reiterated those ideas at the House Science Committee Hearing on High Definition Information Systems. Leading exponents of flexible high-resolution systems filled the panels. In addition to Liebhold, others testifying included Robert Khan, an early Internet inventor, David Staelin of MIT, Robert Sanderson of Kodak, and Gary Demos, President of DemoGraFX, all names that would occur again and again. That same month, *Time*, *The New York Times*, and *The Washington Post* all carried stories about HDTV.²⁷ In September, the COHRS submission to the US CCIR covered the “Universal Header/Descriptor” that started in the ATSC/IEEE Digital Systems Information Exchange workshops and that COHRS had developed under the SMPTE auspices. The headers and descriptors were ways of “operationalizing” interoperability – that is, they would allow digital bit streams to work in a number of applications, including HDTV.

During the autumn of 1991, Robert Sanderson of Kodak was appointed to head a revitalized ACATS Working Party on Alternate Media. The group’s mandate was

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to consider the FCC decision in the light of technology advances in communications, computing and imaging. In particular, the working party will emphasize consideration of the concepts of interoperability and extensibility in the context of the current FCC HDTV decision process. The members of the working party met at Bell Labs and at Viacom, and their contribution was part of the ACATS report to the FCC. While Wiley had little time for COHRS and its proposals, Alfred Sikes, then Chair of the FCC listened carefully and gave the group the legitimacy of inclusion in the ACATS process. That legitimacy grew in December with the successful report to SMPTE of the complete specifications for “Headers” and with the acceptance in 1992 of the companion report on digital hierarchies for imaging.

The spotlight on HDTV faded during 1992. The administration’s attention turned to the campaign for reelection, and there was no focus on industrial policy. The ACATS proponents were in the middle of testing their systems, encountering serious problems. The IEEE-USA sponsored another Advanced Digital Systems meeting in May, and attendees came from the broadcast, computer, and film industries as well as from medical, educational, and military groups that needed good images via networks.

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28 Robert Sanderson, in email on 6 Oct 1991 12:08:49 EDT to cohrs-arch@media-lab.media.mit.edu, cohrs@media-lab.media.mit.edu.
THE CLINTON YEARS

The election of William J. Clinton as President changed the context of the HDTV development. The spread of computers and the growth of the Internet invigorated innovation. Clinton’s FCC Chair, Reed Hundt, had been a school and college roommate of the new Vice-President and saw digital technologies as helping improve life in classrooms and doctors offices as well as offering more appealing television. Hundt championed competition as the way to produce these benefits and also saw the spectrum as a way to whittle down the $300 billion budget deficit from the previous administration. It was a fraught time for broadcasters as well as for Richard Wiley and his imperative to see ACATS successfully complete its work. There were three areas of activity: the formation of the Grand Alliance and its struggle to create a standard, which lasted from March 1993 to November 1995; the possibilities of flexible use of the new HDTV channel, but against the background of requiring broadcasters to pay for the second channel through spectrum auctions; and the extent to which the new system should be interoperable with computers.

The Clinton administration early-on coined the term National Information Infrastructure (NII) to refer to the Internet and the related newly emerging digital services. Shortly after the formation of the Grand Alliance in March, 1993, Michael Liebhold of Apple approached Richard Wiley about becoming active in ACATS as a bridge into the computer and networking communities. Wiley was not pleased, for he saw Liebhold as a disruptive
force, but Liebhold had support from the Alfred Sikes, who at that point was still the FCC Chair, and represented a major industry. Wiley’s solution was to create a “Joint Experts Group on Interoperability” with Robert Sanderson as Chair. The Group reported to the Planning Subcommittee, whose chair was Joseph Flaherty of CBS, a fan of neither Liebhold nor COHRS. Sanderson accepted the position on the condition that he could appoint the members of the Group, and then appointed Liebhold as Vice-Chair. Sanderson and Liebhold intended that the meeting would demonstrate the areas of commonality between the proposed systems and also the broad support from the end-user community. When the meeting took place on October 6-7, 1993, it drew senior representatives from a broad selection of industries and services that depended on advanced imaging, including at one point, Wiley himself. The results showed not only areas of real differences but also the areas of overlap, and the simple fact of the workshop’s existence kept pressure on ACATS and the FCC ATV process. In November, ACATS endorsed a mix of interlace and progressive HDTV formats that would make HDTV compatible with the NII, though how compatible, and at what cost, was disputable.

While the broadcasters and ACATS were fending off assaults from the computer, they were facing a vastly more immediate threat from Congress and their own new FCC Chair. As a means of helping to reduce the federal deficit, Secretary of Commerce Ronald Brown had in April raised the option of distributing broadcast spectrum through auctions.

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29 Brinkley (1997) describes at length Wiley’s animosity to Liebhold and indeed all of COHRS. When meeting the author in October 1993, he flared and said he would not speak (to any of Russ Neuman’s people).
Broadcasters had never had to pay for their spectrum. The threat of spectrum auctions coincided with the growing awareness that the “second channel” that the FCC would award broadcasters for use during the transition to HDTV had multiple other possible uses. Robert Pepper, the highly respected head of FCC Office of Plans and Policy had endorsed the idea of a dynamically flexible HDTV standard, saying, “Six megahertz is a lot of spectrum.” John Sculley, the CEO of Apple, joined the fray in his keynote address to the 1993 National Association of Broadcasters annual conference by exhorting broadcasters to ask the FCC for the freedom to develop other services than HDTV. 30

During the summer of 1993, opposition to mandating HDTV began to grow among broadcasters. Wiley was in the invidious position of fighting a rearguard action on behalf of the Grand Alliance.

I would think there would be a question mark as to how incumbent broadcasters would get a second six-megahertz channel simply to do more of NTSC service...I think leaving high definition television outside on the doorstep would be really a shame, because ... it is the next generation. You have to move on, and ... to deny the American public that advantage – I personally think that would be unfortunate. 31

The broadcasters looked to Congress for support and found it at first from Billy Tauzin (R. La.). 32 As part of the attempt to rewrite the 1934 Telecommunications Act, Tauzin offered

30 “Sculley: Exploit the HDTV Channel,” Broadcasting & Cable, April 26, 1993
an amendment that would have given broadcasters “spectrum flexibility” or the right to use
the channels as they wished, but Tauzin ran into opposition from Charles Dingell (D-Mich.), Chair of the House Commerce Committee. Dingell feared the broadcasters would
offer services that would drive down the value of other parts of the spectrum.\textsuperscript{33} Congressman Markey and Senator Hollings (D-SC) both offered legislation that would
have given broadcasters the right to use the second channel as they wished, but only if they
paid for the spectrum devoted to non-broadcast services, and neither bill passed. The
auction threat then seemed dim enough so that the broadcasters began to back away from
HDTV. At the NAB convention in April 1994, Jonathan Blake, the head of MST, argued
that there was no need for HDTV because digital television was good enough. Likewise,
NAB wanted digital but not high definition television.

The following year saw a very different picture. Spectrum auctions for the new personal
communication services had brought in an astonishing $20 billion.\textsuperscript{34} Although FCC
Commissioner James Quello said that broadcasters should not have to pay for the second
channel, incoming Chair Reed Hundt disagreed. If spectrum auctions were not an option,
then broadcasters should agree to a weekly minimum of children’s programming on the
second channel. Moreover, “(t)he quicker broadcasters move from one place in the

\textsuperscript{33} Kim McAvoy, “Senate Opens Superhighway Lane for Broadcasters (Bill Permitting Broadcasters to
Provide Digital Services; Includes Related Article on the Content of the Bill),” \textit{Broadcasting and Cable},
February 7, 1994,

41, October 1998

\textbf{32 - THE DEVELOPMENT OF HIGH DEFINITION TELEVISION}
spectrum to another, the faster we could recover the valuable public property of the airwaves. Then we could auction it for other uses.”

The specter of auctions reappeared, however, when Larry Pressler (R-Neb.) threatened to introduce legislation that would require auctioning the second channel. At that point, both NAB and MST changed their positions dramatically: the health of the broadcast industry depended on being able to offer HDTV to compete with cable and satellite services, but the transition might be slow. Though auctioning the second channel reappeared in legislation Senators Dole and McCain introduced, and although Hundt continued to support the proposal, the bills never passed.

The broadcasters’ volte face pushed them back into Wiley’s fold and behind the Grand Alliance. During 1994, the alliance members had worked out the problems in the system, and in September 1995 ACATS voted to accept the standard and recommend it to the FCC. It seemed that Wiley had been successful, that the broadcasters had been able to protect their old and new spectrum, and that the FCC would accept the standard despite Hundt’s reservations about the spectrum “give-away.”

Opposition to the Grand Alliance then came from two sources. The first came from Hundt, who, in the Notice of Proposed Rulemaking (NPRM) the FCC released in May, asked if the Commission should require broadcasters to follow a specific standard, if there

35 “CES Notebook,” Communications Daily, Vol. 15, No. 5; January 9, 1995
should be a mandate, or whether interference guidelines were sufficient. The NPRM also asked if the Commission should shorten the transition period during which time the broadcasters would have the additional channel. Hundt’s support in the White House was obvious, when, in a September Broadcasting & Cable interview, President Clinton gave support to the shorter transition and compatibility between television and computer.

I have proposed a plan for the return of the analog television channels within seven years of the advent of digital broadcasting, with exceptions for small, rural and noncommercial broadcasters. I do not think it is unreasonable to expect that this transition will take place in seven years.

The best standard would be one developed by and supported by all the affected industries, which could then be endorsed by the FCC. I am still hopeful that this is possible, although at the moment broadcasters and computer manufacturers disagree on many details of the national standard for television transmission. We want to make sure that there are no roadblocks to future compatibility between television and computers.  

The second source of opposition came from the computer industry. Since early in 1995, Reed Hundt had tried to interest Bill Gates and “...Microsoft (in blocking) the high-definition television channel giveaway and (breaking) the grip of broadcast television on the country’s politics.” Gates supported Hundt’s argument that the market rather than the FCC should determine the best uses of the second channel, and Microsoft officers, as well as Andy Grove and Hollywood stars and producers, criticized the Grand Alliance and promoted television compatibility with computers. Microsoft called the ACATS standard

37 Reed Hundt, You Say You Want a Revolution, (2000) p.103

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...fatally flawed...amalgam of old technologies and compromises forged in the light of the investments made by members of the Grand Alliance." 38

To develop interoperability with HDTV, ten leading computer companies formed CICATS, the Computer Industry Consortium on Advanced Television Systems, consisting of leading computer companies. CICATS wanted the FCC to endorse voluntary standards or minimal ones to prevent interference.39 Should that not be possible, it wanted the FCC to adopt a standard with progressive scan and square pixels, or at least a specified "migration path" to an all-proscan system. Donald Norman of Apple and Craig Mundie of Microsoft, along with other CICATS officials, met over the course of the summer and early fall with broadcasters to find a compromise.

When that effort failed, Susan Ness, the Commissioner who had become the mediator on the fractured FCC, brought the contending parties together and pushed them to come to an agreement. The solution was essentially an agreement to disagree: the group agreed to support the ATSC/ACATS standard - but with the references to scanning parameters removed. On December 24, 1996, the Commission adopted the standard and the following April allocated the second channel and adopted flexible guidelines for their use.

38 In his memoirs, Hundt says that Microsoft wanted broadcasters to use a Microsoft protocol that would make HDTV pictures compatible with computers and to bundle their software with new digital TV receivers. (p.202)

Although the development of the standard would seem to end here, in fact it did not. It took more than twelve years to move from deciding on the standard to the formal switchover to a digital system, and a great deal changed during that time. For a long time, the FCC, broadcasters and equipment manufacturers dealt with a serious “chicken and egg” problem: consumers had little reason to buy a new television set when there was little programming, and broadcasters had little incentive to broadcast HDTV programs if no one was watching them. Meanwhile, researchers were developing entirely new video applications that viewers were accessing over diverse devices—cell phones, iTouch, and iPads, as well as computers. The consumer imperative to view information whenever, wherever, and over whatever device was at hand provided consumer electronics manufacturers with clear incentives to make monitors capable of handling multiple sources of information—digital photographs, streaming video, and text messages, as well as more traditional television programs. The sustained fight over interlace vs. progressive had become moot.

Digital convergence had in fact happened, though in ways that meant the players in the television game “won.” The broadcasters did not have to relinquish any of their spectrum to other services, and they got the use of two large spectrum bands for more than a decade, a decided help given not only competition with cable and satellite systems but also the costs of retrofitting transmission stations for digital broadcasting. The networks also had the time to begin to figure out how to move programming onto the Internet. Consumer electronics manufacturers had a large open market. Last, and possibly least, the 15% of the
American households that received television over the air had the choice of purchasing new sets or a converter that would translate digital into analog signals. Consumers for whom that purchase was a burden could receive a small federal subsidy. Getting information and subsidies to affected viewers was awkward and a large task – the final cutover had to be postponed for four months at the last minute – but otherwise happened without controversy.

**The Theoretical Puzzle**

Aaron Wildovsky says politics is at least partially “...conflict over whose preferences shall prevail in the determination of national policy.”\(^{40}\) It is the contention of this dissertation that the development of HDTV was fundamentally a political process, and, moreover, a process designed to achieve goals that often changed and often had little to do with television. In the 1970s and early 1980s, as companies began to develop the next generation of television, it would have been entirely reasonable to have expected that the formal standardization of the new system would take place in the established broadcast organizations along a path well-understood in at least rough outline. In that case the contending system developers would submit their proposals to standards groups such as the Society for Motion Picture and Television Engineers (SMPTE) and eventually to the FCC for final adoption. Nobody would have expected the process to be amicable – the memory of the CBS-RCA fight over the initial color standard and the disputes over VHF

vs. UHF and AM vs. FM radio were still vivid – but the general path to a standard seemed predictable.

Predictability was deceptive. Beginning in the early 1980s, communications technologies and industries entered a period of rapid innovation so profound that it seemed almost to transform the world. A number of factors account for the change, especially the deregulatory philosophy that swept the US and Europe in the 1970s through 1990s; the blurring of technological and therefore legal boundaries among telephone, television, and computers; the flexibility that digital technologies offered; and the move from wired to wireless communications and information networks.

One consequence of these changes was to call into question the effectiveness of the traditional standardization and regulatory regimes. How, actually, should one conceptualize a telephone on which one read email or a computer on which one watched streaming movies: as a phone? a computer? a television? The government had regulated communications technologies as separate systems: telephones or televisions or radios, but in this new blurring world, how able were agencies to involve the new universe of actors, interests, technologies, and goals? How able was the regulatory process to foster innovation? Did the process seem fair?

The development of HDTV put these stresses on display and raises the central question of this study: why did we get the standard we did? What, basically, were the politics of setting
this standard? Why did we end up with a system that was so different from what we had anticipated, a system that led to television shows on computers and YouTube on the television? Who made the decisions? In what fora? For what reasons?

There are a number of bodies of literature that study the development of technologies: constructivists such as Trevor Pinch and Wiebe Bijker\textsuperscript{41} who look at the social forces shaping technologies; media historians such as William Boddy, Susan Douglas, and Brian Winston;\textsuperscript{42} and economists such as James Farrell, Stanley Besen and Garth Saloner,\textsuperscript{43} to name only a few. In this case, since the power to decide over-the-air television standards resided with the FCC, working with television broadcasters, the obvious place to begin is with the literature on government regulation of the economy.

The relationship between regulators and regulated industries has been the focus of much scholarly scrutiny, but three works in particular stand out: Samuel Huntington’s 1952 study of the rise and fall of the Interstate Commerce Committee., Marver Bernstein’s

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analysis of the history and characteristics of regulatory commissions, and George Stigler’s “Theory of Economic Regulation.” All three argue that regulatory commissions work to the benefit of the regulated industry. At the end of his analysis of the railroads and the Interstate Commerce Commission (ICC), Huntington quotes a Supreme Court decision:

The outlook of the Commission and its powers must be greater than the interest of the railroads or of that which may affect those interested. It must be as comprehensive as the interest of the whole country.

Huntington goes on to say that the injunction is not only a public policy norm but a requisite for administrative vitality which commissions ignore at their peril, as the ultimate demise of the ICC demonstrated. Yet Stigler argues that to criticize regulatory agencies for ignoring promotion of the general public interest and instead promoting the interests of their regulated industries is “…exactly as appropriate as a criticism of the Great Atlantic and Pacific Tea Company for selling groceries.” Why? Because the structure of incentives virtually requires regulatory agencies and regulated industries to protect each other. Huntington showed that the ICC depended for its very existence on the support of external groups. When the railroads became a weakened force, so did the ICC. The heart of the regulatory commission’s support is to protect the regulated industry from competition, and the most effective way to do that is by limiting entry. Stigler argues that there is a quid pro quo of course: the regulatory commission offers to protect the regulated

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46 George Stigler, p. 17
industry from potential competitors' entry into the field, while the regulated industry in turn offers electoral support to politicians. Huntington's entire argument is that the commission (the ICC in this case) depends for its very existence on support from the regulated industry, and when that support diminishes or disappears, the commission must find new support or will wither away.

The relationship between commissions and regulated industries is possible because there is no public outcry, or at least no effective one, since the costs of commission decisions are spread over so large a public or the decisions are so arcane that the public does not know or care. Moreover, as Bernstein notes, the regulatory commissions set up in the Progressive era were established on the premise that they were dealing with technical issues, issues that demanded specialized expertise and should not be the province of politics. In sum, the arguments say that in return for industry support of politicians and of the regulatory commission, the agency will protect the industry's interests by erecting barriers to entry, keeping issues apolitical and out of public controversy, and clothing deliberations in technical language that make the issues under deliberation seem both neutral and accessible only to the experts.

These arguments explain a great deal - though not all - about the process of developing the HDTV systems we have today. Since the regulatory agency in question in this case was the FCC and since its primary connection was to broadcasters, especially the networks, the first expectation is that the FCC would protect broadcast interests, as was indeed the case.
The primary tool was erecting barriers to entry, and those barriers excluded not only the computer companies but even independent television engineers such as William Schreiber, respected but nonetheless not a broadcaster. This pattern has deep historical roots going back to the establishment of the Federal Radio Commission (FRC) radio assignments and continuing on through the FCC decisions in the VHS-UHS allocations and in the “freeze” on license assignments in the early 1950s. In those cases and more, the Commission had not only barred entry into the field but had also consistently decided in favor of corporations, usually RCA. There is good reason why scholars routinely say that the FCC is a “captured” agency.

Bernstein argues that the commission movement had its roots in a belief in “objectivity,” simply basing decisions on rational assessments, and removing the subject from partisan politics. “Regulation has been viewed as a matter of collecting facts and of deciding issues in an unbiased way by examining the facts and applying a rule of law.” The effect of this view was to circumscribe the scope of discussion to only “technical” issues, an arena the

49 Bernstein, P. 71
staff and Commission established. This technical language had two appeals for the FCC and broadcasters. First, it limited attention to broadcast technologies, and second, it gave a rationale to ignore larger issues of where the technology was more broadly going or what the public interest might be.

In particular, there are a number of occasions when the FCC acted in favor of the broadcast industry in the face of another plausible decision, precisely as the literature proposes. They include:

1. **Freezing spectrum reallocation and establishing the docket on Advanced Television Services.**

   The initial request to open an inquiry into advanced television services came from broadcasters responding to the possibility the FCC would take unused TV broadcast spectrum away from the broadcasters and give it to providers of emergency services such as fire and police communications systems. Certainly this decision protected broadcasters from competition from new rivals.

2. **Deciding to allow only current broadcast license-holders to offer HDTV.**

   This decision by definition barred newcomers. Moreover, the Commission justified this decision on the grounds that only existing broadcasters had the ability to make the transition to the new service quickly and would therefore be able to serve the public interest.

3. **Maintaining the second channel allocation despite calls to give it back quickly or pay for it.**

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50 Stan Baron, Vice President for Engineering, NBC, told the author during the Interoperability Workshop in 1993 that she could not understand the issues because she was not an engineer.

The decision that HDTV should be an entirely new and therefore simulcast service rather than an improvement on existing NTSC television received widespread approval from virtually all involved in HDTV. It was not an instance of regulatory capture. However, the FCC certainly defended the allocation plan in face of calls to make the broadcasters pay for it during the 1993-96 period.

4. **Permitting and defending flexible use of the second channel, thus allowing broadcasters to offer lower-than-HDTV programs along with pay services**

The Commission clearly followed the broadcasters' lead about the use of the second channel.

5. **Resisting calls to auction the second broadcast channel.**

In this instance, the Commissioners, with the important exception of FCC Chair Reed Hundt, resisted not only Congressional calls to use any second channel auction proceeds to reduce the federal deficit but also similar calls from their own staff members.\(^{52}\)

6. **Defining the public interest in terms of consumer choice rather than even such token changes as required hours of children's programming.**

Here the issue was still barriers to entry, but the entry in question was of ideas that competed with existing broadcast approaches rather than to new groups.

7. **Excluding representatives of computer companies from the ACATS process.**

As noted above, the FCC excluded respected but independent television engineers such as William Schreiber, as well as computer company representatives, from all the important ACATS work.

It is clear that there are many ways in which this literature explains FCC actions in the case of HDTV. Just as Huntington argues that the ICC was unable to shield the railroads from competition with trucking, so the literature also suggests that the FCC would be unable to protect broadcasters from competition in a world of flexible digital video technologies. Despite these insights, there are critical ways in which these explanations fall short. They

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\(^{52}\) Goodman, p. 537
explain none of the behavior of the digital convergence supporters, despite their ultimate success, and they do not explain divisions within the regulatory commission itself, as happened under Reed Hundt. Both of those conditions were critical to the final outcome of the HDTV story, and to explain them, it is necessary to turn to a different approach.

**THE ECOLOGY OF GAMES: AN OVERVIEW**

An approach that appears to explain the outcomes of the HDTV story is Norton Long’s model of an ecology of games. During the 1950s, a major American social science debate concerned political pluralism. It examined the extent to which policy making was open to a wide range of groups and individuals regardless of rank or wealth. It was particularly interested in the power and nature of elites and interest group politics. Were policies the result of political elites as Schattschneider suggested? Was power more fluid, flowing among interest groups and political leaders as Dahl found in *Who Governs?* Sociologist Norton Long joined the debate. He studied urban politics, and he argued that municipal policies were the result of an amorphous and unprompted, though functional, process.

The local community whether viewed as a polity, an economy, or a society presents itself as an order in which expectations are met and functions performed. In some cases, as in a new, company-planned mining town, the order is the willed product of centralized control, but for the most part the

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order is the product of a history rather than the imposed effect of any central nervous system of the community. His question was how the system worked in the absence of a central control? His answer was that instead of a group of leaders, civic or political, making community-wide decisions, policies were the result of interactions within smaller, more focused societal sectors such as the media, religion, real estate, and education. Within these spheres, interests competed on various bases. In this model, power was diffuse and, at level of the entire community, unfocused and uncoordinated.

Long called each of these sectoral interactions “games.” Each game consisted of clearly discernable players who were trying to achieve an objective - a goal - using accepted practices. It was possible, then, to see the community governance in terms of teams, competitive for goals, using understood tools and following accepted rules. In a media game, for example, Long suggests players would compete for readership and advertising support (the goal) following journalist and advertising canons and laws (the rules) by using compelling stories, scoops and advertising gimmicks (the tools). Games provide structure and purpose. It is obvious, however, that municipal governance does not consist solely of individual games - a media game or a real estate game or the like - but of all the games in the area. Taken together, the results of the games in total created the municipal politics of the community. The way the games connect and overlap forms what Long calls an “ecology.”

56 Long, p. 251

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In making this argument, Long takes issue with both the elite theorists, who say that politics is the result of a small group of individuals with economic, political or social power, and the pluralist or interest group theorists who see democracy as an (at least partially) open system, with policy decisions the result of competition among groups. In Long’s view there is no one leader; the mayor or other elected official is simply a player in the electoral politics game or the real estate (zoning) game. There would no doubt be a social or business elite, but they function as a source of legitimacy and coordination. Nobody, however, has overall, community-wide leadership and makes decisions for the community as a whole.

This approach is clearly useful as a “sensitizing device” as William H. Dutton and Benjamin Cornwall have argued. It shows how abstract policy areas such as “urban politics” grow out of specific conditions and decisions. Several questions, however, arise about it usefulness in other areas. First, is it applicable to other subject areas? Long himself thought not, but Dutton disagrees and has used it to great effect to study telecom policies and the development of the Internet.

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seeming difference, in fact the study of communications policy or the Internet regime is really quite like Long's urban politics. In all three the subject is intangible and abstract, there is a variety of inter-related games, each with its own goals and objectives, and the policy or regime is the sum of all those actions.

Is it, however, possible to apply the ecology of games to the process of arriving at a specific policy such as the development of a standard? Cornwall et. al. applied the model to the process of building the Paul Brown stadium in Cincinnati. Their analysis not only explained the steps in that endeavor but also tried to specify the relative importance of the games, one to another. For this study, the importance of their analysis is that they successfully applied it to a specific issue and that they raised the question of the relative importance of each game in influencing the ultimate outcome.

The question of the relative importance of games is important to assess, especially when there is competition - among rather than simply within - them. Cornwall et. al. looked at whether the presence of a specific individual or set of players hastened or slowed down the building process. They found a correlation between the number of times players appeared and the success of their team. While interesting, that technique is useful only in hindsight. Is there another way of predicting the outcome, not formally but as part of a sensitizing or heuristic device? To stay with the game metaphor, think of the difference between an easy summer afternoon game of tennis and Wimbledon. There is, of course, a difference in the level of skill. But there is also, absolutely apparent, the importance of the outcome. To
Venus Williams, it matters who wins. To the good club player on that summer afternoon, winning is one goal in a nexus of values that also include being part of a community, a friend and neighbor. The difference is salience, the importance of the issue to the player.

To measure salience in the context of an HDTV ecology of games, three criteria stand out:

1. How much money do the players have riding on the outcome?
2. What percentage of the player’s total work does the game represent?
3. How much, to what extent, does the outcome reflect professionally or personally? How much does the game contribute to the player’s identity?

Long’s model, together with Dutton’s and Cornwall’s refinements, is particularly helpful for explicating the forces at work in developing HDTV. The model can show that there were two sets of games, though games of apparently unequal weight. One centered on television broadcasting, the other on digital convergence.

The center of the television broadcast game was the drive to set an HDTV standard. That the standard changed – Japanese then American, analog then digital, compatible or incompatible with television – did not matter. What mattered was the impetus, the drive to set it. Without that goal, no part of the broadcast game would have existed. That said, the first confusing part of this story is that developing a standard was not the broadcasters’ primary goal. For them, the overriding issue was safeguarding (and then gaining) their allocation of radio spectrum, and HDTV was the enabling mechanism. Within the broadcast game there was a struggle over spectrum usage and potential auctions, over the actual standard, over the timing of the transition to HDTV, and over the choice of the actual hardware and software system. While the primary focus developing the US HDTV
standard was domestic, some of the competition also took place in international arenas. Moreover, in the very early days of HDTV, a kind of prologue to the main story, the competition took place largely in international fora, where the proposed standard was a way to corner the international television program production market as well as a source of ammunition in a US bureaucratic turf battle. Table 1 sets out the broadcast game and its parts.

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<th>Overarching Goal</th>
<th>General Goal</th>
<th>Issues &amp; Fora</th>
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<tr>
<td>Protect spectrum allocations</td>
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<td>International standardization</td>
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Table 1
The Broadcast Television Game

The second game centered on the convergence, present and future, of digital technologies. Here the overarching goal was to make HDTV part of the emerging of digital information and communication networks. Beneath that general goal, there were more specific ones, "innings" as it were. Initially the intent was to use HDTV as a means of enhancing US international economic competitiveness. It could help revitalize the US consumer electronics industry. It could also provide an incentive for the US government to launch a public-private partnership in advanced video systems. Subsequently the goal was ensuring that the emerging digital communications and information network was interoperable and that HDTV would be useful for computers, films, and or as a tool for educational and
medical services. To achieve these goals, the final HDTV standard needed to be compatible with computers and to have room to incorporate future innovation. Table 2 set out the parts of the digital convergence game.

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<th>General Goal</th>
<th>Issues &amp; Fora</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital convergence</td>
<td>Enhance international economic competition</td>
<td>Revitalizing consumer electronics</td>
</tr>
<tr>
<td></td>
<td>Promote interoperability, extensibility &amp; scalability</td>
<td>Industry-government relations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computer interoperability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Film interoperability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public goods (for medical, educational uses)</td>
</tr>
</tbody>
</table>

Table 2
The Digital Convergence Game

The following chapters apply the model of the ecology of games to HDTV. Chapter Two covers the early efforts to develop a new standard, a time when the broadcast game centered on bureaucratic turf wars and international standardization. Chapter Three covers the middle years, 1987 – 1990, a period of enormous ferment in the development and uses of HDTV. Chapter Four covers the development of HDTV as a digital technology, beginning in 1990 and ending with HDTV as part of an interoperable digital system. Chapter Five assesses the analytic usefulness of the ecology of games in this case.
Chapter 2

Prologue: The Beginnings of High Definition Television
Inception to 1986

The prologue begins with work on a new HDTV standard in the late 1970s and ends in May 1986, with the failure of the International Telecommunication Union (ITU) Consultative Committee on Radio (CCIR) to accept the US proposal for a worldwide HDTV production standard. HDTV was to be a new and better kind of television, a means for displaying entertainment in homes and perhaps also in movie theaters. The specific questions centered around how to make television look like film. To do so meant making changes in the optimum appearance of the picture (aspect ratio), the sound, the number of scanning lines, the design of luminance and chrominance signals, and on trade-offs among delivery methods. Although a number of companies were developing new HDTV technologies, only the Japanese Broadcast Corporation (NHK) system was viable by 1983. That system had 1125 interlaced scanning lines, operating a 60 frames per second, and it had been the US proposed international production standard at the 1986 CCIR meeting.

HDTV in the United States emerged as a policy issue in the early 1980s, when the head of the State Department Office of Communication and Information Policy (CIP), Diana Lady Dougan, formed a partnership with broadcasters and equipment manufacturers to gain control of the international television programming market. This initiative offered the CIP the chance to increase the importance of communications and information issues within the Department. To accomplish this end, Diana Dougan worked closely with Joseph Flaherty, Vice-President for Technology at CBS.
and William Connolly, President of Sony America, both of whom were major proponents of 1125, and the Department’s role was critical to the outcome.

Analysis of advanced television standards took place simultaneously in the United States, Europe and in the International Telecommunications Union (ITU). In the US, the State Department, which serves as the coordinator for US positions in official international communications negotiations, requested that industry choose an HDTV standard the Department could support. The Advanced Television Systems Committee (ATSC) was established as an industry association to develop the recommendations, and it voted to support the 1125 standard in March 1985.

Before proceeding, it is necessary to bring in Norton Long’s model of an ecology of games and to look at how one identifies a “game.” By definition games involve competition, and developing an ecology of games involves identifying overlapping competitions. In this case, the existence of a game centering on HDTV standardization is obvious, and the press extensively covered the existence of a significant struggle between Diana Dougan and David Markey. Since Dougan used both INTELSAT and HDTV to show leadership in international communications coordination, it is reasonable to see an ecology that included two games, one on standardization and the other on bureaucratic competition.

The overarching goal of the standardization game was to capture the international television program market. The goal of the second was to increase the stature of the State Department’s Office of Communications and Information Policy. Support for the 1125 HDTV standard was a means for achieving both those goals. The Tables 3 and 4 set out the games.
## Table 3

**Prologue: The Standardization Game**

<table>
<thead>
<tr>
<th>Overarching Goals</th>
<th>Instrumental Goal</th>
<th>Fora</th>
<th>Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture international television program market</td>
<td>Gain US and international support for 1125</td>
<td>US Committee for the CCIR</td>
<td>Diana Dougan, Joseph Flaherty, Tedson Meyers &amp; staff of CIP Sony &amp; CBS vs. NBC, ABS, some television engineers &amp; computer scientists</td>
</tr>
<tr>
<td></td>
<td></td>
<td>International Telecommunications Union</td>
<td>Diana Dougan, Tedson Meyers, Joseph Flaherty, William Connolly, &amp; US CCIR delegation vs. European Commission Delegation</td>
</tr>
</tbody>
</table>

## Table 4

**Prologue: The Bureaucratic Game**

<table>
<thead>
<tr>
<th>Overarching Goals</th>
<th>Instrumental Goal</th>
<th>Fora</th>
<th>Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase stature of Bureau of International Communications and Information Policy (CIP)</td>
<td>Gain US and international support for 1125</td>
<td>US State Department NTIA Congress</td>
<td>Diana Dougan (CIP) David Markey (NTIA)</td>
</tr>
</tbody>
</table>

### The Drive to an International Standard

Early research on HDTV began in the mid-1970s in the research laboratories of the Japan Broadcasting Company (NHK), as well as in the CBS labs. The initial steps in

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59 That the Japanese should be developing a system for the US market was not simply fanciful. Many consumer electronic goods available in US stores were of Japanese origin, and the Japanese television system had been modeled on the US system since the end of WWII, and their color system, NTSC-J, was but a slight variation on the US NTSC standard.
standardizing HDTV in the United States began in 1977 with the establishment of the Study Group on High Definition Television under the auspices of the Society of Motion Picture and Television Engineers (SMPTE) Committee on New Technology. The Study Group met seven times during the ensuing two years in order to

... examine present technology as applies to high-definition television systems, to examine new technology applicable to the special needs of television broadcasting, to theatrical motion-picture production using television cameras, and to the needs of the cable television industry. The active members consisted of two broadcasters, CBS and NHK, and several consumer electronics companies: Video Corporation of America, General Electric, Eastman Kodak, Thomson-CSF, Tektronic and Ampex Corporation. Interestingly RCA, the two other major commercial networks, ABC and NBC, and Zenith, the only remaining US manufacturer of television receivers, were not part of the process. The group examined all of the research under way dealing with HDTV for the home, movie production and projection, as well as suggestions for further research and development, but it endorsed none of the systems.

Despite this lack of a domestic consensus, the United States moved ahead with standardization on the international front. NHK had developed the HDTV standard, known as 1125 because it has 1125 interlaced scanning lines and operates at 60 Hz. In 1985, the standard was the only existing, proven HDTV system. It represented to its patent

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60 There was an long historical rivalry between NBC/RCA and CBS, particularly vivid in the FCC decision against the CBS system for color television and in favor of RCA’s system.

owners and the program producers who used it the only shot at capturing the worldwide program exchange market, because delaying would give other countries a chance to develop other, competing systems. The United States formally submitted the 1125 system as a proposed standard for production and international program exchange to the International Telecommunications Union (ITU), the intergovernmental organization that coordinates the international regulation of broadcast spectrum. In order to gain access to the world market, there had to be a universal studio standard, and the body in which that standardization took place was the ITU.

The part of the ITU that dealt with broadcasting was the Consultative Committee on International Radio (CCIR), now named ITU-R. The CCIR ran on a four-year cycle for approving new standards; that is, one had to submit a proposed standard in year one of the cycle, take the proposal through a series of ITU technical negotiations and then wait for the plenary meeting four years later to ratify the proposed standard formally. In this case, the CCIR Study Group 11 had taken up the question of high definition television in 1981, with the expectation of reaching an agreement by the fall of 1985 and formal ratification at the May 1986 Plenary Meeting in Dubrovnik.

The international and domestic standardizations processes ran concurrently. On the domestic front, after the SMPTE Committee on New Technology released its final report, discussions among industry associations began on the creation of a new organization to move the standards process forward. In late 1982, the Joint Committee on Inter-Society
Coordination formed the Advanced Television Systems Committee (ATSC). Members of the ATSC were terrestrial broadcasters, cable and satellite companies, electronics manufacturers, telephone companies, motion picture companies and universities. The purpose of the new organization was to develop and coordinate standards, to propose voluntary standards to the Federal Communications Commission (FCC) and the American National Standards Institute (ANSI), and to recommend positions for the United States to use in international standards negotiations. To carry out its mission, the ATSC formed three groups, each charged with the responsibility for examining one aspect of new television systems. One studied ways of making improvements that would be compatible with NTSC. A second studied enhanced NTSC transmission systems that used several or multiplexed analog components (MAC). The third examined high definition systems.

Discussion among members in the high definition group was contentious. The arguments focused on whether to accept or reject the NHK 1125 production standard. The major US supporter of the system was CBS. However, RCA, NBC, and ABC were also members of ATSC and argued against it. Their problem was partially economic: CBS had patents in 1125, but the dissenters did not. The problem was also solidly technological: the most

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62 Members of the JCIC were the Electronic Industries Association, the Institute of Electrical and Electronics Engineers, the National Association of Broadcasters, the National Cable Television Association, and the Society of Motion Picture and Television Engineers.

63 The dominant television system in the United States today grew under the auspices of the National Television System Committee and is known as NTSC. Given the success of that standard, which had survived even then for almost half a century, there was an obvious intent for the new organization to trade on the success of the old.
heated arguments centered on whether interlace or progressive scan was preferable. 1125 was interlaced, but the systems RCA/NBC and ABC were working on were progressive systems. Nonetheless, the argument for a worldwide standard was sufficiently compelling so that in the fall of 1984, it appeared that all parties had compromised on the need for a single worldwide standard to facilitate international program exchange. 1125 would do for that purpose, and there appeared to be but a small window of opportunity for setting that single standard.

That consensus fell apart when RCA proposed a new, progressive scan system in the winter of 1984. The RCA proposal received support from a number of members of the group, including representatives from Ampex, Harris, ABC, Panavision, North American Philips, the Association of Maximum Service Telecasters and the Motion Picture Association of America. NBC also supported a progressive scan system. The NBC Vice President for Engineering and Technical Services, Steve Bonica, said,

NBC's aspirations are for a progressive scan standard. If it means not concluding this year, then that's not the worst thing. A world standard could be provisionally adopted before the next CCIR meeting.

There were other strong criticisms of the NHK system as well. MIT's William Schreiber argued that the NHK system did not take advantage of developments in digital technology, semi-conductors, and signal processing and that it required too much bandwidth.

As a result its system design is no more advanced than that of the 32-year old NTSC system. Its efficiency is about the same. What was barely

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64 "Day of Decision for World HDTV Standard," Broadcasting, March 18, 1985, p.29
65 Ibid, p. 29-30

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tolerable for the 6-MHz NTSC channel, however, is intolerable for the NHK 20-to-30 MHz channel. 66

Despite this opposition, ATSC and the State Department continued to push for support for the 1125 proposal. The CCIR timetable required an ATSC recommendation to the State Department by the spring of 1985, but by February 1985, no clear agreement had emerged within SMPTE or ATSC.

While ATSC had the authority to develop new standards, it relied heavily on SMPTE recommendations. The SMPTE Working Group on HDTV met in San Francisco on February 17th and 18th, 1985, to decide on a recommendation to ATSC for the HDTV standard. After a full day of deliberation, the Group could only reach a contingent agreement that the Working Group

... would prefer a progressive scan standard for production, however, in the interest of achieving a world wide standard, this committee will accept a family of standards that include both 1125 line 60 Hz 2:1 interlaced and a progressive member and will continue to work towards the evaluation of preferred specifications for the progressive system. 67

In other words, the standardization process could go forward, but not with full support of the key actors. Faced with this lack of consensus, the ATSC executive committee met on March 19, 1985. Although the agenda did not include a vote on a recommended standard, that was in fact the focus of the meeting. Broadcasting reported that "

...the widespread sense that a single recommendation from the US, whether for the NHK or a progressive scan system, presented the only possibility of reaching an international agreement, led ATSC executives to jettison a draft

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67 SMPTE Working Group on High Definition Electronic Production, Meeting Minutes, February 17 and 18, 1985
RCA/NBC had submitted a proposal for a single worldwide HDTV studio standard based on 750-line progressive scan. After discarding the family of standards concept, the Group argued for two hours about the merits of the 1125- vs. the 750-line systems. Finally, RCA together with the support of ABC agreed to drop its proposal and back, if grudgingly, the NHK standard. However, RCA agreed to drop its proposal on the condition that the Dubrovnik CCIR Plenary accepted 1125. Should that acceptance fail to materialize, then RCA would resume its work on a progressive system.

Even so, the vote was very close. ATSC administrative procedures require a two thirds vote to approve a standard, but the March 19th vote on the 1125 standard was a simple majority. However, the trade journal Broadcasting reported that counsel advised ATSC executives that a majority would suffice, since the question on the floor was a "recommendation for a standard" (to the State Department) and not a standard itself. The vote was twenty-one for the NHK parameters, fourteen against, and six abstentions. The margin was a clear six votes short of the two-thirds necessary for adoption and in fact was the minimum needed for a simple majority. However, it was enough, and ATSC was then able to present the State Department with a unanimous ATSC recommendation for the
new system, despite behind the scenes grumbling from disappointed advocates of
progressive scan.  

However, following the vote, the SMPTE Working Group unanimously approved a
recommendation that work on progressive scan continue. Despite that unanimous
agreement, the cover letter ATSC Chairman William Henry sent to Diana Dougan with
the ATSC recommendation for a standard makes no mention of continued work on
progressive scan. Instead, Henry reported on the ATSC meeting as follows:

After full and open debate, at a meeting attended by a thoroughly
representative group of television and film industry companies, the
Technology Group decided to recommend that the US urge the adoption
of a single, clearly defined worldwide standard....I'm pleased to note that
SMPTE....has gone on record in support of the ATSC's action....

What happened to the SMPTE recommendation that work continue on a progressive scan
system? Where did the ATSC support come from? Certainly not the SMPTE HDTV
Working Party, which had explicitly endorsed the concept of a family of standards. The
ATSC officers, who had always been highly supportive of 1125, were moving to present a
unified front. Moreover, not only were these supporters in leadership positions, but they
pushed for agreement on a single standard rather than further exploration of possible
alternatives. In a March 29, 1985 letter from Kerns Powers of RCA to William Henry,
Chair of the ATSC, Powers says,

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72 Broadcasting, March 25, 1985, p. 70
73 Correspondence from E. William Henry, Chairman, ATSC, to Ambassador Diana Lady Dougan,
Coordinator for International Communications and Information Policy, March 22, 1985

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RCA and NBC have now submitted two definitive documents to the Technology Group, both proposing a single worldwide standard based on progressive scan. Despite the strong expression by SMPTE favoring progressive scan, the ATSC has not adequately debated the technical merits of the progressive scan alternative. At both the 17 October and 19 March meetings, a proposal from the chair was presented and offered for discussion instead. At the 19 March meeting, the entire morning agenda (not distributed in advance as required by ATSC Administrative Procedures, Article VIII, Section 8.2) was apparently designed to place any proposal other than the NHK 1125/60/2:1 system in the light of an attempt to either derail or defer a standard. This effectively stifled any possibility to consider the technical merits of alternative systems.

State Department Involvement

The State Department was active in the domestic process, though largely out of the public eye. There were Department officers at the SMPTE and ATSC meetings, and indeed Howard Miller said at the February SMPTE meeting that he "...had been directed by the US State Department to do everything he (could) to achieve a standard." He naturally would have reported to Diana Dougan that there were deep disagreements and difficulty in achieving consensus. The State Department, moreover, was aware of the tenuous nature of the support for 1125 through numerous letters to Dougan from opponents to the 1125 standard in which they outlined their dissatisfaction with the standardization process, as the preceding letter from Powers to Henry shows.

Despite this opposition, Dougan and CIP continued to campaign for 1125. Dougan undertook an extensive speaking campaign in support of the proposed standard. Her

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74 Correspondence from Kerns H. Powers to W. William Henry, March 29, 1985
75 SMPTE Working Group on High Definition Electronic Production, Meeting Minutes, February 17 and 18, 1985
office widely distributed the US proposal to the CCIR. Not all the initiatives were so
benign, however: CIP officials were vociferously angry at William Schreiber for - in their
view - upsetting the standardization process by introducing new ideas and pressing to hold
off making a decision on a standard until the technology was more settled.76

More publicly, in June, 1985, Communications Daily reported at length on strong arm tactics
the Department used to quell dissent and present a unified front, for the Department was
quite intent on bringing RCA/NBC solidly behind 1125. In a letter to RCA President
and CEO Robert Frederick, Diana Dougan said,

"As you know the Department of State has long encouraged the
formulation of standards through industry cooperation, with but minimal
interest and participation by the U.S. government . . . In the case of HDTV,
however, we are aware of the unique limitations imposed by the current
CCIR study period. Moreover, we have concluded, together with interested
industry representatives, that failure to attain a worldwide HDTV standard
during this study period will probably result in failure to attain such a
standard at all, with significant adverse consequences to U.S. trade and
information interests.

"I have to share with you, however, concern about news which has surfaced
in my office in recent days. I am sure you will understand the basis for my
reaction. First, by the attached news item it appears that an RCA marketing
representative has expressed something of a different viewpoint from that
which you shared with me in your letter. Equally important, our staff has
been advised that at least one member of the U.S. Congress visited the
RCA exhibit stand at NAB in Las Vegas, received something of the same
negative impression, and concluded that RCA does not share the U.S.
determination to attain a worldwide standard this year. I know you are
aware of the importance of acting in a most united manner between now

76 Warren Richards, Bureau of International Communications and Information Policy, US Department of
State, conversation with author, March 1986
and the final decision point in May 1986. I welcome your advice about how we can assure this goal is achieved.\footnote{“High Level of Sensitivity; State Dept Urges Acceptance of HDTV Standard,” \textit{Communications Daily}. June 25,1985. Vo. 5, No. 123, p. 4}

This kind of a forceful and blunt letter, taking a clear leadership position on this technical issue, was completely our of the norm for the Department. Interestingly, Dougan framed the issue not as a technical but as an international trade issue. Doing so allowed her to argue that she was simply supporting US industry - at industry's request. It also enabled her to increase the value of her own office, an important step in light of the bureaucratic battles she was fighting both within the Department and with NTIA in the Department of Commerce, as we will see in greater depth in the next section.

Internationally, leading up to the Dubrovnik plenary, CIP with Dougan in the lead, spearheaded a vigorous campaign to convince the European and Australian delegates to accept the 1125 proposal. Dougan worked closely with ATSC, Joseph Flaherty, the CBS Vice President of Technology, and Tedson Meyers, a major lobbyist.\footnote{Warren Richards, Bureau of International Communications and Information Policy, US Department of State, conversation with author, March 1986} The rationale for the State Department/ATSC position was that agreement on a universal standard would benefit the US international trade in general and program producers in specific, because the United States had the leading program production industry in the world. Proponents of this position argued that the 1125 standard would provide greater ease of program exchange than did the current system and that such greater ease would lead to an increase
in program exchange benefiting all viewers and bringing increased revenues to US program producers. Moreover, international sales of US programs was an important revenue source for their producers and one of the country's most successful exports, as the following figures that the ATSC and State Department released as part of their campaign clearly show.

Table 5
US-Produced Programs Broadcast per Day in Europe 1984

<table>
<thead>
<tr>
<th>Country</th>
<th>% total broadcast time</th>
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<tbody>
<tr>
<td>France</td>
<td>16%</td>
</tr>
<tr>
<td>Germany</td>
<td>25%</td>
</tr>
<tr>
<td>Italy</td>
<td>31%</td>
</tr>
<tr>
<td>UK</td>
<td>24%</td>
</tr>
<tr>
<td>European average</td>
<td>25%</td>
</tr>
</tbody>
</table>


In the months leading up to the Dubrovnik ITU meeting, however, international opposition to the NHK standard became increasingly unavoidable. A State Department cable dated February 6, 1986, translated an article in the Tribune de l'Economie about European opposition to 1125 and concluded,

We would be surprised if the above article does not hit the nail right on the head as far as identifying the real worries and position of the French toward the HDTV question and the upcoming CCIR meeting. There is every indication that the French are going to persist in their hard line against the Japanese and US views on adoption of a worldwide HDTV studio standard,

and at the CCIR meeting in May they will try to get agreement on some
general statement which avoids commitment to any one system. The cable was accurate; the US strategy did not work. It was, in fact, counter-productive, for it presented officials of the European Commission DG XIII, the newly formed Directorate in charge of communications policies, with a new version of la défie américaine, a rallying point for opposition to American hegemony. It also presented the newly established DG XIII with a tool it could use to establish its own mission and relations with European communications companies. In the end, the DG XIII officers, in concert with Thomson, Philips, and Siemans, united in opposition to the US-Japanese position. The result was that the CCIR Plenary deferred selection of an HDTV standard until the following (1986-90) CCIR study cycle.

The initial phase of HDTV development in the United States was important in several ways. It firmly defined HDTV as a video application for home entertainment; it ensured that future chapters would involve broadcasters and the FCC; and it diminished chances for a connection with the developing computer systems. Second, the inability of the television networks to agree on a common position or vision of the future showed the disarray within their industry on the future of television. Third, the defeat in Dubrovnik left the State Department and ATSC officials with a marked reluctance to work with those who had opposed the 1125 standard. Fourth, the vigorous US lobbying efforts in Europe

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80 Department of State cable, unclassified Paris 07455, February 1986
and Australia had the effect of catalyzing effective European opposition to any US or
Japanese standard and therefore to a single global standard. Last, the definition of HDTV
as simply new and better traditional television inhibited (though did not halt) US research
efforts to define television’s future in dramatically new ways.

The State Department as Coordinator of International Communications?

This attempt to set the worldwide standard was not an American success story. The
endorsement of NHK, Sony and CBS all are entirely understandable given their financial
investment in 1125. The surprise is the State Department advocacy. To answer that
question, it is necessary to place the account in its larger context and then to focus on State
Department organization and inter-agency relationships. What were the relationships with
other agencies and private interests? What roles did agency heads play? What kind of
support did they offer? What tools were available for the officials to use? Who were the
bureaucrats’ constituents, and how important were those constituencies?

The answers to these questions show the power of a well-connected, energetic, hard-
working and ambitious agency head with a clear drive to establish a presence in a fairly
wide-open bureau in a technological and industrial context of burgeoning importance,
opportunity and flux. It is also shows an energy-sapping bureaucratic turf war that resulted
partially from the personalities of the participants but arguably even more from the
fundamental organization problem of where to put the function.


**Background: Computers and Satellites**

In the early 1980s, the world of American communications and information was in turmoil. The diffusion of personal computers had just begun. Networking among them was in its absolute infancy, taking place through painfully slow modems over analog dial-up phone lines. The Internet was still ARPANET and accessible - if one had access - only with arcane commands. For all the clumsiness of these early systems, though, it was clear that something unmistakably big and exciting was happening.

The ferment did not apply simply to computers. Two decades earlier, in 1962, the US had launched its first commercial communications satellite and then a decade later was the prime mover in establishing INTELSAT, the international organization that held a monopoly on international satellite communications. INTELSAT was a treaty organization; members were states which participated in deliberations through their own domestic monopoly organizations. Comsat was the US representative. Because INTELSAT was a monopoly of state organizations, it was not mean and lean, honed of its fat by market competition. Quite the contrary. Its pricing was well above cost on its popular routes, and in fact, it explicitly cross-subsidized north-south (and south-south) communications through profits from the north-north links, particularly from the lucrative North Atlantic traffic. This situation greatly benefited southern hemisphere countries but

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82 In fact, the Soviets had a parallel system, Intersputnik, established at the same time as Intelsat, the height of the cold war, but the two systems had only minimal overlap.
also made INTELSAT a perfect target for competition on the North Atlantic routes once its monopoly hold weakened.

The movement towards deregulation and privatization of state-owned or regulated industries had reached the communications sector by the early 1980s. Judge John Sirica had presided over the breakup of the AT&T monopoly with the 1982 Consent Decree. British Telecom was preparing to sell off 49% of its assets. Why, some reasoned, should INTELSAT, with its immense organization and market distorting pricing remain untouched? It was no surprise, then, when three companies submitted applications in 1983 to the FCC to launch private international communications satellites. One, PanAmSat, would have offered services to Central and South America. The other two, Orion and ISI, would have competed directly in the North Atlantic market. Whether to approve the applications and under what terms was a question of deep controversy among State, Commerce, INTELSAT, and satellite companies.

The early 1980s was a time of technological turmoil, industrial restructuring, and widespread uncertainty about how to deal effectively with the changes. The organization of the US government to deal with these changes was also unclear. The changes seemed momentous at the time, and rightly so, for the technological innovation promised to unleash unimaginable potential, so much so that Time magazine made the computer its 1982 “Man of the Year,” and the accompanying article said

Now, thanks to the transistor and the silicon chip, the computer has been reduced so dramatically in both bulk and price that it is accessible to
millions. In 1982 a cascade of computers beeped and blipped their way into
the American office, the American school, the American home. The
"information revolution" that futurists have long predicted has arrived,
bringing with it the promise of dramatic changes in the way people live and
work, perhaps even in the way they think. America will never be the same.

**Organizing the Bureaucracy: A Quandary**

Richard Neustadt, compleat insider in the Carter White House, summed up the
relationship among the communications bureaucracies on the eve of HDTV’s inception by
saying “The FCC and NTIA develop communications policy objectives, and State runs the
negotiations.” Moreover, no one would have disagreed. There was a long-standing
bureaucratic quandary over how to coordinate telecommunications and information
policies within the executive branch, a problem since at least the Nixon presidency.
During that administration, the solution was to locate communications functions within
the Executive Office of the President in an Office of Telecommunication Policy (OTP).
OTP not only administered traditional communications responsibilities but also in later
years monitored the media for ideological bias. It became the center of controversy as the
increasingly beleaguered president railed against a “liberal” bias in the media. The office
lost its effectiveness, and though it remained in existence in the Ford administration, it
had no real power. Ford tried to solve the bureaucratic problem by establishing the

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84 Neustadt, Richard. “Communications Policy in the Carter Administration,” White House Domestic
Policy Staff (memorandum), September 1980, p. 8, quoted in Krasnow, Erwin H., Lawrence D. Longley,
Commission on the Organization of the Government for the Conduct of Foreign Policy. Known as the Murphy Commission, its task was to study the organization of the executive branch for foreign policy. The Commission, in its June 1975 report, recommended that communications affairs receive higher level attention within State and specifically that CIP move from the third level (office) to the second (bureau), under an assistant secretary.

The Carter administration, according to Francis E. Rourke, strove to distance itself from Nixon’s imperial presidency by dispersing power from the White House to the cabinet departments. To deal with communications issues, the administration created the National Telecommunications and Information Administration (NTIA) within the Commerce Department. Under the leadership of Henry Geller, a thoughtful and widely respected communications lawyer, and a former FCC General Counsel and Assistant to FCC Chair Dean Burch, the NTIA became the principal advocate for the Carter administration’s communications agenda. Against the backdrop of the Nixon administration’s politicization of the Office of Telecommunications Policy, NTIA under Henry Geller set out a full agenda of issues that included minority ownership, more broadcast outlets, improved services for rural areas, and funding for public broadcasting. As Krasnow points out, however, the agency’s only power was the power to persuade; it had no direct power to make policy.

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All of Geller's good work, however, could not solve the bureaucratic problem or effective communications coordination in the executive branch. Executive Order 12046, which created NTIA, said

The Secretary of Commerce shall develop and set forth, in coordination with the Secretary of State and other interested agencies, policies and programs which relate to international telecommunications issues, conferences and negotiations.

It also said, two sentences later, that

The Secretary (of Commerce) shall provide advice and assistance to the Secretary of State on international telecommunications policies to strengthen the position and serve the best interests of the United States in support of the Secretary of State's responsibility for the conduct of foreign affairs. 87

There is understandable confusion here, but neither here nor elsewhere did it receive resolution. Was Commerce supposed to be the lead agency and receive help from State among "other interested agencies," or was the opposite true? The substantive issue of international communications also received the attention of Zbigniew Brzezinski, the head of the National Security Council, but the organizational questions did not. Thus, at the dawn of the Reagan administration, communications issues were receiving greater attention, but no one had figured out how to organize the executive branch to deal with them.

This quandary received more attention if not a solution during the early Reagan years.

One source of that attention was the new Secretary of State, George Schultz. Wilson

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87 Executive Order 12046, "Relating to the transfer of telecommunications functions," (43 Fr 13349), March 26, 1978

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Dizard argues that Schultz, as a former head of Bechtel, had seen how communications networks could hold a geographically dispersed network together and understood the need for a more coherent executive branch organization.\textsuperscript{88} Schultz, an MIT-trained economist, brought to his position an appreciation of the importance of economics unusual at State, and recommended creating a new Bureau of Communications and Information, bumping the office up a level as the Murphy Commission had recommended ten years earlier. Creating a new bureau required Congressional approval, which, however, was not forthcoming. In the meantime, Schultz appointed Diana Dougan to head the existing office but asked the White House to appoint her with the personal rank of ambassador, thereby enhancing the stature of the office.\textsuperscript{89}

Simultaneous with these developments at State, NTIA released a substantial report on US international and communications policy which recommended centralizing international communications policy coordination in a single executive branch office and implied that Commerce, with its expertise in trade and business, was the appropriate site.\textsuperscript{90} In addition, in the summer of 1983, President Reagan proposed a new Department of International


\textsuperscript{89} Dizard, Ibid.

Trade and Industry,\textsuperscript{91} again enhancing the position of Commerce as the coordinating point for international communications issues.

Within the State Department, there were, at the beginning of the Reagan administration, two logical offices for coordinating international communications policy: the Office of Communications Policy within the Economics Bureau, and the Office of Communications and Information Policy within the Bureau for Security Assistance, Science & Technology. They were, however, much smaller than NTIA, and neither of them had had a long history in communications policy development or coordination.\textsuperscript{92} Their expertise was mostly in facilitating international standards development and technical negotiations at the International Telecommunication Union and similar venues. Their work was largely behind the scenes, convening delegation and working group meeting at home and running the delegation meetings during the conferences. Delegations to these negotiations consisted largely of industry representatives. Though the delegation head was always from the private sector, the State Department officials together were responsible for developing the agendas and maintaining a united front within the delegation.

The world of international technical negotiations is a small world, full of close, if sometimes acrimonious, relations. Relevant companies, especially in the early days of the


\textsuperscript{92} The information in this and the following paragraph comes from the author's participant observation from 1985 through 1995.
communications "revolution," were few: in the United States there was AT&T, Comsat, three broadcast networks, and a few consultants, and in the rest of the world there were primarily post & telecommunications agencies (PTTs). Moreover, not only were these companies few in number, they tended to send the same delegates. Department officials such as Warren Richards, Richard Schrum, and Harold Kimball, who were in charge of US delegations, had all build up long-term relationships with ITU officials and the American private sector delegates, as well as with members of other delegations. Guiding delegation members to a unified position required skill and expertise, and these officials were good at their jobs. However, their expertise was in overseeing smoothly running delegations and in building consensus, not in policy formulation or even coordination. Their work was often a challenge: at one ITU Plenipotentiary Meeting, the conflict within the US delegation was said to be far greater than the disagreements on the conference floor. The State Department’s claim to coordinate international communications policy for the executive branch certainly seemed thin.

NTIA had a much broader area of authority and expertise. It had line responsibility for coordinating US government spectrum needs; it ran the Institute for Telecommunications Sciences, a laboratory for telecom technologies for government civilian and military use; and it made grants to public and nonprofit organizations to enhance their communications infrastructure and applications. In addition, it was responsible for advising the president on domestic telecommunications needs. Executive Order 12046 directed NTIA to coordinate international communications, but the language was equivocal. On the other
hand, the State Department had also not been the traditional executive branch coordinator for international communications issues. The State Offices habitually had had a line function for coordinating technical negotiations in international communications but no policy functions beyond that. Executive Order 12046 seemed to locate coordinating power in NTIA, but the division of responsibility between State and Commerce was ambiguous, and that ambiguity fueled competition between the two departments through the mid-1980s.

That competition took the form of a vintage bureaucratic turf battle. On one side was Diana Dougan, with a strongly supportive Secretary of State, in the Department most centrally charged with international relations, but one that had historically given priority to geopolitical over substantive issue areas. As Erwin Krasnow said, "...State plays a technical role in international communications issues, including holding conferences (and) negotiating treaties.... The substantive interest of the State Department, however, is negligible." On the other side was the Department of Commerce, with a solid reputation and with close ties to business, but ties that were primarily domestic.

The intensity and scope of the fight is quite clear in the press coverage of that period. During the first three full years of Diana Dougan’s tenure, from 1984 through 1986, Communications Daily, the respected newsletter for the industry, mentioned her a total of

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103 times. Of that total, a full 26.2% were references to bureaucratic turf fights. During 1984, 41% of all the references to her concerned turf. 1985 saw a diminishment to 28.5%, most of which were prior to May, and in all of 1986, after Congress had voted to approve the Schultz reorganization plan that elevated her office to a full bureau and gave her the rank of Assistant Secretary, there were only two. That first year there were, by a wide margin, more references to turf than to any single substantive policy issue. The second year, only the questions around INTELSAT and the separate satellite systems received more attention.

During this time there were two sets of turf battles. The first, and by far the more enduring and intense, was with NTIA. The second was within State over which of two offices would incorporate the other. The struggle with NTIA was about boundaries and relative power, about which agency had the right to be the coordinator for international communications policies, and it was fought in terms of mundane, often petty issues. The tension surfaced in a dispute over which agency was appropriate to have solicited telecommunications industry comments on the Maitland Commission’s initiative to improve telecoms development in poorer countries. The State Department had been the first to ask for suggestions from industry leaders, because it said that the President had asked it to take the lead. The Secretary of Commerce, on the other hand, also wrote this group, and his spokesman emphasized that the Secretary’s cabinet position included his
being “the President’s principal advisor” for telecommunications policy.” Congress became concerned: the issue was on the agenda of a House Telecommunications Subcommittee, and Senate aides hinted at a Senate hearing. That dispute also became overtly personal.

Personality problem may be at center of dispute, some aides conceded. “Let’s just say that the State Dept. has been less than politic,” argued one hardly veiled reference to Ambassador Diana Dougan, controversial Coordinator for International Communications & Information at State Dept.

By late spring both Secretaries Schultz (State) and Baldrige (Commerce) were publicly involved in the feud. Baldrige accused Schultz of having “greatly understated” the authority of Commerce in this area; Schultz used the language of Executive Order 12046 as giving the Secretary of State “primary authority” in determining US positions in the field.

These turf battles were far from trivial, however. Though they certainly spoke to real confusion about responsibilities and authority, they also reflected substantive disagreements. In a short time they widened to include not only responses to the Maitland Commission (an important initiative if one happened to live in a poor country) but also real policy differences in the INTELSAT debate over separate satellite systems that directly affected the existence of some of the players. Moreover, the participants in this struggle

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95 “Bickering Raises Worries; Congress to Investigate Commerce-State Dispute,” Communications Daily. April 24, 1984, Vol. 4, No. 79, p. 2
96 Communications Daily, April 24, 1984, p. 2
included not only Markey and Dougan but also Dougan’s immediate boss, Under-Secretary William Schneider (with whom Dougan was reputed to have a strained relationship), the Secretaries of Commerce and State, and members of Congress.

The bureaucratic struggle continued through 1984 and well into 1985 in a variety of fora that included hearings in the House and Senate and, in late 1984, a proposal from Representative Cardiss Collins (D-Ill) to re-establish a White House Office of Telecommunications Policy. Throughout this period, Dougan had the unwavering support of the Secretary of State, and eventually, in June 1985, Congress approved the promotion of her office to the second level in the Department by establishing the Bureau of International Communications and Information Policy, with her as an Assistant Secretary at its head.

The establishment of CIP as a Bureau not only gave Dougan and Schultz what they had wanted for two years, it also ended the intra-departmental battle. In this case, there were few if any substantive policy differences between the two offices. Earl Barbely’s Office of International Communications Policy was part of the Economics Bureau (EB); Diana Dougan’s newly promoted Bureau of International Communication and Information Policy was part of the Bureau of Security Assistance, Science & Technology. Both offices gave advice to the Secretary on communications issues but primarily provided coordination.

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98 Coordinator Function Seen; Collins Proposes White House Office of Telecommunications Policy, Communications Daily, November 30, 1984, Vol. 4, No. 232; p. 2
for international negotiations and meetings. Indeed, so similar were the functions that the Inspector General issued a report that found that “(w)asteful bureaucratic wrestling, a growing duplication of effort, and a less than optimal handling of some international communication and information issues” was the result of the existence of the two offices within State. The report also criticized “... both the internecine guerrilla war that has gone on for at least the past year and the continued bureaucratic limbo in which the subject has wallowed.”

The IG report was a clear impetus to resolving the internal Departmental dispute. There was also a growing sense of weariness on the Hill over the fracas. Dante Fascell, a major Dougan supporter and chair of the House Foreign Affairs Subcommittee, admitted that he “...personally got tired of American businessmen (complaining) all the time about what the State Department wasn’t doing.”

For the time being, the new bureaucratic arrangements resolved the strife over who was responsible for international communications policy coordination, and during the remaining two years of Diana Dougan’s tenure as Assistant Secretary, relations within the executive branch on this topic were quiet. In looking back over the conflict, one becomes aware of how few mechanisms there were to resolve the dispute. There were only two, and

99 "Dougan's Role Queried; State Dept. Inspector Hits 'Internecine Guerrilla War' over International Communications Policymaking," Communications Daily, April 19, 1995, Vol. 5, No. 77, p. 3
100 "Shultz Announcement; 6 Policy Goals Outlined For Dougan's New Bureau At State Dept." Communications Daily, September 12, 1985, Vol. 5, No. 178, p. 4
they were paltry at that. One was the use of memoranda of understanding; the other the Senior Interagency Group (SIG).

The members of the Senior Interagency Group were Markey from NTIA, William Schneider, Diana Dougan's boss at State, Charles Wick from USIA, and representatives from the Departments of Defense and Justice, the CIA, the Agency for International Development, NASA, the National Security Council, the FCC, Offices of Science & Technology Policy, Management & Budget, and Policy Development, U.S. Trade Representative, National Security Agency, and the Board for International Broadcasting. Not only is this an unwieldy assembly but the decisions it made were only advisory and not binding. The SIG could provide coordination, possibly, but certainly not conflict resolution.

More than senior interagency groups, memoranda of understanding offer the potential to avoid conflict through clarifying boundaries, but they do depend for their efficacy on the very existence of boundaries, which were precisely absent in this case. In this case, there were two MOUs between State and Commerce, one in late 1983 and one in late 1984. Neither was enough to overcome the rifts, and both fell apart over differences in interpretation of the wording. Stuart Brotman sums up the situation well:

101 "Markey to Co-chair; Commerce and State Depts. Reorganize Senior Advisory Group," Communications Daily, November 19, 1984, Vol. 4, No. 224; p. 3
102 Dizard, op. cit, p. 124 and Communications Daily, November 19, 1984, p. 3
The turf war wasted departmental resources and led to a loss of morale among key staff members on both sides. At a time when decisiveness was essential, an uncoordinated Executive Branch allowed bureaucratic infighting to delay a significant communications policy decision. Interagency competition was the apparent rule of the day.

**BUREAUCRATIC WARS, 1125, AND THE ECOLOGY OF GAMES**

Applying the ecology of games to the activities during this period is useful in analyzing the initial early stages of developing HDTV. The model shows that the proposal for the new HDTV system was the result of multiple forces in two discernibly different games. One was concerned with capturing international markets. The other was concerned with bureaucratic power. There were opposing sides in both games. The bureaucratic game was simplest. On one side was Diana Dougan, with support from the Secretary of State. On the other side was David Markey, with the support of the Secretary of Commerce. The standardization game was more complicated, with opposing sides in both the domestic and international aspects of the game. The model also shows that there was a reciprocal relationship between the two games - effective leadership of the 1125 initiative enhanced the standing of Dougan and of her office, while her energy propelled State Department sponsorship of 1125 in the international arena.

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The Bureaucratic Game

Players and Their Objectives

As just noted, the players in the bureaucratic game were few. The competition was between Diana Dougan from the State Department and David Markey, Director of NTIA. The Secretaries of State, George Schultz, and of Commerce, Malcolm Baldrige played supporting roles, usually behind the scenes. However, identifying the goal in this game is in one sense problematic, because the competition was not explicit, though observers in Congress and the press all understood the existence of a bureaucratic war. The goal was the central point for international communications policy coordination. Diana Dougan wanted CIP to have that function, but precisely what that looked like, where the edges were, is less clear. Was it enough that she became an assistant secretary presiding over a Bureau rather than an Office? However, imprecise edges can co-exist with a real goal, even if it is one we can only infer it from actions.

Power and Strategies

To an extent unique in developing HDTV, both of these games key off one person: Ambassador Diana Lady Dougan. Who was she, and where did her power come from? Diana Dougan’s main, but not sole, power in the bureaucratic game was her political backing. She had close ties into the Regan administration - on the side table in her office, visible to all visitors, was a charming candid picture of herself talking with the President.
She was also a hard worker and sought advice from many sources, including Tedson Meyers, a well-known beltway advisor, William Connolly, the president of Sony/USA, and CBS Vice President Joseph Flaherty. She had good access to high-level figures in the administration, not least to the Secretary of State, and to Members of Congress. Less successful but still useful were public appearances and interviews in the press. Last, she was arguably the right person at the right time and place. She arrived in Washington with the new administration as communication and information were entering a period of flux. Not only were the technologies rapidly innovating, but industries were restructuring and often becoming more international. In place of sporadic contact, she set up regular meetings overseas with governments and international telecommunications companies, and according to Wilson Dizard, "... expanded them to include the political and economic implications of the new communications environment."\textsuperscript{104} Out of an office traditionally the home of civil servants and understated diplomats, Dougan brought energy and a vision.

Her background offered few clues to the scope and intensity of her ambition. After brief stints with the Maryland State Legislature and the nascent Time cable network, she married J. Lynne Dougan, scion of the Marriott family and son of “Mike” Dougan, Utah’s biggest oil man. Moving to Utah, she raised a family and became active in the civic life of the community. She joined fifteen civic and arts boards, often as an officer, and was


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involved on a pro bono basis in producing and sometimes hosting television programs. Like much of the Marriott family, she was also active in the Republican Party. Her federal government experience began in 1976, when President Ford nominated her to a Republican slot on the Corporation for Public Broadcasting board; President Carter subsequently re-nominated her in 1980. Her family was reputed to be major contributors to the Reagan presidential campaign, and soon after the election, the President offered her the position at State. It was not a particularly plum job, since CIP was mid-level and had no substantive assignments, but the appointment from the beginning came with the personal rank of ambassador, which would help to alleviate the sting of such a low-level assignment.

Dougan arrived at the State Department in 1983 with energy, political backing, and ambition, and she entered in a place and time that presented her with a tabula rasa for all intents and purposes. Communications and information technologies, and indeed the entire industries themselves, were in an obvious period of innovation and transformation. Part of that transformation was the extraordinary development in computers and networks; part was the increasing importance of international communications activity, particularly trade; and part was an increasing faith in competition and markets. There were new companies, here and abroad, in telephony, computers, satellites and manufacturing. Clearly coordinating international communications policy had become necessary. While

\[105\] Testimony before the House Committee on Science, Commerce, & Transportation on re-nomination to CPB Board, August 5, 1980. www.lawlibrary.rutgers.edu
leaving that task to NTIA made some sense, as Executive Order 12046 seemed to imply, that agency had never really had much international expertise. There was, therefore, at least an arguable justification for enhancing the telecommunications expertise in State rather than enhancing the international expertise in Commerce.

And Diana Dougan, with the backing of the President as well as the Secretary of State, set out to do just that. Whether or not she succeeded, it is clear her initiative came at a price. The turf battles with NTIA and within State were bruising. She had taken a great deal of heat over her handling of the separate satellite system question and over the preparations for the Space WARC, the major ITU conference to reallocate satellite locations. At the point that she turned seriously to HDTV, she had just been promoted to Assistant Secretary over a newly created Bureau, and HDTV seemed in many ways like a winning issue. It would strengthen American industry, and while there was no consensus on the standard, Dougan was able to broker an agreement among the broadcasters. It was also possible to argue that HDTV was not only an international question but also a kind of issue the Department had traditionally handled. Certainly at that time there were no federal agencies involved with it and no threat of turf battles.

Had the US been successful at the CCIR, Dougan would have reaped a major coup for her office and herself, but that was not to happen. Soon after Dougan resigned from the State Department to work on George H.W. Bush's campaign, the Bureau of Communications and Information Policy was bumped back down to a third level "Office," though the head
still holds the rank of ambassador. HDTV moved entirely out of State as an issue except for one small reappearance. The 1125 supporters had been right in at least one regard: either the CCIR would approve a universal program exchange standard in 1986 or there never would be one.

Dougan’s tools in this turf battle, then, were her political backing and access to upper levels in the administration, her vision and energy for her new assignment, her luck in being in a field that was rapidly changing and becoming international, and a comfort in making her arguments in public. J.Q. Wilson defines goals as “...an image of a desired future state of affairs.”

Diana Dougan clearly had an image of a desired future state, and she assembled the power to come close to achieving it.

**Rule, or constraints on action**

If tools are the strategies and tactics to reach the goals, rules govern what is or is not permissible; they constrain the behavior of participants. The major rules in this game were those governing bureaucratic interaction. Anthony Downs argues that bureaucracies operate in “territories” in which they have varying degrees of dominance, from the “heartland” in which they have complete dominance through to “alien territory” in which they have no dominance at all. One of the intermediate territories Downs calls “no-man’s land.” He argues that whenever two or more agencies operate in the same territory, they

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will conflict. Such was certainly the case with CIP and NTIA. For NTIA, international communications as a policy issue was not part of the heartland, and in no substantive sense had it been part of CIP’s. Consequently, as Downs had foretold, it was essentially up for grabs, and CIP and Dougan tried to grab it.

Although there were certainly many rules and regulations that govern CIP’s work with international conferences, the constraints on Dougan’s and Markey’s actions in this game were only canons of acceptable political fighting: don’t make your boss look bad, don’t lie or expose state or corporate secrets, treat the press well.

**Salience and legitimacy**

Does salience or legitimacy affect the outcome of this game? It is clear that salience, the relevance of the issue to the core mission of the company or person, has a major influence on who wins the game. It is also clear that legitimacy, the right to act, the legality of fora, procedures, and questions, significantly factors into outcomes. In this instance, the salience of the outcome was central to the contest. David Markey was the head of a large agency and did especially need to have more responsibilities. For Diana Dougan, on the other hand, showing that she could forge a broadcasting industry consensus over HDTV and that she was rightly central to the INTELSAT controversy was key to her ability to raise the importance of both her office and herself within the State Department. Consequently, she was a more prominent and active competitor. However, NTIA's history of substantive

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expertise in communications gave his side of the fight more legitimacy, and in the long
run, enough to win.

The Standardization Game

Players

In this game, the major players were Diana Dougan, along with William Connolly,
President of Sony/America, and Joseph Flaherty, Vice President of CBS. They were the
major players because they took the lead in initiating actions, setting the goals, and
inducing others to follow. The supporting players were officials from CIP, Tedson Meyers,
a Washington lobbyist, and members of the US CCIR delegation to Dubrovnik. The
opposing players were both domestic and international. The Americans were
representatives of the other major networks, ABC and NBC, as well as computer scientists
and television engineers, notably William Schreiber of MIT; they argued that setting any
standard was premature. The international opponents were the Australians, the EU
countries, especially France, and the European Commission DG XIII, the directorate in
charge of communications systems. The American goal was CCIR approval of 1125 as an
international program standard. The European Commission led the move to block
acceptance of 1125, thereby carving out a market for their own programs producers.
Rules

Rules structured this game as they had not the bureaucratic game. There were rules governing SMPTE decision-making, contributions to US CCIR positions, and participation in ITU meetings. On a more abstract level, seeing rules as constraint on action requires including timetables as rules, a crucial aspect of ITU deliberations. The relevant rules are the following:

- **SMPTE** - A proposed standard needs a two-thirds vote from the sponsoring SMPTE Study Group for approval. A recommendation for a proposed standard needs only a majority vote. This arcane allowed 1125 to go forward to the State Department as the US position with apparent SMPTE blessing.

- **US CCIR Committee** - Here the rules covered the submission of documents to the Committee, the discussion and agreement on a US position at the international meeting, and membership in the US delegation.

  Documents for consideration at the ITU went first to the Diana Dougan’s office at the State Department. CIP would then circulate them to Committee members, who would discuss the documents and decide whether or not to include them, in whole or in part, as formal submissions to the ITU.

  Membership in the US CCIR Committee was open, but to be effective, it was necessary not only to make solid submissions but to attend the meetings. CIP scheduled the meetings in consultation with the informal Committee leaders, those who had been deeply involved in the Committee in the past.
Membership in the US delegation to ITU meetings was at the request of the delegate and the approval of the State Department. Once at the CCIR meeting, the constraints on behavior were palpable. The delegation presented a united front, and deviations from the official positions were grounds for dismissal from the delegation. As a consequence, deliberations at the commonly early morning daily delegation meetings could be fiery.

- **ITU** - Rules covered the cycle of meetings, including submission of proposals, the and eligibility for participation.

  Full, voting membership in the ITU was open to national governments only. Non-profits organizations and corporations both could have associate memberships, with no voting rights and a large admission fee. Given those constraints, institutional participation was normally via the US delegation.

  The CCIR worked on a four-year cycle. The CCIR would receive submissions from national governments for a proposal early in the cycle; study groups and working parties would work on the proposal, and then the full assembly, the CCIR Plenipotentiary Meeting, would approve or not at its quadrennial session. For the supporters of 1125 to have locked in the standard as the official worldwide program exchange standard, it was necessary for the CCIR meeting in 1986 to approve the proposal. Otherwise, by the next vote, in 1990, there would have been too much time for competitive standards to emerge and the chance to capture the worldwide market would have disappeared.
The implicit rules in these international negotiations assumed some diplomatic maneuvers among countries between CCIR meetings. However, the degree to which Diana Dougan, her assistant Tom Ramsey, and Tedson Meyers pushed the Australians and Europeans was beyond normal practice, so much so that it irritated the Europeans, raised memories of *la défi américaine*, the specter of American hegemony, this time in partnership with the Japanese consumer electronics industry. The result was a last moment, cabled-together alternative proposal from the Europeans, poor in technical terms but good enough to kill 1125 as a worldwide standard.

**Tools**

Despite the rules, all the players used multiple tools. On the domestic front they included:

- Parliamentary procedure – SMPTE’s acceptance of the “recommendation for a proposed standard” rather than just a recommendation for a standard allowed the proposal to go forward despite the limited support. Scheduling US CCIR Committee meetings to suit the 1125 proponents is another example.

- Control of the agenda – Limiting serious consideration of HDTV proposals to those from US CCIR Committee members is one example of this tool. The requisite to reference past CCIR submissions and decisions made it difficult to submit radically new ideas. The power of CIP and US CCIR Committee leaders to set up the agenda controlled the flow of ideas.

- Persuasion
• The most dramatic example of the power of persuasion was Diana Dougan's managing to get ABC and NBC to agree to back 11:25 at the Dubrovnik meeting, an agreement she created in the face of the companies' own research agendas.

• Agreement on documents for the CCIR in Geneva — One of the tools the 1125 proponents used during this period and subsequent ones was to urge delegates with reservations not to keep a document from going forward, that is, not to oppose it. Counter-intuitively, the technique was effective in keeping 1125 in play despite lack of widespread support.

On the international front, they included:

• Diplomacy

Diana Dougan and her colleagues used this tool intensely if self-defeating, as noted above, in trying to garner international support for 1125.

• Nationalism

The prospect of 1125 raised fears of a Japanese-American juggernaut, fears that two decades earlier had given rise to the French and German development of their own color television standards as non-tariff trade barriers against the American NTSC.¹⁰⁸ Now shortly before the Dubrovnik meeting, the European Commission had just formed the Directorate for communications issues, DG XIII, and the European desire to halt the

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American initiative merged with the excitement of a new organization. Moreover, DGXIII needed only to garner enough support for a semi-plausible alternative to block 1125. Its defeat then gave the Europeans enough time to develop a more technically sound system.

Last, and interestingly, the lack of a traditional constituency, with established working relationships, in fact provided Diana Dougan with freedom to choose her battles and tactics. CBS had naturally been a part of the CCIR negotiations, but Dougan’s proactive partnership with the network outside the framework of conference preparation was most unusual. So, too, were the attempts of her office to use US missions abroad to garner support for the 1125 standard. Only someone with her kind of backing would have been able to pursue such an independent strategy.

Salience and legitimacy

For the 1125 proponents, the meeting at Dubrovnik was do-or-die. Everyone knew that failure to agree on 1125 meant the world would continue as it had since the 1960s, with competing US/Japanese and European television systems. Since Sony and CBS had already made investments in the system, they had more to lose than the Europeans, at least in the short run, so for Diana Dougan, CBS and Joseph Flaherty, and Sony and William Connolly, agreement on 1125 was of prime importance. It was a means for Dougan to increase the importance of her office. It was seriously important to Joseph Flaherty of CBS

109 Eammon Lawlor, European Commission, DG XIII; conversation with author, April 22, 1988

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and to William Connolly of Sony/America because of their companies’ significant financial investment and patent ownership in 1125. Since other companies were researching high definition systems, and since 1125 was the only HDTV system that actually existed at the time, that CCIR cycle was in fact the only shot the US and Japanese had to capture the worldwide program market. The proposal had less salience for the other US broadcasters, since they were researching their own systems and thought that 1125 was a premature standard, an opinion independent television engineers and computer scientists shared.

The question of legitimacy was more straightforward and not particularly important in determining the outcome of these games. SMPTE was an accredited standards body following accepted (if hard-ball) procedures, Diana Dougan’s leadership was unusual but well within legal bounds, and the proceedings in the US CCIR Committee and the ITU were - in term of legitimacy - unremarkable.

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In drawing this period of HDTV development to a close, the ecology of games highlights two issues in particular.

First, HDTV became a flash point, a goad to oppositional action, even after the proposed proponent systems became digital. For the ensuing six years, 1125 appeared in a whack-a-mole fashion in the domestic and international standardization fora. Second, unlike any other part of the HDTV story - and troublesome for theory development - this phase keys
off one central figure: Diana Lady Dougan. Without her might, but equally well might not, have been the US proposed standard, for there was certainly no industry consensus as late as March 1985. On the contrary, there was great feeling within the technical community that the moment was inauspicious for setting a standard because the technologies were in a state of flux. Without her there might well not have been even a paper consensus on HDTV. Without her the European Commission might, but equally well might not, have focused on this opportunity to take a leadership role in building a European coalition against a new défi américaine. Without her it is quite possible, certainly in light of the very low profiles of her successors, that NTIA would have become the executive branch focal point for international communications issues, as the Carter administration had probably intended with Executive Order 12046.

The ecology of games is useful in analyzing this period for three reasons. First, it clarifies the various forces at play around the proposed standard and uncovers the rationality of the actions. Second, it highlights a reciprocally supportive relationship between the two games for Diana Dougan. Success in seizing leadership of international communications coordination (the bureaucratic game) strengthened her hand in expanding support for 1125 and thereby drawing nearer the goal of capturing the international program exchange market. Last, it covers curves from left field, since the European defeat of the American-Japanese proposal was to throw the process wide open again. William Dutton argues that the ecology of games incorporates such surprises well.

This framework emphasizes the potential for unanticipated, unplanned developments, while raising doubts about perspectives on technological
change, such as the single inventor thesis, that posit a more governed, isolated, and predictable system of action.... (T)he ecology of games concept strongly supports the thrust of institutional perspectives, such as those articulated by March and Olsen (1989, p. 9): "... the long-run development of political institutions is less a product of intentions, plans and consistent decisions than incremental adaptation to changing problems with available solutions within gradually evolving structures of meaning."110

The European’s surprise HDTV proposal in Dubrovnik, and a surprise it was, for the counter proposal came together very quickly, was only the first in the development of HDTV. The ecology of games model offers a combination of rationality in developing new technologies and room for changing conditions needing incremental adaptations. March and Olson’s description is as accurate of technology development, as the ecology of games shows as it is of political institutions.

Chapter 3

1987 - 1990: The US Attempt to Create a Domestic HDTV Standard

With the demise in Dubrovnik of the US proposal for a universal HDTV production standard, the development of the new television system entered an entirely new phase. The primary activity was domestic and centered around the Federal Communications Commission (FCC) as well as Congress and the Defense Department Advanced Research Projects Agency (DARPA). In addition to the change in fora and an increase in the number (and variety) of players, the games themselves and their goals metamorphosed into a “television broadcast game” and a “digital convergence game.”

The primary players in the television broadcast game were the FCC, television broadcasters and system developers, the Advisory Committee (ACATS) the FCC appointed to oversee HDTV development, and television manufacturers. The playing field was the FCC, with secondary action in the Advanced Television Testing Center (ATTC), which tested the proponent HDTV systems, and the CCIR. The broadcasters’ primary goal was to protect their spectrum allocations, though at times, that goal came into conflict with the goal of the ACATS chair to produce a new television system.

The digital convergence game was less formal. The goal was to develop flexible digital communications and information systems that easily connected with each other and that
had easily permitted further innovations. The (geeky) mantra was interoperability, scalability, and extensibility. The primary players came from the computer and movie industries and from academia, where they were largely computer scientists, television engineers, and social scientists. They partnered with Members of Congress and DARPA. Their fora were more diffuse than in the broadcasting game and included Congressional hearings, workshops, ad hoc meetings, and virtual meetings through email and conference calls.

It is helpful to see the technologies under consideration as mapping onto different agencies and companies. In the broadcast game, the FCC and ACATS focused on television technologies, which were analog until 1990, then a mixture of digital and analog. In the digital convergence game, the involvement of Congress and the Departments of Defense and Commerce focused on computer technologies, either in terms of applications (military, commercial, medical, educational) or of industry-government relations (consortia, collaborative R&D, antitrust legislation).

One could see the development of HDTV in terms of a lead agency working with its traditional private sector corporate partners according to traditional, legally mandated procedures, all the while beset by informal private-public partnerships that pushed a different technology. However, widening the context exactly reverses the power differentials: where the FCC was strong and the contenders at a disadvantage within this process, in the outside world the opposite was true: innovation and rapid diffusion of
digital technologies were sweeping away both stand-alone and analog technologies. Ultimately, the outside world won, but that victory was not clear until well into the next century.

These nuanced complex sets of relationships were at their most contentious during this period of HDTV standardization, which ran from the opening of the FCC Inquiry into Advanced Television Services (Multimedia Bureau Docket 87-268) in 1987 through the end of 1990, by which time all the proponent HD systems became digital. During this time the fundamental questions about HDTV arose:

- What was this new technology, television or video?
- Where would the decisions be made?
- Who would deliver HDTV?

Although in the almost two decades it took to flesh out and implement the answers to these questions, and although what finally appeared in home television screens was quite different, by the end of 1990, the basic shape of the new systems seemed clear:

- HDTV was television, not a video component of a computer system.
- The new system would break entirely with the old, existing system. It would therefore need a separate allocation of spectrum on which to simultaneously broadcast, “simulcast,” in HDTV
- Only current broadcasters would be given spectrum to broadcast HDTV.
- The new system would be digital.
- The FCC was the primary locus for making decisions about the new system.
The issue did not resolve whether HDTV would use progressive or interlace scanning systems, and it reappeared during the 1993-96 period. In the end, the FCC simply agreed on a standard that, for all intents and purposes, left that parameter open. Ultimately, for all the heat of the interlace-progressive scan fight, the issue became moot, because HDTV was digital, processing power became cheap and abundant, and manufacturers found no allure in dead-end interlace useful only for television rather than progressive scan with its multiuse flexibility. By 2009, the end of analog transmission, HDTV sets were able to process multiple signals at virtually no cost, but in 1996, few foresaw that.

Tables 6 and 7 on the following pages set out the US government and industry interests in HDTV in more detail before turning the historical account first of the broadcast and then the digital convergence game.
### Table 6
**US Government Interests in HDTV**

<table>
<thead>
<tr>
<th>Government Agency</th>
<th>Formal Interest in HDTV (Goals)s</th>
<th>Source of Authority</th>
<th>Funding</th>
<th>HDTV – Related Activities</th>
<th>Salience of HDTV Issue to Agency</th>
<th>Close Industrial Ties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dept of State/ Bureau of Communications &amp; Information Policy</td>
<td>Represents US at intern'l communic negotiations</td>
<td>Congressional legislation</td>
<td>Depends on Congress/ OMB/ State decisions</td>
<td>Coordinates positions for int'l conferences; member SIG</td>
<td>DOS: extremely low CIP: An impt issue among several</td>
<td>broadcasters and early ATSC people (Flaherty/Meyers, etc.)</td>
</tr>
<tr>
<td>DOD/DARPA</td>
<td>military procurement</td>
<td>size and importance of Defense spending</td>
<td>shrinking but non-trivial for product devt</td>
<td>procurement</td>
<td>factually: low symbolically: high</td>
<td>computer</td>
</tr>
<tr>
<td>Department of Commerce</td>
<td>none</td>
<td>Departmental</td>
<td>none</td>
<td>might support HDTV as generic key industry</td>
<td>low to middle</td>
<td>none especially though some with computers</td>
</tr>
<tr>
<td>National Telecom. and Information Administration (NTIA)</td>
<td>coordinates USG use of spectrum and USG positions at international conferences</td>
<td>statutory resp for spectrum &amp; int'l conf negotiations</td>
<td>none</td>
<td>Issued HDTV Notice of Inquiry in December 1988</td>
<td>low to middle except in strict spectrum terms</td>
<td>traditionally, spectrum users (broadcasters)</td>
</tr>
<tr>
<td>National Institute for Standards &amp; Tech/ Advanced Tech. Program</td>
<td>hdtv/digital imaging appropriate for ATP funding</td>
<td>Congressional appropriation</td>
<td>$10 mil this yr $50 - 100 mil in process for FY 91</td>
<td>ATP supports devt to prototype stage</td>
<td>middle/high if ATP chooses to fund it</td>
<td>none especially though some with computers</td>
</tr>
<tr>
<td>FCC</td>
<td>Formally chooses terrestrial broadcast standard</td>
<td>Statutory</td>
<td>only for general FCC operations and some Advisory Comm. activities</td>
<td>Issues NOIs, etc. Runs Advisory Committee on ATV</td>
<td>high</td>
<td>broadcast (spectrum mgt); telephone cos; NOT computers</td>
</tr>
<tr>
<td>Advisory Committee</td>
<td>Charged with recommending HDTV broadcast standard</td>
<td>FCC appointment</td>
<td>Self-funded by participants</td>
<td>Subcoms. study tech &amp; economic aspects of ATV proposals</td>
<td>centrally high</td>
<td>broadcasters, esp., some cable</td>
</tr>
<tr>
<td>ATTC/ Cable Labs</td>
<td>Charged with testing ATV proponent systems</td>
<td>Charged by FCC Advisory Committee</td>
<td>industry funded</td>
<td>runs technical tests on proponent systems</td>
<td>centrally high</td>
<td>broadcasters</td>
</tr>
<tr>
<td>Congress - House - Telecom &amp; Science Ctees - Senate</td>
<td>none; interest is by choice</td>
<td>the constitution</td>
<td>dispensing agency</td>
<td>hearings and legislation, esp two Markey bills and Gore bill on broadband networks</td>
<td>low to low/middle</td>
<td>traditionally close to bcasters; working relations with telecoms; evolving with computer</td>
</tr>
</tbody>
</table>

102 – *The Development of High Definition Television*
Table 7

Industry Interests in the Development of HDTV

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>terrestrial television</td>
<td>maintain or gain new spectrum allocation competition with cable and sat broadcasters</td>
<td>complex, closely regulated</td>
<td>-industry critical to individual politicians -means of connecting with voters -source of national pride</td>
<td>-capital needed to -buy equipment for transmission -produce and buy programs -buy rights to cover events</td>
<td>-deliver as many viewers as possible to advertisers -get good programs (to support first objective)</td>
</tr>
<tr>
<td>broadcast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>receiver manufacturers</td>
<td>create new market</td>
<td>support for Zenith-otherwise negligible</td>
<td>national prestige -maybe revival of consumer electronics industry</td>
<td>purchase labor and materials to sell commodities in highly competitive market</td>
<td>develop mass market for their commodity product</td>
</tr>
<tr>
<td>TV program producers</td>
<td>a. gain competitive edge with good pictures b. correctly choose new children’s programs</td>
<td>some regulation, especially positive balance of trade</td>
<td></td>
<td>purchase labor and artistic properties- highly chancy; power curve applies</td>
<td>create hits</td>
</tr>
<tr>
<td>TV cable companies &amp; satellite broadcasters</td>
<td>use HDTV to compete with terrestrial broadcasters - develop new (paying) markets</td>
<td>avoid regulation more than at present</td>
<td>- cable, some regulation - sat. only as concerns spectrum order &amp; efficiency</td>
<td>to expand &amp; upgrade cable systems</td>
<td>-attract more subscribers -become competitive with broadcasters</td>
</tr>
<tr>
<td>Hollywood film companies</td>
<td>protect film as dominant production source; sell more pictures</td>
<td>same as program producers</td>
<td>same as TV program producer</td>
<td>same as TV program producer</td>
<td>same as TV program producer</td>
</tr>
<tr>
<td>-production equipment</td>
<td>sell new production equipment</td>
<td>negligible</td>
<td>industry too small to justify special consideration</td>
<td>to develop equipment in a highly specialized market</td>
<td></td>
</tr>
<tr>
<td>manufacturers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>computer companies</td>
<td>equipment optimization</td>
<td>-government as equipment purchaser -avoid regulation</td>
<td>clear national security and economic vitality issues</td>
<td>capital needed for hardware development and upgrades in competitive, fast-paced industry</td>
<td>-develop/upgrade hardware -sell more computers -differentiate from other computers</td>
</tr>
</tbody>
</table>
INTRODUCTION AND EARLY HISTORY

It is perhaps surprising but true that the roots of FCC decisions about HDTV lie in the early days of radio broadcasting. Those days are eerily reminiscent of today's Internet environment. Both were chaotic, vibrant, full of struggles with corporations vying for control: sometimes brushing against existing laws, sometimes occasioning demands for new ones, developing in users surprising new capabilities, and trying to define the relationships between the government and the emerging technologies. Both gave rise to new companies and organizations. Both changed the ways Americans - and others - lived.

Those days are important, because the relationships that arose out of that struggle set the pattern for all US broadcasting regulation to this day; so that actually the FCC decisions in the advanced television docket grew out of regulatory patterns set more than eighty years previously. Conventional wisdom is that the early days of radio broadcasting in the United States were wild and chaotic, so much so that broadcasters cried out for federal regulation, for a “traffic cop of the air.” Congress heard the cries and created the Federal Radio Commission (FRC). This wisdom lasted for decades, unchallenged until the 1990s, when scholars from several social science disciplines - history of science, history, communications - began to tell a very different story. Douglas, McChesney, Slotten, all
argue that while there was indeed chaos in the “wild west” of the air, and while there were indeed unsavory characters who occasionally broadcast hazardous messages, the chaos was really - to the listener - nothing more than occasionally annoying, and the radio equivalents of malware were quite limited. What the conventional wisdom hides and the more recent scholarship shows is that the early radio days were full of energy and experimentation across wide swaths of society. Boy scouts, church groups, unions, universities, amateur radio operations - in short all sorts of groups - were developing ways of using this new technology to suite their needs and purposes.

In competition with these nonprofit groups, however, were, at varying times, the Navy, RCA, and the emerging commercial broadcasters. For the Navy, questions of security and reliability were paramount, and the specter of interference was highly problematic. For the commercial broadcasters, in the process of forming into “chains” or networks as we now know them, there was an equally obvious drive to gain title to clear and reliably consistent allocations of the spectrum. For them, interference from adjacent broadcasts and uncertainty about access to reliable time slots was intolerable. How could you compellingly sell time to advertisers if you could not promise a consistent audience? AT&T, GE, Westinghouse, and United Fruit owned the critical patents and could fight off the Navy’s attempt to control the broadcast system, but the struggle between the commercial and the

nonprofit broadcasters lasted longer and was more contentious. That struggle centered on
the apparently value-neutral, “technical engineering” questions of how best to use the
radiofrequency spectrum, specifically who could use which bands and for what periods of
time.

In the end, the Federal Radio Commission followed the wishes of the commercial
broadcasters, but these decisions were anything but value neutral. Their effect was to
strengthen commercial broadcasting, reify the model of advertiser-supported programming,
and push the noncommercial broadcasters literally to the edges of the useable spectrum.

This early model continued through the establishment of the Federal Communications
Commission in 1934 and over the rest of the century: broadcasting in the United States
has always been a joint activity in which the regulatory body (FRC then FCC) provided
(primarily corporate) broadcasters with a safe arena in which to operate, an arena with high
barriers to entry and guaranteed access to the most critical resource, spectrum. The
broadcasters for their part developed reliable audio and video signals with fairly frequent
incremental improvements and agreed to meet minimal behavioral standards of localism,
decency, balance (now removed), and safeguards for children’s viewing. This regulatory
regime rested on the assumption that radio spectrum was a scarce resource and that
broadcasting was in the national interest, “served the public, and needed to be supported.
By looking at the submissions to the Commission in the case of HDTV and at the FCC's decisions over time, the nature of the relationships, the arenas in which each had power and authority, becomes clear.

- FCC decided who got to play, in what part of the spectrum, and in what size part.
- Industry, through the proponents, got to decide which of the possible technologies would work within those constraints.
- Industry and the Commission together negotiated, implicitly or explicitly, the timing of developing the new standard and the transition to an all-digital system, and, while the decision to accept the new system specifications was *de jure* the Commission’s, *de facto* the decision was joint.

The process of making these decisions was iterative; it went back and forth between the FCC, and the outlines became clear only over time. Nonetheless, the pattern is there and obvious once one looks for it.

**FCC Docket 87-268: Advanced Television Systems**

The FCC became the central government agency in the HDTV debate through its authority to regulate the radio frequency spectrum. The immediate cause of the agency interest was the petition of land mobile communications companies (police, ambulance, and other public service providers) for spectrum allocation at the 12 GHz band (General Docket 85-172). As a blocking motion, the Association of Maximum Service Telecasters (the terrestrial television broadcasters' association, known as MST) and fifty-seven other
broadcast companies filed a “Petition for Notice of Inquiry” on February 13, 1987. The broadcasters wanted the FCC to open the question of the impact of new broadcast technologies (both television and mobile radio) on FCC spectrum allocation and channel assignment policies. In response, the FCC issued a Notice of Inquiry (NOI) on Advanced Television on August 20, 1987.

The full title of the NOI clearly indicated the Commission's approach to this question: a Notice of Inquiry on Advanced Television Systems and their Impact on the Existing Television Broadcast Service. The NOI was to be "...a wide-ranging inquiry to consider the technical and public policy issues surrounding the use of advanced television technologies by television broadcast licensees." In fact, it framed a very narrow debate: it asked for comments on alternative arrangements for spectrum allocation to include advanced television, taboo channels, compatibility with home receivers or current channel allocations, compatibility requirements between Advanced Television (ATV) and NTSC and among ATV standards, interference questions, and consequences of non-broadcast use

See Appendix XX for the list of fifty-seven petitionerers.
The petition itself drew comments over whether the FCC should continue action in 85-172 and assign new spectrum to land mobile users or whether the Commission should hold off on any assignments until it had reached a decision in the new Inquiry. On July 16, 1987, the Commission froze the table of allotments. The comments were from the Satellite Broadcasting and Communications Association (SBCA), the Consumer Electronics Group of the Electronic Industry Association Hughes, Communications Galaxy, Home Box Office, American Petroleum Institute, the Corporation for Public Broadcasting (together with the National Association of Public Television Stations and the Public Broadcasting Service), Motorola, Buffalo Broadcasting Company (WIVB-TV), ATSC, Land Mobile Communications Council, the National Association of Business and Educational Radio, and Telecommunications Research and Action Center.

See Appendix 1 for a list of the FCC documents in this case along with brief summaries of each.

FCC Notice of Inquiry on Advanced Television Systems and Their Impact on the Existing Television Broadcast Service (Docket No. 87-268), ¶ 3
of ATV on terrestrial broadcasters. The NOI did not include requests for comments on trade-offs between picture quality and access to more channels or between quality and interactivity. It also did not take into consideration advances in digital video technologies that had been occurring in other industries, most notably in computers, but rather only traditional broadcast concerns.

The responses to the NOI came from terrestrial broadcasters and networks, cable and satellite broadcast companies, broadcasting associations, manufacturers (including GE/consumer electronics, Hitachi, Matsushita, and Toshiba), research groups and other academics, and mobile radio companies. With virtually no exceptions, the comments responded to the issues as the Commission had framed them. These submissions, together with the Commission's deliberations and the advice of the Advisory Committee, formed some of the basis of the FCC's Tentative Report and Further Notice of Inquiry, released on September 1, 1988.

**ACATS: THE ADVISORY COMMITTEE**

To help advise the Commission, Dennis Patrick, the FCC Chair, created the Advisory Committee on Advanced Television Services (ACATS) with Richard E. Wiley as Chair, on

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115 The exception was MIT professor W. Russell Neuman, who raised the question of trade-offs among quantity, quality and new services.
November 17, 1987. The purpose of the new committee was to recommend to the FCC a transmission standard for HDTV and to take

...all steps necessary to provide advice on desired features of a Terrestrial Advanced Television Service.

(a) Define the desirable characteristics of Advanced Television Service; for example, in terms such as picture quality, population served, costs to broadcasters/consumers/manufacturers, relationship to existing broadcast service, and relationship to non-broadcast service.

(b) Review the technical planning factors for the existing television service and recommend planning factors for advanced television service, including consideration of factors such as coverage area, quality of service, frequency reuse criteria, receiver quality, and spectrum allocations."¹¹⁶

The members largely represented broadcasters but also came from other industries involved in advanced video systems. To carry out the work of the Committee, there were three subcommittees, each headed by a member of the ACATS executive committee. The three subcommittees were Planning, Systems and Implementation, headed respectively by Joseph Flaherty from CBS, Irwin Dorros from Bellcore, and James Tietjen from Sarnoff Labs. The Committee Chair was Richard E. Wiley, the senior partner at Wiley, Rein & Fielding, a prominent Washington law firm, and previously Chair, Commissioner and General Counsel of the FCC in the Nixon and Ford administrations. Each of the subcommittees divided its responsibility for examining specific issues among a number of working parties. The Planning Subcommittee was most active with six and subsequently seven, the Systems Subcommittee had four, and Implementation two.

¹¹⁶ Federal Register, Vol. 52, No. 200, 10/16/87

110 - THE DEVELOPMENT OF HIGH DEFINITION TELEVISION
The Committee began its work under much pressure to proceed with dispatch. At the first meeting, FCC Chair Dennis Patrick gave the Committee a short timetable for its work, asking for its recommendations by the end of 1988. Alex Felker, Head of the FCC Mass Media Bureau pointed out that freezing spectrum was not “costless” and that the Commission needed to respond to spectrum allocation demands from other industries. The State Department’s Diana Dougan argued that defining positions quickly helped the US posture in international fora, or other countries would preempt us.\footnote{117}

In fact, from the start, the whole FCC debate was cloaked in a sense of urgency. The trade press was reporting that broadcast would begin in 1991.\footnote{118} Some of the pressure came from the other industries’ demands on the FCC for spectrum. Some came from the concern on the part of broadcasters to safeguard or improve their competitive position \textit{vis-à-vis} satellite broadcasters and cable companies, as well as non-electronic distribution system products such as video tape and optical discs. Last, increasingly over the following two years, some pressure came from a vague but pervasive threat from foreign, particularly Japanese, competition. The result was a strong push not to examine a broad range of activities but to make a choice quickly - in essence to accept that which already did or very shortly would exist.

\footnote{117}{"Blue Ribboners Go to Work on TV's Future," \textit{Broadcasting}, Vol. 113, No 21, November 23, 1987, p. 35}
\footnote{118}{Eileen Norris, “Zenith works on HDTV game plan,” \textit{Electronic Media}, October 31, 1988, Pg. 24}
As of November 1987, the only system in existence was NHK's 1125. The movement to coalesce around 1125 fell into place the following month. The American National Standard Institute (ANSI) accepted the SMPTE proposed studio production standard. Known as SMPTE 240M, this standard was basically 1125. ANSI approval increased the power of the 1125 proponents both inside the FCC process and in international negotiations.

The major issues HDTV raised before the FCC were (1) how to allocate spectrum among competing users, the Commissions' traditional responsibility, and (2) what kind of protection the FCC should afford to terrestrial broadcasting in relation to cable and satellite systems. The first issue found expression in debates over the possible allocation of new spectrum for HDTV and over the size of channels allocated to the new television service. The second found expression in debates over cable and satellite HDTV policies, receiver compatibility and cost of HDTV retrofitting.

The question of spectrum allocation pitted the mobile communication equipment manufacturers, led by Motorola, against the television industry. The mobile communications proponents argued that their service supported public good activities (for example, police, ambulances, and fire fighters) and used spectrum more efficiently than did television broadcasters with their 6 MHz channels. The broadcasters argued that to remain

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competitive with other distribution systems with less restricted transmission channels, the FCC should actually set aside additional spectrum not already allocated to television for ATV. Though thorny and arcane, this issue was precisely the kind the Commission had been dealing with for half a century, and the decision not to reassign any spectrum was a traditional support of broadcasters.

The question of protecting terrestrial broadcasting was more difficult. “Free” terrestrial television had been facing increasing competition over the previous twenty years. The competition came from two directions: one from increasing strength and number of other electronic networks, primarily cable and satellite broadcasting; the second from non-electronic video entertainment systems, primarily VCRs, but also video disks. In 1970, as work was just beginning on HDTV, terrestrial broadcasters had well over 90% of the US television market; by September 1988, when the FCC released its Tentative Report, terrestrial broadcasters had less than half of the US market compared with cable, and the penetration of VCRs exceeded 60% of the US homes. Moreover, the 1984 Cable Act had largely deregulated that industry.

The broadcasters’ concern was that the FCC would place restrictions on broadcasters’ transmission abilities that would disadvantage them compared with other distributors.

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120 In November 1988, the cable penetration rate in the country was 53.8%. Communications Daily, December 21, 1988

121 “57% Cable Penetration Seen; High Growth Rate for Communications Predicted to 1992,” Communications Daily, June 28, 1988
CBS, in its comments on the NOI, contended that "(b)roadcasters should not be relegated to second-class status in the video marketplace."\textsuperscript{122} To achieve that end, they wanted ATV standards to be compatible with NTSC (except for CBS, which continued to support 1125) and one way to achieve this "compatibility" was through simulcasting ATV in newly available spectrum. \textsuperscript{123} The broadcasters also wanted the Commission to adopt a single standard that would apply to cable operators and to satellite as well as terrestrial broadcasters. The cable and satellite position was that the public should have access to the best pictures possible and that each delivery system should have the freedom to optimize the standard for its own system. The FCC decision in its 1988 Tentative Decision and Further Notice of Inquiry was in line with the broadcaster wishes.

\textbf{THE PROONENT SYSTEMS}

While the FCC was engaged in establishing the rules governing the new TV system, researchers were developing systems. The proposals were all for transmission standards rather than for the studio production standard that had been the focus prior to Dubrovnik. However, William Schrieber, himself one of the proponent system designers, argues that that distinction is more apparent than real. If one divides a video system into image capture/production, transmission, and display, then, Schreiber argues, specifications at the end of the chain determine the shape of the previous stages. For example, NHK

\textsuperscript{122} "No Discouraging Words on TV, but...," Broadcasting, Vol. 113, No. 21 November 23, 1987, p. 37

\textsuperscript{123} Possibilities for new spectrum came from use of the "taboo" channels that separate or buffer existing television signals within or between broadcast areas.
supporters could argue that its “MUSE” transmission system was not exclusively compatible only with an 1125 production standard, but in fact it was designed for that standard, and choice of MUSE as a transmission system would implicitly entail selection of 1125 as a studio production standard. Therefore, to design the transmission system at that point in history was effectively to select a system. Table 8 shows the basic characteristics of the initial proponent systems.

Table 8
System Proponents in 1987

<table>
<thead>
<tr>
<th>Developer</th>
<th>System</th>
<th>Size of channel</th>
<th>compatible</th>
<th>scanning scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avelex Co</td>
<td>Avelex</td>
<td>6 MHz</td>
<td>yes-channel</td>
<td>progressive</td>
</tr>
<tr>
<td>Sarnoff</td>
<td>ACTV-E</td>
<td>6 MHz</td>
<td>yes-channel</td>
<td>progressive</td>
</tr>
<tr>
<td></td>
<td>ACTV-1</td>
<td>6 MHz</td>
<td>yes-channel</td>
<td>progressive</td>
</tr>
<tr>
<td></td>
<td>ACTV-2</td>
<td>6 MHz – plus 6 MHz channel for augmentation</td>
<td>yes-channel, yes-channel</td>
<td>progressive, progressive</td>
</tr>
<tr>
<td>Del Ray Group</td>
<td>HD-NTSC</td>
<td>6 MHz</td>
<td>yes-channel</td>
<td>progressive</td>
</tr>
<tr>
<td>Faroudja Lab</td>
<td>SuperNTSC</td>
<td>6 MHz</td>
<td>yes-channel</td>
<td>progressive</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>MIT-RC MIT-CC</td>
<td>6 MHz</td>
<td>yes-receiver, yes-channel</td>
<td>interlace, progressive</td>
</tr>
<tr>
<td>New York Institute of Technology Vista</td>
<td>6 MHz – plus 6 MHz channel for augmentation</td>
<td>yes</td>
<td>progressive and interlace</td>
<td></td>
</tr>
<tr>
<td>NHK MUSE-6 MUSE-9 Narrow MUSE MUSE- Extended</td>
<td>6 MHz</td>
<td>yes-channel</td>
<td>interlace</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 MHz</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 MHz</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 MHz</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA Philips</td>
<td>HDS-NA 6 MHz – plus 3 MHz channel for augmentation</td>
<td>yes-receiver</td>
<td>progressive</td>
<td></td>
</tr>
<tr>
<td>Osborne Osborne Compression</td>
<td>6 MHz – plus 3 MHz</td>
<td>yes</td>
<td>interlace</td>
<td></td>
</tr>
<tr>
<td>Production Service Inc Genesys Transmission System</td>
<td>6 MHz</td>
<td>yes</td>
<td>interlace</td>
<td></td>
</tr>
<tr>
<td>Zenith Spectrum Compatible</td>
<td>6 MHz</td>
<td>no</td>
<td>progressive</td>
<td></td>
</tr>
</tbody>
</table>

Source: Broadcasting; Hugh Carter Donahue

Advanced Television Testing Center

To test these systems, the National Association of Broadcasters (NAB), Cap Cities/ABC, NBC, CBS, PBS, and MST formed the Advanced Television Testing Center (ATTC). Funding came from the companies along with fees from companies proposing systems. The ATTC had no formal ties with the federal government but worked closely with ACATS and the FCC.\(^{125}\)

However, before the ATTC could begin operation, there had to be agreement on the test design, and that work fell largely to the ACATS working parties. The question of how to choose fairly among the proponents without prejudicing the outcome was extremely difficult. Not only was it hard to set up one test to handle different systems equitably, but the choice of content and the order of its presentation itself could affect the viewers’ assessments. The process was particularly suspect because of the large representation from CBS and former CBS employees, all of whom had been connected with CBS vice president Joseph Flaherty, long an ardent 1125 supporter. Not only was Flaherty head of the Planning Subcommittee, but his former employees headed the Cable Lab (the cable television industry's version of ATTC) and the working party on psychophysical research.

\(^{125}\) The three major networks and the National Association of Broadcasters pledged $700,000 each over the following two years; other broadcast associations also pledged smaller amounts. Halonen, Doug. “Broadcasters agree to fund HDTV center,” Electronic Media, February 29, 1988, p. 43

116 - The Development of High Definition Television
which was responsible for choosing test material; in addition, other present or former
employees were active throughout the committee structure.

The question of 1125 infused the ATTC process, for the decision in Dubrovnik against
1125 as a global television standard marked the beginnings of new strategic directions
rather than the ultimate demise of the standard. One new strategy was to make 1125 a de
facto standard through wide use in the production and post-production communities, and
central to the ATTC process. If, for example, the benchmark for testing proponent
systems was material generated on 1125 tape, then the standard would become more firmly
entrenched in the video community's use. This argument occurred in the working party on
psychophysical research. The counter argument on the merits was to raise the benchmark
from the equivalent of 35 mm film to material generated on 70 mm film,\(^\text{126}\) a position that
eventually prevailed. Another strategy was to promote the use of 1125 in Hollywood
through easy access to equipment, through vigorous promotion at National Association of
Broadcaster conferences and other HDTV meetings, and through the formation of the
1125 Group, which coordinated lobbying activities.

Equally contentious was the debate concerning receivers, the well-known "television set."
MIT's William Schreiber began the debate with his proposal of an "open architecture
receiver." He argued that given the rapid advances in all aspects of video technologies, it

\(^{126}\) Research at the MIT Media Lab comparing audience reactions to NTSC, 1125, and 70 mm in fact
showed significant audience preference for the latter, indicating that the "knee" in the curve of audience
perception of quality was much higher than 1125.
would be most useful to build flexibility into receivers. His suggestion was to build a receiver using the bus architecture common to personal computers, with open interfaces between the core of the receiver and the "peripherals," such as programs for higher resolution television systems. He argued also for the creation of a "friendly family" of standards, a series of interrelated standards, each of which had different levels of quality or were optimized for a different transmission medium. Such development would give receiver manufacturers economies of scope and scale and would provide the end user (home viewers) with easy access to technological improvements as they became available.\textsuperscript{127} However, this approach, which looked costly, threatened set manufacturers who operated with minute profit margins.\textsuperscript{128}

Clearly, by the fall of 1988, there was in the United States a large and concerted if untidy effort under way, centered on the FCC and its Advisory Committee, to choose the standard for the next generation of television for the home. Although the question of what HDTV meant (home entertainment), what issues were involved with the decision (spectrum, compatibility, competition between terrestrial versus cable and satellite broadcasters),\textsuperscript{129} and who was appropriately part of the

\begin{footnotesize}
\begin{enumerate}
\item Ultimately, Schreiber's idea of a flexible receiver became the norm, but not until the next century.\textsuperscript{128}
\item Though William Schreiber re-iterated that HDTV was about economics and not television, his contribution made little impact on changing the direction of the FCC debate.
\end{enumerate}
\end{footnotesize}
debate (primarily broadcasters and receiver manufacturers), though it was by no means clear who would win or even whether the consumers wanted this new service.

ACATS met its first deadline and submitted an interim report on June 16, 1988. It focused on the relationship between terrestrial broadcasters and video distribution systems and emphasized that terrestrial broadcasters needed to be able to deliver HDTV signals to remain competitive. To that end, it recommended that the FCC consider channel allocations broader than 6 MHz. It also recommended that the Commission look at intermediate steps in picture enhancement ("improved" and "extended" definition television, respectively, IDTV and EDTV), that it not require identical HDTV standards for cable and satellite broadcast but that it support the development of inexpensive interfaces or multi-standard receivers to permit easy reception from all transmission systems.

THE 1988 TENTATIVE DECISION AND FURTHER NOTICE OF INQUIRY

In its September 1, 1988, Tentative Decision and Further NOI, the FCC set out fundamental questions that would affected the entire rest of the proceeding and ignored much of ACAT's advice. To no one's surprise, the Tentative Decision began by finding that advanced television services would benefit the public. It then went on to suggest it would limit the delivery of the new system to existing broadcasters, though it did vaguely leave room for some additions in an unspecified future. The new systems would have to fit
into 6 MHz channels in the currently assigned UHF and VHF bands; that is, while the Commission would be willing essentially to freeze new allocations in the current broadcast band, it would not willing to re-allocate new spectrum. Current NTSC users would have to be able to receive their signals during the transition period, most logically through simulcasting.  

The FCC suggested it would postpone consideration of intermediate standards (IDTV and EDTV) until after choosing an ATV standard (which essentially killed that issue) and would leave the question of standards for non-broadcast services up to those industries.

With these decisions, the FCC would essentially narrow the field substantially, and at the March 1989 ACATS meeting, FCC Chair Patrick announced that the Commission had done so. The result was that of the original twelve proponents, five systems depended on augmentation channels and therefore were rejected (NYIT, Sarnoff ACTV-2, NHK MUSE-9, North American Philips, and Osborne). Avelex and Production Service also dropped out, leaving six proponents in the running (Sarnoff, Del Ray Group, Faroudja Labs, Massachusetts Institute of Technology, NHK, and Zenith). These remaining developers did not have to worry about making the new system compatible with existing sets, a mammoth and fairly pointless challenge. The broadcasters knew that they had not only

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130 “Simulcasting” is the technique of “simultaneous broadcasting,” that is broadcasting signals on two separate spectrum bands, one in NTSC and one in HDTV.


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warded off the challenge from the land mobile services but that they would have an allocation of new spectrum for the duration of the transition, a potential boon.

**CHALLENGES**

This consensus began to fall apart primarily with the emergence of alternative conceptions of HDTV, which is the subject of the following section, but also with three events that directly affected the FCC process: the ABC challenge to SMPTE 240M, the change in the US position on CCIR HDTV negotiations, and finally the changes in US proponent systems. Each of these occurrences represented a challenge to the FCC process not because each diminished the chance of 1125 becoming a *de facto* standard, though that was true, but because each indicated the breakdown of the old and emergence of a new conception of HDTV.

The Cap Cities/ABC challenge to the ANSI accreditation of the SMPTE 240M standard grew out of ABC's long standing opposition to 1125. ABC engineers, like those at NBC, were interested in moving from an interlace to a progressive system and had never liked 1125. ABC mobilized a letter-writing campaign among opponents to 240M and challenged the ANSI endorsement, arguing that at both the time of the SMPTE decision and the ANSI approval, there was significant opposition to 240M. On April 18, 1989,
ANSI withdrew its accreditation, on the grounds that SMPTE “lacked current consensus based on the latest information presented.”

The second challenge to the FCC consensus came in the ATSC/US National Committee to the CCIR process formulating a position for the CCIR Study Group 11 Extraordinary Meeting on HDTV. The Australian and Canadian broadcast communities saw the development of multiple regional HDTV standards (by early 1989 the Europeans as well as the Japanese had HDTV systems in stages of serious development) and began to search for a compromise that would build on similar elements among the emerging systems. Their solution was to create a “Common Image Format” or CIF. The CIF would break down HDTV systems into component elements, each of which was subject to individual negotiation. The effect of this proposal was to provide the international negotiators with elements on which they could agree and a way to avoid the elements on which they could not agree, the frame rate and number of lines, thus giving time for a consensus to emerge. By March 1989, it was clear that there would be no agreement within the ATSC and or the US National Committee for the CCIR for the Japanese 1125 line system, much less the European 1250/50 (which had never been a serious alternative for the United States). Consequently, the ATSC executive committee decided to withdraw US support during the current study cycle for 1125 as a universal standard, to urge the US negotiators to support

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postponing any final decision on a standard until the 1990-94 study cycle, and to support Common Image Format.\footnote{Communications Daily, May 22, 1989, p.5}

The final challenge to the FCC process, which turned out to be a massive sea change, came with the shift in proponent systems from analog to digital proposals. Although there had been numerous changes in the proponents and in their systems during the more than two years of ACATS existence, it was not until the last day for new submissions that a serious proponent presented a digital proposal.\footnote{Indeed, only a year earlier, James McKinney, then head of the US delegation to the CCIR advanced television meetings, vehemently argued with the author that digital television was simply not on the horizon. In fairness to McKinney, though, most engineers agreed that GI's June 15th proposal was sketchy at best.} On June 15, 1990, General Instruments submitted a proposal based on digital signal capture, transmission and display. The GI proposal was the camel's nose: within six months, all of the remaining proponents except NHK had turned their proposals into digital systems. Developing the testing procedures progressed slowly, with the first not tested until fall, 1991.

The General Instruments submission of a digital proponent system occurred simultaneously with the 1990 CCIR Plenary Meeting in Dusseldorf. The (justifiably) widespread expectation at the 1986 Dubrovnik Plenary was that the 1990 meeting would see international agreement on some kind of HDTV system. Instead, of course, not only had such an agreement not emerged, but in the United States, disarray on the issue was greater than at any time in the past.
Table 8
FCC Proponent Systems as of December 31, 1990

<table>
<thead>
<tr>
<th>Company</th>
<th>System Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBC/Sarnoff/RCA/Thomson</td>
<td>ACTV</td>
<td>Combined analog and digital interlaced systems</td>
</tr>
<tr>
<td>GI/MIT</td>
<td>American TV Alliance</td>
<td>two digital systems, one interlaced and one progressive</td>
</tr>
<tr>
<td>ATT/Zenith</td>
<td>~</td>
<td>digital</td>
</tr>
<tr>
<td>NHK</td>
<td>Muse</td>
<td>analog interlaced</td>
</tr>
</tbody>
</table>

**STATUS OF THE FCC HDTV PROCESS AT END OF 1990**

By the end of 1990, the FCC/ACATS process was well, if uneasily, underway. Given all the controversy and difficulty with developing HDTV, it is easy to miss the solid ground. There was a structure in place for choosing a new system, with the FCC and ACATS and ATTC all working together. For all the very public angst over funding for ATTC, the proponents had in fact found the resources. Within the FCC rule-making mechanism, there was an understood and acceptable procedure for translating industry and Commission decisions into action, and the FCC had, moreover, more scope than any of the other federal bureaucracies involved in HDTV.

Reviewing this phase, five issues stand out:

(1) There was a tight link between the broadcast industry and the FCC, and it will become clear that it grew out of historical FCC regulation of the broadcast industry;

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(2) The definition of HDTV meant an updated form of television for home entertainment;

(3) Competition was a question of the different means of distributing entertainment programs to the home;

(4) The vision of the future was of a broadcast system quite similar to the past, with powerful stations broadcasting television programs to fairly unintelligent home receivers. What was unclear in this vision was how the terrestrial broadcasters would be able to compete with cable and satellite systems;

(5) The "world view" of this debate was also narrow. The discussion was about the US market. The tacit if rued assumption was that equipment came from other countries, particularly Pacific rim, and the global dimension as an issue of concern really existed only in terms of international program exchange, where US exports were strong.

**Digital Convergence Game**

The story of the FCC and broadcasters and proponent systems seems so full and complete that it is tempting to think it explains why we ended up with today's HDTV system, but it does not. It does not, for example, explain why the US National CCIR Committee dropped support of 1125 for Common Image Format in 1989. It does not, because in parallel with the broadcast game there was another, very active game, focused on enhancing
the convergence of digital networked technologies. In this game HDTV was part of a
multi-faceted digital network and a means of pushing the development of imaging
technologies for medical, manufacturing, military and educational uses, improving the US
position in international trade, as well as bringing better TV images to viewers. The players
came from a number of sources. In the public sector, the Defense Research Projects
Agency (DARPA), the National Telecommunications and Information Administration
(NTIA), Congress and, to a smaller extent than previously, the State Department were
important. In the private sector, the computer industry together with researchers in
television engineering, the social sciences, and computer science were key players. The
mechanisms the players used, their strategies and tactics, included legislation,
Congressional hearings, workshops, and the creation of the Internet equivalent of an
“invisible college.”

PUBLIC SECTOR LEADERSHIP

Congressional Leadership

Were war the metaphor for this study, it would be tempting to begin analysis of the digital
convergence game by saying that Edward J. Markey fired the first volley on September 7,
1988, with his opening remarks at his House Telecommunications Subcommittee hearings
on HDTV. Markey took HDTV out of the context of spectrum allocation and scanning
methods and placed it squarely in the context of economic productivity and international
competitiveness. He argued that the future of HDTV in the United States would affect
the state of US consumer electronics as well as advances in microprocessing, photonics and
other related industries; it would also affect tens if not hundreds of thousands of jobs; and it would involve, over the ensuing decades, fifty to two hundred and fifty billion dollars worth of economic activity. ¹³⁵ “HDTV and other advanced television technologies are the gateway to the electronics industry of the future,”¹³⁶ he said, and “…it will be very difficult to defend the core strengths of American economics - in technology, flexibility and cost - without a reentry into the field of consumer electronics.”¹³⁷ Markey also requested “action memos” by January 4, 1989, from industry groups and from the NTIA, setting out strategies for the US domestic industry response to HDTV. Markey held three hearings on HDTV during the fall and winter of 1988-89, including an actual demonstration of HDTV systems on Capitol Hill, which drew more than a thousand spectators. Those testifying represented not only broadcast companies (including satellite and cable operators), but also computer companies and academics with economics and trade expertise.

While Markey, as Chair of the Telecommunications Subcommittee, was a natural focal point in Congress for HDTV activities, he was not alone. George Brown, Chair of the Science, Technology and Competitiveness Subcommittee of the House Science Committee, was also central. In the 1988 Omnibus Trade Act, Brown had succeeded in including provision for creating an Advanced Technology Program (ATP) in the old

¹³⁷ Edward J. Markey, Statement before the Association of Maximum Service Telecasters (MST), September 7, 1988
National Bureau of Standards. The purpose of the ATP, which was not funded in 1988, was to support private sector development of advanced technologies critical to the national interest, most definitely including HDTV. In addition, both Don Ritter (R.-Pa.) and Mel Levine (D.-Ca.) supported the development of US HDTV capabilities. These four spearheaded the creation of a Congressional Caucus on HDTV, which was to coordinate congressional efforts on the subject. Although the caucus never resulted in specific legislation, it supported conceptualizing HDTV as an economic and political issue. In addition, in the early winter of 1989, there was a spate of legislation all aimed at supporting HDTV as a means to increase US international competitiveness. Sherwood Boehlert (R.-NY), Norman Mineta (D.-Cal), Douglas Walgren (D.-Pa) and Don Ritter (R.-Pa.) as well as George Brown, all proposed legislation that supported HDTV development through funding R&D activities, creating consortia, easing antitrust restrictions, or providing guaranteed loans.

**DARPA’s Role**

In the 1987-1990 period, DARPA had a particularly important role. It argued that HDTV was important to the country’s technological and economic vitality, and in December 1988 it published a Broad Agency Announcement (BAA) soliciting proposals for high definition display technologies. The BAA rested on the assumption that “(c)omputer technology and video/audio technology are converging” and that home television, which had traditionally not been part of the Defense Department’s scope of interest, could have dual...

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138 Renamed the National Institute for Standards and Technology
139 "Recorder Project Hinted; Pentagon Offers $30 Million Grants For HDTV," Communications Daily, January 3, 1989, Vol. 9, No. 001, p. 1

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civilian and military uses. DARPA wanted to “maintain compatibility” with future HDTV standards and enable companies to “... realize economies of scale through high-volume manufacturing.” The only way to achieve those economies of scale would be for the technologies to become part of the market for consumer electronics and other civilian applications as well as to fill military needs.

The BAA called for proposals for digital signal processing and display technologies, with awards totaling $30 million in grants. There was a surprisingly large number of submissions, eighty-seven in all, some from large, well-known companies, and some from small ones. The proposals covered display processors and receivers, display technology, and manufacturing tools and technology. In fact, at a House Telecommunications Subcommittee hearing in March 1989, Craig Fields, DARPA Deputy Director, pointed with pride to the number of companies that had never before been involved with Defense Department grants, saying that the BAA had "...mobilized a new talent pool..." of US companies. There was considerable discussion in public about whether or not the grantees all had to be “American” and of what that actually meant. On June 15th DARPA announced the recipients, all of whom were US corporations. They were

- NewCo (San Jose, California)
- Raychem (Menlo Park, California)
- Texas Instruments (Dallas, Texas)
- Projectavision, (New York)
- Photonics Technology (Northwood, Oregon)

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140 "Recorder Project Hinted; Pentagon Offers $30 Million Grants for HDTV," Communications Daily, January 3, 1989, p. 1
141 "DARPA Narrows HDTV Projects to 49," Communications Daily, March 23, 1989
The effect of these grants was three-fold: they not only supported research in this specific field, they gave DARPA a lead role in the debate over industry-government arrangements for developing important technologies. They also legitimized the alternative conceptualization of HDTV as more than “NTSC with a new look” and instead placed it firmly within the larger, increasingly digital world, a world of converging video, audio and computer technologies. This move also placed DARPA’s activities in opposition to the FCC process, which was at that point still firmly focused on analog systems, with no connection to computer technologies. No longer did the FCC and the ACATS proponents provide the only approach to high resolution systems.

DARPA’s public role in developing these new systems was out of character for the agency. Founded in 1958 in response to the Soviet’s victory in the race to launch a satellite into space, DARPA’s traditional mandate has been to fund cutting edge basic and applied research, which, though highly risky, has the potential for high military return, although there had frequently been civilian spin-offs as well. In addition to major advances in computer technologies, a very partial list of technologies that DARPA has helped shape include the Saturn V engines, the F-117 stealth fighter, unmanned aerial vehicles (UAVs), and the Internet, which of course was originally ARPANET.142 The agency operated largely out of public scrutiny, and, to the extent that anyone can see where basic research will lead,

its focus was on military applications. During the Bush administration, however, that focus began to shift to include a greater emphasis on "dual-use" technologies, until the Clinton administration dropped the "D" and renamed the agency ARPA in 1993. The 1989 $30 million HDTV grants were among the first indications of this broadening.

In addition, Craig Fields, who was promoted to the post of Director of DARPA in May 1989, testified at a House Armed Services Investigations and R&D Subcommittees hearing that DARPA's goal was to

... prod resurgence of U.S. electronics industry and reduce potential American military dependence on foreign supply of HDTV systems and components and that "(i)f we funded Sony with no restrictions . . . it probably would hurt [American electronics] rather than help."

Clearly, Fields was placing this agency in the forefront of the debate over the government's role in bolstering American high technology industries.

The traditional leadership at DARPA was as circumspect as its programs were risky, and for good reason. American political culture does not easily tolerate vast expenditures of money on ventures that fail, and a low profile was necessary for DARPA to continue in its normal activities. Under Craig Fields' leadership, however, the profile rose, and as it did,

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143 The change only lasted three years. In 1996 the Republican Congress re-inserted the "D" in the 1996 Defense Authorization Act, an action entirely consonant with the retreat from direct government leadership in the civilian economy.
144 The greatest indication was DARPA's support of Sematech, a consortium of semiconductor manufacturers which DARPA funded at $100 million/year in FY 1988 and 1989. Evelyn Richards, "Study Sees Sematech as Success So Far; Report Urges Caution On Consortium Idea," The Washington Post, May 9, 1989, p. B1
so did his vulnerabilities. When DARPA published the BAA at the end of 1988, a new administration was about to take office, inheriting from Reagan a mammoth national debt, an economy that seemed to be losing technological and possibly economic leadership to Japan. DARPA’s funding was almost $900 million in 1988 and rose to $1.3 billion in fiscal year 1989 (FY 1989), only 3% of DOD’s R&D budget, but still a noteworthy amount of money. Fields also spent a great deal of time on Capitol Hill arguing in public, and presumably also in private, for federal support to develop critical technologies.

In the grand tradition of high-risk, high return ventures, Fields created a new kind of financial arrangement with a private company, Gazzelle Microcircuits. DARPA invested $4 million in Gazzelle, in return for a partnership position that would, were Gazzelle successful, pay a return to the agency. DARPA had in effect become a venture capitalist. Fields had been under intense criticism for his nationalist arguments and his proactive approach to government’s role in technology development. DARPA was attracting attention in any event because of the size of the budget. Now its Director had generated a fair amount of publicity with a new form of government support for the private sector. The combination was clearly too much for the administration. In April 1990, Fields was dismissed as DARPA Director and reassigned to a more prosaic job overseeing the national military labs.


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The Commerce Department became involved in HDTV, both with fanfare and out of the public eye. Within the Department’s National Bureau of Standards, it established and funded the new Advanced Technology Program (ATP). The ATP was to provide some government funding to support public-private sector consortia or other cooperative ventures developing high-risk, high-return technologies that would improve US international economic competitiveness. The 1989 Brown bill authorized funding the ATP at $100 million a year for five years but was opposed by the administration, which saw support at that level as effectively creating a civilian DAPRA. Eventually, the program was funded at just under $10 million in the FY 1990 budget, however, and made eleven awards in a broad range of emerging technologies. In the early 1990s ATP also made awards to digital imaging technologies. The program was generally considered quite successful, and over the next ten years, it made 581 awards totaling $1.8 billion, matching private contributions evenly.

Another Commerce agency involved with HDTV was the National Telecommunications and Information Administration (NTIA). Because of its location within Commerce, it was open to international trade considerations. Alfred Sikes, a former radio broadcaster and current NTIA Administrator, was appalled at the absence of US companies at the 1986

148 Conversation with Robert Sienkwich, Senior Technical Advisor to the Director, ATP, NIST, April 10, 2002
National Association of Broadcasters Conference.  Sikes and Paul Misener, one of his deputies, supported an HDTV system that would enhance the development of US technologies; they were also willing to oppose the domestic adoption of 1125. Sikes also appointed an Advisory Committee on Advanced Television in November 1988. Its members were

Arthur Barron (Gulf & Western)
James Dowdle (Tribune Broadcasting)
Robert Galvin (Motorola)
William Miller (SRI International)
Jerry Perlman (Zenith)
John Roach (Tandy)
William Schrieber (MIT)
Thomas Woodward (McKinsey)
plus ex-officio representatives
Richard Wiley (ACATS)
Erich Bloch (NSF)
William Graham (White House OSTP)

The Committee met twice during November and December and again in January. Its report reiterated the concern for the “small and dwindling” US base in consumer electronics, noted the linkage between advanced television and semiconductors, found that the United States lagged Europe and Japan in HDTV research, and asserted that “...cooperative efforts between private industry and the government to ensure effective U.S. participation in ATV” were necessary. The Committee was unable, though, to recommend concrete steps, and it eventually just faded from sight.

151 Communications Daily, November 17, 1988
152 Report of the Advisory Committee on Advanced Television to the Secretary of Commerce, January 1989, p. 5
NTIA under Sikes did not give up on HDTV, though. At the House Science Committee HDTV hearings in March 1989, Sikes emphasized the importance of HDTV for the Bush administration, a “top priority,” he asserted. In addition, NTIA requested an additional $250,000 in the FY 1990 budget for additional staff in HDTV policy development.\textsuperscript{153}

Not all of the Commerce Department activity was so quiet, however. Most notable was the position of Robert Mosbacher on HDTV. In one of his first public statements as President George H.W. Bush's new Secretary of Commerce, Mosbacher focused at his confirmation hearings on HDTV as a central trade and industrial development issue. “HDTV is not just another stage in TV,. . . not just another consumer good, but a whole other generation of electronics.”\textsuperscript{154}

In his January 1989 Senate Commerce Committee confirmation hearings, Mosbacher went on to frame HDTV as an critical arena in which the United States had fallen far behind Europe and Japan. The frame was common during this period:

> The Japanese and perhaps the Europeans are moving well ahead of us in a very organized, cohesive way with the private sector and the public sector working together... While it's very, very late in the game, it's not too late. .... If we move quickly and together in both the legislative and executive branch, we can get back in the game.”\textsuperscript{155}

\textsuperscript{153} Doug Halonen, “Congress unbudged on HDTV policy,” *Electronic Media*, March 27, 1989, p.8
\textsuperscript{154} “Mosbacher Sees need for Govt.-Industry Cooperation on HDTV,” *Communications Daily*, January 25, 1989
\textsuperscript{155} Melinda Gipson, “Commerce nominee: HDTV a top priority,” *Electronic Media*, January 30, 1989, p. 8
With this encouragement, AT&T and IBM plus fifteen companies agreed at the National Association of Broadcasters conference to fund a study of the possibilities for a government-supported consortium for HDTV design and manufacture, and they agreed that the Boston Consulting Group would put the study together.

It was unclear what specific form the Commerce support would take, but the options certainly included government funding for a research consortium such as SEMATECH. Indeed, the question as the new administration came into office was not so much whether there would be a widespread US HDTV initiative, but rather what form it would take and what the funding and mix of public and private responsibilities would be. At one point, one of Mosbacher's top aides, Assistant Secretary for Technology Bruce Merrifield, admitted that the government would have to provide "seed money" because it was highly unlikely that any cooperative venture would be entirely privately funded. Discussion of the same point was also occurring in DARPA, on the Hill, and in the private sector.

Sematech (Semiconductor Manufacturing TECHNOlogies) was a partnership among thirteen private companies and the federal government. President Reagan signed the enabling legislation in 1986 that provided antitrust protection and some federal funding to the new organization as a means of revitalizing the US semiconductor industry. Relationships among the partners were not always smooth, but SEMATECH exists to this day. In the mid-1990s it became an international consortium. See www.sematech.org.

“Debate on Govt's HDTV Role Accelerating under Mosbacher,” Communications Daily, January 30, 1989
PRIVATE SECTOR LEADERSHIP

During this period there were many private sector initiatives, including those led by the American Electronics Association (AEA), IBM, the IEEE, and MIT. The largest involved the American Electronics Association, a trade group representing primarily US companies. Under the leadership of AEA Vice-President Patricia Hill Hubbard, a group of computer companies including DEC, Hewlett-Packard, IBM and Apple, created a Task Force on HDTV in February 1989, and they contracted the Boston Consulting Group to design a business plan for HDTV development. The report was due in the late spring, and the widespread assumption was that it would recommend a public-private consortium for advanced imaging.

IEEE Workshops

At the same time, academics and industry leaders were also searching for an organizational structure that would build on US strengths in research and development and overcome difficulties in bringing new ideas effectively to market. The National Research Council and the Institute of Electrical and Electronic Engineers-USA Committee on Competitiveness and Information Policy (IEEE-USA) hosted three workshops in 1989 to further the objectives in its National Initiative for the Electronics Industries. The participants came from the computer, entertainment, and related industries, as well as from government and academia. The first workshop took place in late January in
Washington and was an exploration of the economic and technological implications of HDTV.

The second, February 13-14, was a review of the history of US consortia such as Sematech and RCA and the current state of the US consumer electronics and related industries. The discussion focused on a “food chain” that showed how Japanese companies, with government support, had been able to capitalize on US ideas in critical components. The participants in particular explored establishing a new consortium, a Technology Corporation of America, or TCA.

The third workshop was on DRAMS; it took place in Washington the following June and focused on the possibility of re-developing a US design and manufacturing capability in DRAMS as a means of revitalizing the country’s electronics base. The featured speaker was Clyde Prestowitz, a former Reagan administration official, who argued forcefully and often that the United States had lost leadership to Japan in electronics technologies. The reason for this loss, he argued, was that Japan had invested in long-term planning and industry-government collaboration, whereas in the United States there was poor government coordination and a lack of industry-government cooperation. This argument was a powerful rationale for the development of a consortium to manufacture DRAMS, the basis of the proposal Sanford Kane, an IBM Vice President, presented at the workshop. There

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was considerable support at the meeting for this venture as a plausible way the US economics industry could get back on its feet.

In the case of all three IEEE meetings, the participants saw HDTV as an enabling mechanism. In the case of TCA, HDTV would provide the rationale for getting back into consumer electronics, and by using interoperable standards, HDTV could spur the development of other new parts of the industry. In the case of DRAMS, HDTV would support US manufacturing ventures by creating a large and guaranteed domestic market for the chips.

**The Ad Hoc Meetings**

Another mechanism that kept HDTV alive was a series of off-the-record meetings called the “Ad Hocs.” They usually took place in Washington, so that Congressional, administration, industry and academic representatives could share information about developments in all aspects of high resolution imaging.\(^{159}\) The Ad Hocs grew out of a meeting that actually took place at the MIT Media Laboratory on November 22, 1988. The participants included

George Brown, Chair, House Subcommittee on Science & Technology
Jerome Weisner, President Emeritus of MIT
Craig Fields, then the Deputy Director of DARPA
Mel Levine, Co-Chair of the House HDTV Task Force
Ed Horowitz, Senior Vice President, HBO
Vint Cerf and Robert Kahn, developers of the ARPAnet and founders of the Corporation for National Resource Initiatives
Nicholas Negroponte, Director of the MIT Media Lab

\(^{159}\) The Ad Hocs ran until the mid-1990s, and in later years widened to include discussions of policy implications of a broad range of new communications and information technologies.
as well as MIT faculty and staff. The agenda focused on four issues:

- "state-of-the-art technological opportunities and R&D problems for implementation..." of a wide range of video technologies,
- non-technical issues of structural and industrial barriers, interest groups, the role of standards, and international trade issues,
- the possible creation of a pilot project for advanced video and broadband technologies, and
- funding and financial issues.

There was clear agreement on the need to put HDTV into this broader framework, and the participants wanted to continue searching for ways to give life to this new kind of HDTV. They agreed to meet again in a month. At that meeting, which took place in the Library of Congress, discussion again centered around ways to support new, more flexible video technologies. One of the ideas that came out of this meeting led to holding the IEEE workshops described in the previous section.

Since the Ad Hocs were truly off-the-record, it is impossible to trace the development of ideas and policies, but it is noteworthy that between 1989 and 1990, there were fifteen Ad Hoc meetings, all at the Library of Congress and all under Congressional sponsorship, and that they continued, every two or three months, until 1993. Congressional staffers and usually Members of Congress, representatives of the Administration and of computer, telecom, other industries (often broadcast) participated along with the MIT academics who ran the meetings. The Ad Hocs were mechanisms for sharing information widely, and they provided opportunities for people who would rarely have met to hear and question each
other. They also kept the energy level high for those whose conceptualization of HDTV was broader than simple television.

This insistence that HDTV was about “more than pretty pictures” was one of the two motivating forces behind this alternative perspective, which placed HDTV squarely in an economic and strategic context that was quite unlike the television industry’s tight focus on free, over-the-air broadcasting. For non-broadcasters, the importance of HDTV lay in its relation to economic needs and opportunities. Even the technical arguments about system design were in support of these larger concerns. These arguments were based on a coherent view of the direction of technological change, the reasons for the current state of the US information industries, the nature of international economic competition, and an appropriate set of industry-government relations.

**Technological change**

The heart of the arguments was that HDTV was about more than television. This argument saw society as entering an “...Information Age in which computer power to process information becomes the engine of economic growth.” In this view, HDTV was a key element in a system of related, integrated imaging technologies that would to be part of an information infrastructure, the backbone of the “Information Age” in much the same way that canals and railroads were the backbone of the “Industrial Age.” If such an assessment was accurate, then it was critical that the HDTV standard be related to the

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160 W. Russell Neuman, Testimony before the Subcommittee on Science, Research and Technology, Committee on Science, Space and Technology, US House of Representatives, Hearings on New Directions in Video Technology June 23, 1988
computer technologies that were the heart of the new infrastructure. Andrew Lippman, Associate Director of the Media Laboratory, stated this view starkly in a submission to the Markey Committee in 1989. His submission began

**Forget television sets.** In three years, there won't be any. Instead, there will be computers with high-quality display screens. Inside these computers, there will be digital instructions allowing them to receive ABC, NBC, HBO, BBC, and anything we can dream up.

HDTV is the tip of a digital iceberg and the start of the introduction of computing in large scale into our homes and communicative lives. This is a technological revolution which is fortuitous for Americans, because computers are something that we know best. Yet, we have only one window of opportunity – if the United States misses this boat, we miss the next half century.  

William F. Schreiber, the Director of the MIT Advanced Television Research Program fleshed out this argument in a paper he presented at the 1989 National Association of Broadcasters arguing for a "Friendly Family of Transmission Standards for All Media and All Frame Rates." This modular approach applied the model of computer architecture to television technology. Other work from the Media Lab further refined this perspective and provided the basis for the work on "headers" and "descriptors" that SMPTE published under David Staelin's and Gary Demos's leadership, as well as the development of interoperability, scalability, and extensibility discussed in the next section.

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Economic arguments

Economic arguments among the broadcasters focused on the importance of the survival of free, over-the-air television and in particular on the vulnerability of the broadcasters to competing delivery systems such as satellite TV and cable. For the non-broadcasters, the economic arguments focused on the almost moribund state of the US consumer electronic industry and the economic and national security implications of that condition. This group saw HDTV as a way out of the morass, because the new system would use many chips and would therefore be a driver for the major re-invigoration of the US consumer electronics industry. For example, in his August 1988 letter to the head of the American Electronics Association, Russell Neuman said “There is strong agreement that HDTV and related chip and display technologies ... represent a critical technical growth area with particular strategic significance for the economy, the trade balance and national security.”  

This linkage of display technologies and strategic significance came up again and again in discussions and conferences, including in the “food chain” argument that David Staelin and Robert Cohen used in the IEEE/NRC workshop on the Technology Corporation of American in February 1989. The argument assumed that computer chips were a basic component of consumer electronics and that consumer electronics were a major

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164 W. Russell Neuman, letter to Richard Iverson, President, American Electronics Association, August 12, 1988
component in the emerging information infrastructure; therefore, off-shore (Japanese) control of chip and consumer electronics design and manufacture placed the United States in a highly vulnerable economic and military position. Moreover, as Russell Neuman said, traditional American reliance on

“... private industrial entrepreneurship” (won’t work, because) “... the communications industries are themselves experiencing revolutionary change” (and are consequently trying to protect) “... their turf and market share.... The pressure to protect return on investment in the next quarter is a very strong impediment to the type of long-term planning and research vision that this technological transition requires.”\textsuperscript{166}

Vint Cerf in a March 1989 IEEE Newsletter said

The most serious effect on the U.S. electronics industry results from the fact that Japanese industry has a head start in the production design of MUSE equipment. Against a two-year learning curve advantage, it seems unlikely that the U.S. would ever manage to compete in the world market for this equipment. Moreover, there is only one television manufacturer left in the U.S.: Zenith and the company has generally let it be known that, without external assistance, it is unlikely to mount a successful challenge because of the enormous costs and risks associated with starting a completely new television production line.

More critically, HDTV requires a substantial amount of digital and analog processing capability. The country which captures the HDTV manufacturing business will have a stable, long-term base for capitalizing production facilities for integrated circuits in the enormous quantities needed to satisfy the demand for HDTV sets. The U.S. share of the world semiconductor market could be dramatically reduced if it is unable to participate in the supply of HDTV ICs in the volumes anticipated.\textsuperscript{167}

The perception of the threat from international economic competition was pervasive.

From the current vantage point, with Japan in a long troubled economy, it is hard to

\textsuperscript{166} W. Russell Neuman, Testimony before the Subcommittee on Science, Research and Technology, Committee on Science, Space and Technology, US House of Representatives, Hearings on New Directions in Video Technology June 23, 1988


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remember that in 1989, Japan was apparently unstoppable. Its economy was continuously expanding; it had taken over the US consumer electronics industry; it had taken over the design and production of DRAM chips; it was apparently on the verge of taking over US leadership in supercomputers. The source of this creativity was supposed to be the “MITI miracle,” a set of institutional and financial relationships between MITI, the Japanese Ministry of Trade and Industry, and private corporations, in which the government reduced risk through techniques such as lowered capital costs and antitrust protection for early stages of product development. While this view saw the Japanese as the most powerful competitor, the Europeans also had formed research and development consortia that posed a competitive threat.

These industry-government arrangements made US firms reluctant to engage in HDTV research because, unlike the Japanese and Europeans, American companies have to act alone, on a company-by-company basis. Moreover, falling behind the Japanese and Europeans in HDTV had defense ramifications, because the chips used in HDTV were similar to the ones used for defense imaging purposes in aviation and display technologies. In addition to the direct cost of losing US control over a critical element of our national security to other countries, there was an economic opportunity cost as well. HDTV seemed like a fertile dual-use technology: military needs would create markets for civilian production of components such as DRAMS, and the development of significant consumer demand for HDTV would drive down component prices.
It seemed as though the only platform for a strong US competitive response would be an industry-led cooperative arrangement with government backing. Indeed, such a response was critical. Russell Neuman said that “Without some coordinated response in this area, an economic disaster is almost certain.” However, that consensus operated within severe constraints. Politically, “industrial policy” was an anathema; American belief was that it worked against innovation, curtailed liberty, and was inefficacious, because the government was supposed to be unable to “pick winners and losers.” The government was not supposed to have that kind of expertise, and such choices were much better left to the market. However, it was politically acceptable to have government support in the form of R&D subsidies, tax credits, antitrust protection and other such regulatory devices. Indeed, such help was critical. In his testimony to the Markey committee, Neuman said

Our competitors overseas have come to recognize that the chips which are the basis of telephone switches and video displays are the nuts and bolts of the information age. Future television designs will use special-purpose signal processing chips. Although consumer television may generate the largest unit demand for these microprocessors, the same chips will serve as critical components in industrial and military applications for image processing. If because of a blind faith in some abstraction called the marketplace we allow total off-shore domination of the design and manufacture of these critical electronic components, we may put both our economy and our capacity for military security in jeopardy.

The search for the best arrangement led to Congressional hearings, especially under the leadership of George Brown (D-Calif), to the IEEE-USA workshops on a Technology Corporation of American and on DRAMS, to Department of Commerce efforts including

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the Advanced Technology Program, as well as to the AEA attempt at an HDTV consortium.

In sum, HDTV was seen as part of a critical area of technological growth, imaging systems. The argument was that this system was part of the infrastructure of the information age and an engine of economic development in much the same way that canals and railroads fueled 19th century industrial development. Moreover, this technology promised important dual use capabilities, since advances in military applications would lead to improvements in civilian consumer electronics and visa versa. The heart of that infrastructure was the microelectronics, which were critical for military as well as economic security. It was therefore not acceptable that this country would have to depend on other countries for critical microelectronics. To overcome the reliance on foreign manufacture, there needed to be a US industry-led cooperative initiative with government financing and regulatory backing.

**International Developments**

In January 1989, the Soviet Union announced that it would conduct tests of the NHK 1125 and European 1250 systems the following March. The announcement of these plans, coinciding with Mosbacher’s public interest in HDTV and with the intensifying debate over declining US competitiveness, gave opponents of 1125 material to strengthen their position: these opponents argued that the tests posed a threat to national security.

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171 *Communications Daily, March 21, 1989, p. 6*
since the organizers had failed to obtain clearance from COCOM, the body responsible for clearing high technology transfers to Eastern Europe and the Soviet Union. This argument attracted Congressional supporters, and Dingell (D.-Mich; Chair, House Commerce Committee) and Markey wrote a public letter to the Secretary of State questioning the Department's activities in support of the standard. The letter arrived immediately after word leaked out that the White House had requested Mosbacher and Commerce to re-evaluate all HDTV activities, including support for 1125. These incidents coincided with House Telecommunications hearings on HDTV at which the lack of US consensus on an HDTV standard was unmistakably clear. The weight of the US opposition, together with the existence of a potential compromise standard in the Australian-Canadian proposal for a "Common Image Format," pressured the State Department and ATSC into withdrawing formal support for 1125 in the CCIR.

**Some Endings, Some Beginnings**

The energy and optimism of the digital convergence game players in 1988 and early 1989 began, by mid-summer, to dwindle. The effect of declining US support for 1125 gave new urgency to efforts to restructure public-private sector efforts to develop technologies critical to the country's economic security and defense. However, beginning in May 1989, stumbling blocks in the approach began to appear. The first was the continuing lack of an HDTV plan from the Commerce Department. Markey had requested the plan during the January hearings, but Commerce officials kept postponing its release. Behind the scenes there was a heated debate between Mosbacher, together with supporters of active
government intervention in technology development, on one side and Richard Darman, head of the Office of Management and Budget, and Michael Boskin, head of the Council of Economic Advisors on the other. Darman and Boskin were both champions of restricting government's role in technology development and, in larger terms, were trying to get a handle on the federal deficit. HDTV as the focus of concerted Department action was becoming most questionable.

The second stumbling block to developing a public-private HDTV partnership also concerned Mosbacher. The American Electronics Association released its HDTV proposals in mid-May. The plan covered ten years and called for easing antitrust restrictions, formation of a public-private sector partnership, and federal subsidies, which would be repaid, totaling $1.36 billion over the life of the program. Mosbacher, clearly having lost in the battle with Darman and Boskin, publicly characterized the $1.36 billion subsidy as a handout from "Uncle Sugar," thereby coalescing all the opposition to federal activity around one politically appealing if inaccurate point (the figure was a loan with a repayment plan in the AEA proposal). The press picked up on the "hand-out" issue and never let go, despite AEA officials' efforts to clarify the plan.

Third, shortly after release of the AEA proposal, IBM backed the creation of US Memories, the consortium that would produce domestic DRAMS. US Memories, headed by Sanford Kane, a former IBM Vice-President, was most interesting. It was to be an entirely private sector consortium linking DRAM manufacturers and users; it needed only antitrust
protection from the US government. The rationale for the consortium was the creation of an assured supply of DRAMS for US computer manufacturers in order to support the continued existence of a US R&D and manufacturing base in this vital area and to counter the foreign, mostly Japanese, presence in the DRAM market. Kane’s job between June and December 1989 had been to obtain a minimum of eight firm pledges from each of the consortium members in order to create a business plan and receive an antitrust waiver. As with the AEA proposal, US Memories also failed. This time, however, the lack of support came from the memory chip users, who began to gain easier access to chips and were unwilling to invest heavily in what they saw as a risky venture. In January 1990, Kane formally ceased working on the project.  

The forces trying to organize US private and public sector interests high technology development received a third blow in mid-summer with the “Webre Report.” Philip Webre was an analyst at the Congressional Budget Office and wrote a report on HDTV, analyzing the strengths and weaknesses of the major studies fueling the public HDTV debate. His charge was to assess those works critically.

Webre’s report, and the Glen committee hearing for which it was written, broke from the prevailing Congressional attitude towards HDTV. In all of the previous hearings and

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reports, HDTV had been seen as a positive development, and the fundamental question had always been how best to capture the greatest benefit from the technology: was 1125 or some other scanning system preferable? should there be consortia or some other form of development? And so forth. With Webre's work, this approach changed. He found the earlier reports overly optimistic, the economic impacts of HDTV exaggerated and questionable, and the rationale for direct government support for HDTV development shaky at best. Although the witnesses often disagreed with Webre's conclusions, his argument had a tight enough base and was well enough written to be compelling to many in Congress, the White House, and the press who were skeptical of large scale federal intervention in HDTV.

During the second half of 1989, HDTV initiatives were in retreat. Mosbacher was still silent on a Commerce initiative in the area, and all observers understood the silence for the defeat it was. There were reports of a White House meeting in the spring of 1989 between Mosbacher and Wayne Berman, Counselor to the Secretary, and Darman, Boskin, Sununu and other top aids, at which Mosbacher and Berman were told to back off HDTV in favor of broader support for technology development. The Defense Manufacturing Board (DMB) was folded into its parent Defense Science Board, and the DMB report stressing the importance of High Resolution Systems to US security needs was

suppressed. Most important, DARPA support for HDTV was challenged both within the Defense Department and the White House and in Congress. Deputy Defense Secretary Donald Attwood tried to kill the program, and Senator Inouye's committee effectively held up new appropriations for FY1990 and FY1991.

The final demise of any possibility of concerted industry-government action on HDTV, came in April 1990, with the dismissal of Craig Fields as director of DARPA. The proximate cause was that under Fields' leadership, DARPA had taken what was essentially a partnership position for $4 million with Gazzelle Microcircuits; that is, DARPA would be able to get a return on its investment. Fields had been under intense criticism for his nationalist arguments and his proactive approach to government's role in technology development. Now he had generated a fair amount of publicity with a new form of government support for the private sector. The combination was clearly too much for the administration, and he was reassigned to a dead-end job.

April saw more than Field's dismissal, however. The spring of 1990 marked a turning point in the development of both a US and an international HDTV standard. The State Department finally agreed to withdraw US support in the CCIR for 1125; the Department of Commerce Advanced Technology Program was funded and started its first grant process.

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176 Bob Davis, Ibid
and the Committee on High Resolution Systems (COHRS) came into existence, thus bringing computer company interests explicitly into the HDTV decision-making process.178

Internationally, the CCIR at the 1990 Dusseldorf Plenary meeting postponed for yet another four years a decision on the HDTV standard, though this time there was no expectation that the 1994 plenary would see another discussion of a narrow, home entertainment standard. Instead, it seemed clear that the negotiations would focus on home entertainment as part of a linked series of video standards, some coming out of the ITU and some out of the other standardization bodies, such as the ISO (the International Organization for Standardization).

In the United States, a similar change seemed to have occurred. Although the question of appropriate government involvement in the process was contentious, the terms of the HDTV debate had widened sufficiently so that computer and other industries thought they could have influence on the standardization process. The DARPA HDTV grants were framed in the vocabulary of computer science: digital signal processing and digital display technologies. William Schreiber's proposal for an open architecture receiver, built on the same bus technology as personal computers, made the link between HDTV and computers explicit, thereby affording an additional area for development. Last, computer companies

178 Although the circumstances surrounding the birth of COHRS happened in 1990, its activities fall primarily into the next period, and a more complete discussion of COHRS is therefore part of the following chapter.
had begun testifying before Congress and responding to notices of inquiry concerning HDTV.

At the same time, there was a sea change within the FCC process. General Instrument signaled the beginning of digital HDTV with its June submission to the FCC. Other work on digital systems was occurring elsewhere. The creation of COHRS and of a CCIR Task Group on Harmonization and the move towards digital HDTV systems within ACATS were also part of the process of widening the terms of the HDTV debate. Last, a series of off-the-record meetings under the auspices of the IEEE - USA for computer and broadcast industry leaders had begun to explore bridges between the two worlds.

Thus, as the 1990s began, it appeared that the broadcasters’ and consumer electronic manufacturers’ hold on HDTV standardization was loosening and that the new technology could well be an integral part of the emerging digital information system. Appearances, however, would prove deceiving.

**HDTV AND THE ECOLOGY OF GAMES 1987-1990**

Long’s model directs us to see the competition both within and between games. During this period, all the players who would ultimately determine the HDTV standard made their appearance— in fact so many, with so many purposes, that the whole process seemed bewildering at first. The ecology of games, however, untangles the threads. It sorts out the
action in the “broadcast game” and “digital convergence game” and the competition between and within them. It shows that the two games were quite separate and had distinctly different goals and players, using different strategies, following different rules, and competing in different arenas. While the ostensible objective of the games was to develop a new HDTV system, in fact behind that goal were a variety of other goals.

The major finding that this model shows is that there was a crucial difference between the two games in the arenas and focus of the activities. The broadcast game took place in an established arena, and the action was precisely what was supposed to happen there. The FCC was the legitimate forum for agreeing on broadcast standards, and the players’ actions were concrete, focused, and very operational. They were to establish an FCC Inquiry and develop the rules for it, to establish an Advisory Committee and make it operational, to develop HDTV systems, and to set up a testing center to test the proposed systems. There was in all of these actions, purpose, definition, focus.

In contrast, for the digital convergence game, the conditions were far more complex because there was no established arena. The game took place in Congress, in the halls of the Commerce and Defense Departments, in the US National Committee for the CCIR, in IEEE workshops and in the Ad Hoc meetings. Without the kind of major political backing from Congress or the administration that would result in public-private partnerships or funding of the development of advanced video technologies, all the players
in this arena could do was insert their perspective into a public debate and, occasionally, thwart initiatives.

**Players, Objectives and Arenas**

*The Broadcast Game*

There were two major goals in this game during this period. The broadcasters wanted to make certain that the FCC would not reallocate any of their spectrum, whether or not they were using it. To that end, the petitioned the Commission to open an Inquiry in to Advanced Television Services. The second goal was then to operationalize that Inquiry and the activities associated with it – a time of putting frameworks in place.

The players in the broadcast game were the television broadcasters, the FCC, the proponent system developers, ACATS, and, on the sidelines during this time, the television manufacturers. The broadcasters wanted to preserve their spectrum but were concerned about the costs of switching to the new system, which were generally accepted to run around one or two million dollars per station. Sony and the other set manufacturers were, on the other hand, interested in replacing the existing but saturated color television market.

ACATS was the point at which the private and public sector formally met. The FCC had appointed the members of the Committee, but its voting members were all private sector. ACATS was responsible for overseeing the audience and system testing, for accepting and analyzing the test reports from ATTC and CableLabs, and for submitting periodic formal
reports to the Commission. The ACATS chair, Richard Wiley, was a strong leader and unmistakably committed to running an effective selection process that avoided the setbacks of early color or AM stereo standardization. ATTC and CableLabs personnel had close ties with early 1125 supporters, but both labs tested separate systems fairly.

The Digital Convergence Game

After the defeat of 1125 at the 1986 Dubrovnik CCIR meeting, several conditions coalesced to shape a new debate about HDTV. One was a concern that 1125 proponents would find some way to make it the US standard. Another concern focused on Japan: the US had a large trade imbalance with it; Japanese supercomputing capabilities seemed to be far outstripping American capabilities; consumer electronics manufacturing had moved to Japan as well as other mostly Asian countries; and, with the lone exception of Zenith, the US did not even manufacture television sets, symbol of a quintessential American industry. There was a widespread belief that Japanese success lay in its close arrangement between the government and the seven industrial conglomerates or modern-day zaibatsu. To deal with these conditions, the digital convergence team goals during this period were to stop acceptance of 1125, to facilitate the development of HDTV as part of a flexible advanced video system with multiple capabilities, and to use HDTV as a means of strengthening US economic and technological leadership. Those goals may have been important, but none were concrete or easy to operationalized except by thwarting acceptance of 1125.

As with the goals, the players in this game were informally and loosely organized. There were more public sector actors than in the broadcast game, and their role more essential.
Edward Markey’s September 1988 House Telecommunications Subcommittee hearing started a series of hearings and bills that had the effect of making HDTV a public issue worth watching and characterized HDTV as a means to jobs and to the re-entry of the US into consumer electronics manufacturing. Other Members of Congress, notably Reps. Brown, Ritter, and Levine, also saw HDTV as a means to enhance US competitiveness, and they proposed legislation, spoke at workshops and Ad Hoc meetings, and always sent senior level staff, usually from the relevant committees, to the meetings and workshops.

Support for this game from the Administration was more problematic. DARPA funded advanced video technologies, but only as long as support took the form of the traditional (if high risk) grants, speeches and testimony. Stepping onto new ground, was not acceptable, as when Craig Fields became proactive in his support for Gazzelle Microcircuits and was removed. The lack of administration support for new initiatives was particularly clear with the Department of Commerce. Secretary Mosbacher was plainly interested initially in supporting HDTV, but he pulled back abruptly when White House policy changed. However, NTIA Director Alfred Sikes was an active proponent of HDTV as a source of jobs and as a catalyst for a range of commercial, military, medical and educational applications. Other players were working level officials from DARPA, NASA, and NTIA, who attended the private sector meetings and workshops and provided expertise, advice and encouragement.
The private sector players on this team were a combination of representatives of computer companies (especially Apple), computer scientists, engineers and political scientists (largely from MIT), plus groups including the IEEE, the National Research Council, and National Academy of Engineering. Their goal was to enhance US economic competitiveness and technological strength through public-private funding of consortia or other cooperative arrangements, to promote development of flexible digital video systems, and to make certain the US did not adopt 1125 as the new HDTV standard.

The driving force in this game was the overwhelming sense of being on the cusp of a “revolution.” Even as early as 1987, computing power had moved from mainframes to students’ desktops. Moreover, the movement toward increasingly digital technologies seemed inexorable. Among players in this game, there was a clear sense that history was on their side.

All these players absolutely believed that HDTV should be part of the emerging digital information systems and networks. They believed that the US economy would be stronger in that case. They believed that US consumers would be able to use medical, educational, as well as entertainment systems that would be cheaper and technically superior if the components were designed to work together. And everyone knew that analog HDTV systems could not be part of that network.
Rules and Tools

The Broadcast Game

The FCC process was governed by strict rules in terms of choosing among the proponent systems, but the Commission as a whole had enormous leeway in the way it framed the substance of the Inquiry. It had the ability to choose out of a host of issues the private sector raised in formal submissions, which would merit further scrutiny and which would disappear. It had the ability to decide who could broadcast the new system, who would receive more spectrum, with what constraints and for what period of time. It had the ability to define the public interest. It had the ability to speed up or slow down the process. It had, substantively, great discretion.

During this period the private sector focused primarily on setting up the testing systems and on responding to FCC requests for further information. ACATS made formal progress reports and presentations to the Commission. Communication between the two groups was obviously close. Systems developers worked on their proposals, which ATTC tested as an exclusively technical comparison.

The Digital Convergence Game

As with the other comparisons between games, the possible tactics and rules governing action were less clear and more varied depending on the forum. In Congress, the strategies included studies, hearings and proposed legislation. George Brown, Chair of the Science
Committee, put together a request that the Office of Technology Assessment write a study of HDTV options, resulting in *The Big Picture*. The private players testified before Congress, wrote Action Memos for Markey's Subcommittee, and worked on language for legislation. The legislation had little hope of becoming law, but it was a useful way of keeping the issues of HDTV and competitiveness alive in the media and the public debate. In the end, Congress did create the Advanced Technology Program, but without an explicitly HDTV component.

Within the Bush administration, a major tool was to get approval and funding for consortia and new organizations such as US Memories or the AEA HDTV initiative. However, the rules of politics held, and without White House backing, none of these large ventures could materialize. In the bureaucracy, NTIA, NASA, and DARPA used attendance at meetings and workshops as a way of supporting private sector activities. Some of the nonprofit groups they funded were active as well. As head of NTIA, Sikes publicly supported advanced video development and appointed a blue-ribbon commission to recommend ways to increase US leadership in HDTV.

The academics and computer company representatives' tools focused on keeping attention on questions of competitiveness, digital video research, and the status of 1125 as a possible HDTV standard. To that end they ran workshops, testified before Congress, attended FCC, ACATS, and ATSC meetings, and ran the Ad Hocs. They brought Members of Congress and senior Congressional staff together with computer scientists, engineers and
with computer company executives, particularly Apple. The strategies had two purposes: to encourage the development of interoperable HDTV and to ensure that 1125 not become a US standard. The sad truth is that the latter was far easier than the former, because the standardization process depends on consensus and is much easier to halt than change.\footnote{In one memorable ATSC meeting, two MIT and Cornell professors went to the meeting for the clear purpose of preventing the ATSC from agreeing on a specification that would have greatly supported 1125/60. The meeting went on far longer than the Washingtonians had anticipated. The chair was reluctant to call a break for fear that the professors would work the table and rouse support for their position. One professor brought in very garlicky Chinese take-out but did not share. The meeting finally adjourned without agreement on the specification.}

These players suffered from having no institutional base and clear mandate. However great their perception and however accurate their assessment of a digital future, they had few tools other than the power of their words.

\section*{Salience and Legitimacy}

\textit{The Broadcast Game}

Merriam Webster defines “legitimacy” as being in accordance with law or legal requirements or conforming to accepted rules and standards.\footnote{www.merriam-webster.com} In this case, the FCC as a forum or playing field had complete legitimacy as an arena in which to set a new TV standard. It was equally clear that the broadcasters, ACATS members, and system proponents were legitimate players. The salience or importance of this proceeding for all the players was similarly high: the chance for a Commission to help give birth to a whole new system is rare. For the broadcasters, what happened in this docket would redefine
their work; for the equipment manufacturers, a new system in the US market made an enormous difference to their corporate income; for the system proponents, prestige and patent royalties depended on the outcome; and for Richard Wiley, ACATS offered the chance to culminate a meritorious carrier as the father of HDTV.

The Digital Convergence Game

The players in this game had more legitimacy, and the issues were more salient, than in the earlier game. The issues were more salient because they were a central part of the careers of many of the players. The legitimacy was higher for three reasons. First, given the rapid diffusion of computers and growth of the Internet, it was clear that digital technologies were the wave of the future. Second, the players already had prestigious institutional bases, distinguished careers and easy access to Washington decision-makers. Third, the deep involvement of Apple Computer, with an extensive financial stake in the game, gave the players an air of legitimacy and seriousness.

Nonetheless, there were real limits on the legitimacy in this game, because there was no clear arena within which to pursue the goal. In addition, there was no specific, concrete goal. Team members may well have derived compelling authority from their professional status and technological expertise - for example, Vint Cerf and David Clark were quite arguably among the founding fathers of the Internet, but the absence of a legitimate forum meant that success depended on strong political backing. Ultimately that backing was not forthcoming.
Chapter 4

1990 -1996 and After: HDTV in a Digital World

The years immediately following Craig Field's 1990 dismissal from his post at DARPA coincide with the final years of the H.W. Bush administration. During this period, public interest in HDTV moved out of the public eye and largely onto whiteboards in laboratories and meeting halls, and the broadcast game focused on developing testable systems that ACATS would recommend to the FCC for approval. In 1993, however, three events occurred that changed the development of HDTV dramatically. The first was the inauguration of William J. Clinton as president, with Albert Gore as his Vice President. The second was the end of competition within ACATS among proposed HDTV systems and the formation of the Grand Alliance, a collaboration among the remaining system proponents. The third was the $20 billion proceeds from the FCC auction of cell phones spectrum, which raised the idea of auctioning the HDTV channels.

THE OVERALL POLITICAL CONTEXT

During 1991 and 1992, the Bush administration’s focus was on the economy, the Gulf War, and the presidential election. HDTV and experiments with new forms of public-private partnership had fallen off the radar. With the 1992 election of Bill Clinton and Al
Gore there was not only a new president from a new party in the White House, but a vice
president who had been a strong supporter in the Senate of computer networking, high-
performance computing, and HDTV as a part of the digital network. By 1993, other
parts of the context had changed as well. Japan was no longer a juggernaut force about to
take over the world. No longer was the US economy in the doldrums. No longer was high
tech the province of nerds. Instead, Japan was in the midst of a significant and seemingly
unending recession, and the US economy was entering the longest economic expansion in
the century, an expansion fueled by the very “nerds” who had developed ever more
powerful and ubiquitous computers, all linked together with the Internet.

The years 1993-96 were a period of particular ferment in the communications industries in
the United States. First, the Clinton administration focused great attention on advances in
networking technologies and on their potential economic and social benefits. Second,
after decades of failed attempts, Congress was poised to pass the first major re-write of the
legislation that fundamentally shaped the communications industries in this country, the
Communications Act of 1934. Third, technological advances, together with the move
from an analog to a digital HDTV standard, raised a possibility broadcasters found
extremely appealing. They could now use the new 6 MHz channel, originally awarded for
HDTV, for multiple services consisting of standard definition television, SDTV, which was
digital but not high definition, as well as for assorted data services for which they could
charge subscribers. Fourth, the notion of auctioning the spectrum was a gripping topic in
political discourse: conservatives liked it because it increased the role of the market in the
communications industries; Clinton liberals liked it because it was a means of helping to balance the budget without resorting to taxes. Indeed, so attractive was the idea that everybody, except the broadcasters, supported it for one reason or another.

These were also heady days for computers. There was a palpable excitement in Washington, in all the media, and in the high technology sector: computers, alone or networked together, would solve problems of economic productivity, education, health service provision, and even increase national security. The new administration’s attempt both to push the development and reap the rewards of rapidly growing computer networking, especially the National Information Infrastructure (NII), was in full swing. There was a widespread feeling that the Internet and new digital technologies were going to change the shape of our lives, as this quote from the Information Industry Task Force shows:

Change is coming much faster, and more thoroughly, than ever before. In our lifetimes we will see information technology bring more changes to more aspects of our daily lives than have been witnessed in the preceding century. Digital technology is merging the functions of television sets, telephones, and computers. Fundamental changes are in store for us in the ways we work, learn, shop, communicate, entertain ourselves, and get healthcare and public services. And those are just the applications we can foresee.  

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181 Information Infrastructure Task Force Committee on Applications and Technology, “What it Takes to Make It Happen,” January 24, 1994

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Computer people were feeling powerful, and this feeling spilled over to the HDTV debates. Many observers thought that the energy and momentum from the NII debates was on the side of the computer companies.

Broadcasters may hold the key to the final outcome for they must draw up their own business plans for migrating to a digital world. Which video formats and digital services they adopt and which they reject will determine whether PC-like devices or HDTV terminals will become the future of television. Nevertheless, many are betting on Microsoft. "It seems to me that money will talk in this area," said an industry observer involved in forging the U.S. digital-TV standard, "and my guess is that Bill Gates will win."\(^2\)

Within this context, the political struggle to define the HDTV standard took place over two issues: one was whether or not to assign the broadcast second channels on the basis of spectrum auctions; the second was the extent to which the HDTV standard would tie into the emerging NII or the extent to which it would remain a parallel but quite separate system. The first issue was largely in the broadcast game, the second in the digital convergence game. Since there were multiple sets of actors with often shifting positions, the story is fairly complicated, but the following are the major groups of players:

**Major groups in the broadcast game were the following:**

- **The broadcasters,** who wanted to fight off the competition with the cable and satellite companies on one side and computer companies on the other; they also did not want to spend any more money on HDTV than they had to
- **The FCC,** which was responsible for setting the rules for the standardization process and approving the ultimate standard
- **ACATS,** responsible for overseeing the system development

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Major groups in the digital convergence game were the following:

Computer hardware manufacturers, who were interested in television on computers to gain economies of scope from manufacturing boxes that could be either television or computers. They also thought HDTV could provide positive network externalities from offering more services on the national information infrastructure.

Computer software companies, most notably Microsoft, which was interested in developing a network linking its “intelligent” servers to “dumb” home terminals in homes and therefore supported a strong information infrastructure.

Filmmakers, who were concerned with the display of their products and therefore focused on the aspect ratio for HDTV. They were also concerned with effective post-production work.

Major groups in both games were the following:

Members of Congress, who were looking for ways to cut the deficit and who, on both sides of the aisle, found a potential bonanza in spectrum auctions, which had already netted much more money than anyone had expected.

The Clinton administration – As was clear in the public statements of Vice-President Gore, the new administration believed that the technological revolution and the development of the NII would spur economic growth while simultaneously providing means to overcome numerous social problems, especially in education and the provision of health services. That stance placed a premium on interoperability and meant the administration would give priority to endeavors that enhanced interoperability over stand-alone technologies.

THE BROADCAST GAME

The overarching initiative during the early part of this time period is the broadcast industry’s defense of an intensely valuable resource: the 6 MHz spectrum band the FCC
decided in 1992 to allocate to each existing broadcast station for advanced television. As the previous attempts to define the standard have shown, HDTV was a means to others' ends: at various times it was an opportunity to contribute to the health of equipment manufacturers and television program producers; it was a tool in a related but separate spectrum issue to fight off the encroachment of land mobile service providers; it was the means to revitalize the US consumer electronics industry. Beginning in the early 1990s, HDTV was a potential source of revenue that could diminish the federal deficit as well as a potential major part of the National Information Infrastructure. Most of all, though, during this time, it was the story of the broadcasters' preserving and defending ownership of their new and potentially lucrative resource, the additional broadcast channel, capable of reaching virtually every house in the country. The identification of this spectrum as particularly valuable drove activities in Congress and in the FCC, as well as in negotiations between broadcast and computer industries.

On June 30, 1990, the terms of the broadcast game changed. Anyone wanting to submit a HDTV system had until that date to submit the proposal to ACATS. At the very last moment, Friday afternoon of the last day for submissions, General Instruments proposed a digital system, and within six months, all of the proponent systems were basically digital. This change from analog to digital was dramatic and made a considerable splash. All of the proposals were sketchy and required significant work before it would be possible to test them, and the change in the proponents meant a delay in the ATSC testing schedule. Then in August 1990, the FCC clarified more details for the new system. The FCC
decided that the new HDTV standard needed to fit into a 6 MHz channel which the Commission would lend existing broadcasters until such time that the transition from NTSC to HDTV was complete. The transition period was to last for approximately fifteen years. At the end of the transition period, broadcasters would be required to return the existing analog channels for redistribution for other purposes. The FCC thereby put to rest the question of whether HDTV should be compatible with existing systems, or enhanced NTSC.

The testing among proponent systems took place at the Advanced Television Testing Center. The broadcasters created and funded ATTC, which began testing in July 1991. With Peter Fannon at its head, ATTC worked closely with the ATSC and the ACATS leadership as an independent, industry-funded testing organization. Testing continued over the course of two years but with inconclusive results. By the beginning of 1993, there were four systems remaining, but each one was clearly no better than its competitors. Faced with a stalemate, Richard Wiley, the ACATS chair, brokered an agreement in May 1993 among the partner companies. Called the “Grand Alliance,” it consisted of AT&T, General Instrument Corporation, MIT, Philips Electronics North America Corporation, Thomson Consumer Electronics, Sarnoff Research Center, and Zenith Electronics Corporation. Wiley was able to get the partners to agree to work together and combine

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183 Federal Communications Commission, First Report and Order, MM Docket No. 87-268, 55 FR 39275 (September 26, 1990). It is interesting to note that the transition timetable changed dramatically at this point from a year or two before viewers could see the new system to fifteen years. That estimate was in fact short by four, which is fairly on target, given the magnitude of the task.

184 It is to Peter Fannon’s credit that, despite all the bad feeling and back-biting in this process, no one ever alleged that the ATTC tests were unfair.
their systems into one. The ATTC would then test that system, after which it would go forward to the FCC for approval, and that was, with only one essentially minor change, exactly what happened.

By 1993, the FCC rules governing the HDTV development process were in place— the new system would have to be simulcast and had to fit a 6MHz channel; the broadcasters would receive new but temporary spectrum allocations for the simulcast, and the systems would be fundamentally digital.

**THE QUESTION OF SPECTRUM AUCTIONS**

Beginning in 1993, the broadcasters had to fight on two simultaneous fronts: one front was a continuation of the struggle with the computer industry; it took place both within and outside the FCC/ACATS process, and it used the language of scanning systems. The second and equally critical debate took place in Congress and focused on the possibility of spectrum auctions. This idea emerged as a method of reducing the federal deficit, and, after the economy took off in the mid-nineties, it remained attractive as a potential revenue stream. Enthusiasm for this idea came especially from the unanticipated windfall of

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185 During this period, the FCC had released five decisions in the docket: the First Report and Order (August 24, 1990), Notice of Proposed Rule Making (October 24, 1991), Second Report and Order (April 9, 1992), Second Further Notice of Proposed Rule Making (July 16, 1992), and the Memorandum Opinion and Order/3rd Further Notice of Proposed Rule Making (September 17, 1992)
approximately $20,000,000,000 from the FCC PCS (cell phone) spectrum in 1993-4. Auctioning broadcast spectrum was particularly appealing because the 1992 FCC award of the second channel to existing licensees for the transition to HDTV left the broadcasters with a great deal of spectrum at a time of their own fiscal concern. Since the traditional method of awarding spectrum to broadcasters had always been through the administrative mechanism of comparative hearings, which involved no payment, the broadcasters did not support this change. Ultimately they successfully countered the threat, though their arguments changed 180° in the course of the struggle.

The question of auctions first appeared in the Omnibus Budget Reconciliation Act of 1993 (OBRA), and it applied to a number of communications services. In the parts that concerned broadcasting, Congress authorized the FCC to auction spectrum when subscribers, not advertisers, paid for services. In other words, if the broadcasters were providing “free” over-the-air television services, auctions would not apply. However, if the broadcasters were primarily offering new services to subscribers, and only secondarily offering free or advertiser-supported television, then they were offering just another set of communications services in competition with pagers and cellular telephones and the like. Although no specific actions emerged from the OBRA in terms of broadcast spectrum auctions, the mechanism was in place.

186 www.wireless.fcc.gov/auctions

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Moreover, while the efforts were underway to reduce the federal deficit, efforts were simultaneously underway to rewrite the 1934 Communications Act, and by 1994, they were beginning to coalesce. Rep. Markey (D.-Mass.) offered H.R. 3636, and Senator Hollings (D.-S.C.) offered a counterpart in S. 1822. In March, Rep. Billy Tauzin (R.-La.) proposed an amendment to H.R. 3636 that would have charged broadcasters a spectrum fee in return for allowing them to offer “ancillary and supplemental services” over both NTSC and the new ATV channel.\textsuperscript{187} “Ancillary and supplemental services” became one of the code words referring to potential subscription services broadcasters could create using new digital technologies. This amendment ran into trouble from Dingell (D.-Mich), Chair of the House Commerce Committee, and others who feared that broadcasters would use their spectrum to offer PCS services, thereby driving down the value of the extremely sought-after PCS bands,\textsuperscript{188} and Tauzin withdrew the amendment. However, Markey and Dingell sent letters to the FCC, OMB, NTIA, and industry groups questioning the effects of spectrum auctions on the development of HDTV, thus keeping the issue alive. Although H.R. 3636 passed the House in June 1994, S.1822 failed in the Senate, thus ending the efforts to rewrite the Communications Act in the 103rd Congress.

Broadcasters were deeply interested in ancillary and supplemental services, or “spectrum flexibility” as it was also known. They had realized that with the new digital systems, it was


possible to offer standard definition broadcasts (SDTV) with picture quality much better than NTSC but less than true high definition. Indeed, it would be possible to fit four SDTV channels into one HDTV channel, or, as many were arguing, fewer SDTV channels and more subscriber services. Jonathan Blake, the head of MST, said at their 1994 annual convention that there was no need to broadcast in high definition, because broadcasting digital television was enough. In an interview in Broadcasting and Cable, the preeminent trade journal for the industry, NBC president Robert Wright said that

The digital picture is a better picture than the picture that we, as broadcasters, can provide today. And the digitization of the spectrum gives us more flexibility to provide services, in addition to the picture, and that’s a benefit. The HDTV concept that utilizes all 6 megahertz to make a better appearing picture is less attractive than the benefits the consumer and broadcaster get from digitization. And pursuing HDTV as an objective by itself, requiring you to have an entirely different production technology and cameras, I don’t think that’s working.

Indeed, Brinkley argues that Tauzin’s amendment to H.R. 3636, which would have charged broadcasters a spectrum fee in return for spectrum flexibility, was the broadcasters’ amendment and that its intent was to kill HDTV. Spectrum flexibility was to broadcasters the first unequivocally appealing business opportunity in the FCC HDTV proceeding.

Spectrum flexibility was also appealing to Reed Hundt, the Clinton FCC chair, but for him it was part of a total policy outlook broadcasters found troubling. By 1994, Reed Hundt had turned his attention to HDTV and to spectrum auctions. Hundt was a close school

189 Robert Wright as quoted in Joel Brinkley, p.338
190 Joel Brinkley, p. 337

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friend of the Vice-President’s and shared Gore’s view of the importance of the Internet and the National Information Infrastructure; moreover, he did not have close ties to the broadcast industry. In a speech the following year, Hundt articulated his vision of the FCC’s role in the communications revolution; there should be . . .

. . . twin guideposts for our decisions. We should be for private competition in communications and public benefits from communications. We should pursue both with unrelenting intensity. Let me repeat. We should be the most pro-competitive, market-trusting, investment-encouraging, and economically savvy FCC ever. And we should also be the most consumer-aware, people-oriented, and children-friendly FCC in history.

Throughout his tenure at the FCC, Hundt continued to support market competition as the primary mechanism for bringing the best services to the public. Consistent with that position and with supporting the efforts of the administration to reduce the federal deficit, Hundt vigorously supported spectrum auctions. To the dismay of the broadcasters, however, he was not an ardent supporter of HDTV, saying that digital television technologies were exciting but that high definition contributed nothing to the information superhighway. Indeed at the MST annual conference in 1995, Hundt suggested that the FCC would not require high definition broadcast, because SDTV was more flexible and compatible with the NII.\textsuperscript{192} Early in his tenure at the FCC, Hundt said

They say history repeats itself. I don't know if that's so. And I don't know if this decade's high definition television will ultimately replace our current broadcast technology. I do know this - if the great David Sarnoff couldn't pick the correct technology in 1931, we at the FCC are well advised to approach the HDTV issues cautiously, taking advice from NAB, Dick Wiley's Grand Alliance and others. With their guidance and the input of


\textsuperscript{192} Joel Brinkley, p. 328
others, I believe the FCC will successfully balance the difficult and complex technological and economic considerations involved in questions of spectrum allocation and licensing related to HDTV. But I want to draw one lesson from TV history. Mechanical television didn’t fail in the 1930’s because of the Depression or technological limitations. It failed because the programming for the early mechanical television stations didn’t attract viewers.193

The broadcast industry responded to these admonitions with a stunning volte face. At that same MST annual convention, Jonathan Blake diametrically shifted his argument from the previous year. At the 1995 conference, he said that high definition was the central, critical service in digital television: “…the public—all of the public, which only broadcasters serve in its totality—deserves the opportunity to participate in the benefits of digital TV, most centrally HDTV.”194 Only by claiming to need virtually the entire 6 MHz to deliver a “free” service on which the American public depended could the broadcasters hold onto their positions as guardians of the public trust and thus claim an exceptionalism that would shield them from having to pay for spectrum. Moreover, the transition to HDTV needed to be as fast as possible, since cable and satellite services such as DirecTV could (and did) deliver digital services with no need for FCC approval, and, broadcasters argued, would therefore be the death of over-the-air television.195

While the broadcasters, as represented by Jonathan Blake, were championing high definition, Hundt was pushing lower standards. At the MST conference, he suggested that

194 Joel Brinkley, p. 342
195 Joel Brinkley, p. 347

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the FCC might not even require stations to broadcast full HDTV, arguing that it was less flexible than SDTV and moreover not compatible with the NII. These opposing positions remained in place throughout the rest of the HDTV standardization process; they found reflection in the 4th Further Notice of Proposed Rulemaking, which the FCC adopted on July 28, 1995, and which set out the big questions of what constituted appropriate requirements of broadcasters in a digital world. Whether or not one thinks Hundt's assessment was correct, his position aroused great animosity among broadcasters and eventually weakened his ability to develop a consensus.

The broadcaster's change of position was also necessary because 1995 saw another change in the political context for the HDTV debates with a new Congress, which was now entirely in Republican hands. The House Telecommunications and Finance Subcommittee was now under the leadership of Jack Fields (R.-Texas). Fields supported using auctions to allocate the second channels, asking whether it was fair that broadcasters use them for subscription services if they had been allocated in a process never subject to auction. Moreover, the Congressional Budget Committees under OBRA authorization directed the House and Senate Commerce Committees to find $14 billion in budget cuts, making proceeds from auctions deeply attractive.

In May 1995, Robert Pepper, the head of the FCC's Office of Policies and Plans, estimated in a letter to Senator Lieberman (D.-Conn.) that auction of the second channel would

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196 Goodman, p. 537
bring in anywhere from $11 to $70 billion, whereas auction of the analog channels after
their return would net $20 to $132 billion. In September, Larry Pressler (R.-S.D.), Chair
of the Senate Commerce Committee, circulated but never introduced a bill to auction
HDTV and other ATV spectrum in the largest twenty-five broadcast markets, which he said
should bring $14 billion to the federal coffers. He proposed using these proceeds to create
a trust fund that would support the Public Broadcast System and National Public Radio,
both facing deep budget cuts. At the same time, Senator Lieberman (D.-Conn.) wrote the
FCC about the effect of auctions on the development of HDTV. Hundt, who was a
proponent of auctions, wrote back that "...many broadcasters will compete for and likely
win many digital licenses if Congress chooses to auction them." A week later, the
Association for Maximum Service Television (MST) contradicted Hundt; in another letter
to Lieberman, they said that he was operating on an “incorrect assumption” that auctions
would not harm the development of digital television.

Thus, by the early autumn of 1995, the threat of spectrum auctions was quite real.
Moreover, the Chairman of the FCC was continuing to undercut the broadcaster position
by emphasizing the value of spectrum flexibility and the extraordinary quality of digital
SDTV. In early July, he had requested that Richard Wiley make sure that the Grand

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197 Goodman, p. 533
199 “Letters to Lieberman: Broadcasters Debate the Effect of Digital Auctions,” Communications Daily,
September 18, 1995, p.1, quoted in Hart.
Alliance developed standards for lower as well as high definition television. Hunt’s desire for a range of standards caused a split within the Commission, with Commissioner Barrett leading the opposition. By November, the split was quite public. In the speech to the International Radio and Television Society, tellingly called “DTV: We Can Work It Out,” Hundt stressed his central themes: that the FCC should rely on pro-competitive, market-trusting forces for regulating the communications industry and that the Commission should resist the broadcasters’ calls for what amounted to an “...unprecedented level of regulatory micro-management of digital broadcast.” Indeed, he argued in relation to the new and popular PCS that “the commitment to flexibility is what will give this new technology the greatest prospects for economic success.” But, he went on, in the case of HDTV, the Commission’s history had been quite different, that the Commission had been

force-marching the eminently successful American broadcast industry and its 100-million home audience from analog to so-called high definition television.... This high resolution picture would presumably be so attractive that Americans would naturally elect to purchase new high-definition televisions.... But is a government-mandated transition more of an expulsion from Analog Eden than a pilgrimage to a Digital Promised Land? And does the audience want to go on this journey?.... And if we want to promote any particular product, why not mandate quotas of digital formats that are particularly appropriate for laptop computers?

and finally,

I applaud Congress’ decision to include in the Reconciliation Act just sent to the President a provision that would accomplish that goal by ordering the Commission to report on the use of auctions to assign digital broadcast licenses.

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200 Joel Brinkley, p. 350
Clearly, then, the head of the FCC wanted to steer the agency in a new direction, a direction that diminished the agency’s scope of action and placed the broadcast industry in a more vigorous and unprotected marketplace.

By mid-1995 and primarily because of spectrum issues, the broadcast industry had traveled a twisting road. It had moved from lukewarm support for HDTV in the 1980s and early nineties, (in deference to program producers, consumer electronics manufacturers, and bureaucratic processes), to wholehearted support in 1994-1995 for “spectrum flexibility” and the opportunity to offer other digital services HDTV, and then back to supporting HDTV in 1995, this time with more ardor, in order to protect spectrum allocations.

**Spectrum Auctions Revisited: 1995-1996**

In the fall of 1995, the possibility of spectrum auctions reappeared. In October, John McCain (R.-Arizona) offered an amendment to auction the second HDTV channel. It lost by a vote of 64-25, but two months later, Senator Dole, the majority leader and person responsible for bringing legislation to the floor, mounted another challenge. He argued that the spectrum provisions of the Telecommunications Bill were a “giveaway,” and he threatened to hold the bill off the floor. The impasse was resolved with the FCC’s agreement not to award the second channels before the Congress had had the opportunity to hold hearings on the question. The Senate Budget Committee held one hearing, the Senate Commerce Committee held three, and the House Commerce Committee held one.
In the course of the hearings, the broadcasters were able to refocus the discussion away from ancillary services and back to their traditional role as guardians of the public trust, thus weakening the auction proponents’ positions.

The testimony before the Senate Budget Committee reframed the debate around two points. The first was to determine the economic value of the spectrum. The second was an examination of the trade-offs between the public’s interest in a functioning broadcast system and its interest in the revenues that would flow immediately from spectrum auctions. At this and at subsequent hearings, the broadcasters argued that the FCC retain its existing spectrum authorization in order to provide the clarity and certainty necessary for a transition to the new form of television that would give the public a continuation of the best television in the world. In the June Senate Commerce Committee Hearings, Robert Wright, the President of NBC, said

...I believe that we have to recognize and we have to facilitate the goal of a nationwide, free, over-the-air broadcasting. We have had it for 50 years. It is the best in the world. There is no reason not to create the system that is good for the next 50 years. We must specify a reasonable timetable for the transition to digital. I have not seen, and there is no evidence at all that this can be done in less than probably 12 or 15 years....The sooner we get the Commission to allocate the frequencies, the sooner we get the timetable of the transition agreed upon, then the sooner that Philips and Thomson and others will start making the sets, and the sooner we will produce the programs.

Otherwise, the specter of the AM stereo debacle was present - the lack of clear and timely action in setting a standard and providing clarity and certainty to manufacturers would

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lead, as with AM stereo, to "...no rules, no regulations, no format, no service." In addition, spectrum fees would sap too much money from broadcasters, especially small ones, and would preclude the roll-out of free, over-the-air HDTV. The senators agreed with the arguments, though Senators Lott and Hollings, together with Speaker Gingrich and Representatives Dingell and Bliley, wrote the Commission a letter urging it to assign the new spectrum to broadcasters by April 1997. Hundt, the spectrum auction proponent, argued that such a plan was irresponsible. "Their plan was to get the spectrum first and think about how to use it later....But in order to get these licenses, you should have to serve the public in a specific, quantifiable, measurable, reliable, guaranteeable way." Hundt wanted the broadcasters to agree to use 5% of the second channel air time for public interest programming and to return the upper range UHF channels (60-69), which would not be assigned for HDTV, so that the Commission could auction them.

At the June 1996 Senate Commerce Committee hearings, Congress dropped the spectrum auction question and turned its attention to the upcoming election. In terms of HDTV, the election had three important results. First, Clinton and Gore won, thus continuing interest in the NII and information technologies as an economic engine. Second, Larry Pressler lost, and John McCain, the ardent spectrum auction proponent, succeeded him as Commerce Committee Chair. Third, the broadcasters then had a clear incentive to settle

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203 Ibid, p. 31-32
204 Senator Pressler refused to sign the letter.

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the question of a digital standard and allocation system before the new congress had time to hold more hearings. That fear, together with new and strong allies, encouraged the computer industry to make one last attempt to resolve the debate over scanning and other parameters.

**THE DIGITAL CONVERGENCE GAME**

In the spring of 1990, following the demise of the efforts to make government a paying part of HDTV development, the character of the computer and entertainment industry involvement changed. Although the broadcasters were continuing to work within the ACATS system, building and testing their proponent systems, and despite the setbacks to interoperability in the Bush Administration’s political retreat, those who would tie HDTV to computing were active on a number of fronts. To them it seemed obvious that digital technologies that grew out of computing power were giving birth to new technological systems. As in the past, this group had three primary objectives: they wanted to gain acceptance for the principles of scalability, extensibility, and interoperability (see below); they wanted to find ways of operationalizing those principles; and they wanted to ensure that 1125 would not become the US or the dominant international standard.

To meet these objectives, they banded into a semi-formal coalition called the Committee on Open High Resolution Systems (COHRS), re-engaged with the State Department CCIR process, continued the series of “Ad Hoc” meetings on Capitol Hill and the less frequent
series of cross-industry meetings under the sponsorship of the IEEE-USA, and developed standards for headers and descriptors under the auspices of the Society of Motion Picture and Television Engineers, SMPTE. The irony in this period is that although these non-broadcast forces banded into a group with a name, if not a concrete organization, their tactics shifted away from an organizational focus (starting up a new TCA or formal consortium) to a focus on fully developing the architectural approach to imaging standards. The efforts to influence the FCC/ACATS and CCIR processes continued, as did the Ad Hocs and IEEE-USA meetings. However, these efforts gave the central spotlight over to the more proactive attempts to develop technical specifications that the FCC could use rather than, or in conjunction with, proposals from the system proponents.

**COHRS**

The establishment of the Committee on Open High Resolution Systems (COHRS) in the spring of 1990 marked the beginning of this new phase. COHRS was a loose association of individuals without a formal membership. It included prominent officials from the broadcasting, cable, consumer electronics, banking and entertainment industries, including vice-presidents of Cap Cities/ABC, TCI, Fox Broadcasting, the president of Zenith Consumer Products, and vice-presidents of Thomson Consumer Products and North American Philips. However, those who gave voice and shape to the COHRS vision were computer scientists and academics, most notably Michael Liebhold of Apple, Branko Gerovac of Digital Equipment Corporation, Alan McAdams of the Cornell Business School, and from MIT, William F. Schreiber, Andrew Lippman, W. Michael Bove, Richard Solomon, Russell Neuman, David Tennenhouse, and Lee McKnight. See Table 9.
for all the signatories to the original COHRS charter. What drew the group together was
the desire to build new imaging systems that were technologically sophisticated and
contributed to the economic health of the country as well as for their own companies’
benefit. 'This search for technological sophistication took the form of building “open”
video systems. COHRS members, who were from computer or film companies or were
academics, wanted to create advanced imaging systems, including HDTV, that

- would be useful in different industries (including computer graphics, television,
  medical imaging, military training, and computer-aided design and engineering),
- could upgrade to incorporate future innovations within any one application, and
- could incorporate different levels of sophistication at any one time.

The way to achieve those goals, COHRS argued, was to develop digital information streams
that the various systems and devices could “read.” In other words, digital information
moves in streams or packets of on/off electrical impulses. Each of those streams or packets
contains identifying information. What COHRS wanted to do was to code that
information so that it would be intelligible to different industries, to different kinds of
appliances or machines, and in the future as well as in the present. The terms COHRS
used for these concepts were interoperability, extensibility, and scalability.

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206 Committee to the CCIR Study Group 11 on the: U.S. Position at the March IWP 11/6 in Atlanta on the
"single worldwide standard for HDTV programme production and international program exchange," 22
February 1990

207 “COHRS Mission Statement,” Email from Richard J. Solomon to the author and others, May 10, 1991;
email from Mike Liebhold to the author, September 16, 1991; email from Richard J. Solomon to the
author and others, May 13, 1991; letter from Michael Liebhold to FCC Chair Alfred M. Sikes, May 6, 1991

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Interoperability referred to the ability of the digital information to be intelligible to different industries. An interoperable video standard, for example, could provide the characteristics for different kinds of imaging systems: computers, televisions, perhaps movies. An interoperable standard could also be of interest to receiver manufacturers who would be able to capture economies of scope in manufacturing a range of inter-related products, from television sets for home entertainment to monitors for flight training.

Extensibility referred to systems that could incorporate technological improvements as they occurred. For example, most computer systems and applications are extensible in that newer versions of operating systems or applications work on older machines and with older applications. Another way to see extensibility is as the qualities that permit a system to "mature." Scalability referred to the ability of a system component, such as the receiver, to select only as much information as needed from the signal; the same signal could therefore transmit different levels of information to receivers of different levels of sophistication.

COHRS grew out of a stormy meeting of the US National Committee for the CCIR at the State Department on February 23, 1990. The purpose of the meeting was to agree on the position for the up-coming CCIR preparatory meeting in Atlanta and the subsequent Study Group meeting in Geneva concerning an international advanced television production standard. The computer group's fear was that setting an international standard at that time would in effect pre-empt the US HDTV process and install 1125 as the de facto standard. To avoid that outcome, they drew up a counter-proposal signed by thirty-

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two people, ten academics and twenty-two representatives of primarily computer, entertainment and rump consumer electronics industries, as the following table shows. This group was important because it was, with the subsequent inclusion of Michael Liebhold of Apple, David Staelin of MIT, and Clark Johnson, a DOD consultant, to remain the heart of the efforts to create new imaging systems and the opposition to 1125.

<table>
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<tr>
<th>Industry</th>
<th>Signatories</th>
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<tr>
<td>Broadcasting &amp; Cable</td>
<td>Anthony Uyttendaele, Capital Cities/ABC</td>
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<td>Julius Barnathan, Vice President, Capital Cities/ABC</td>
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<td>Andrew Setos, Vice President, Fox Broadcasting</td>
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<td>John Sie, Vice President, TCI</td>
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<td>Computers</td>
<td>Claude Feistel, IBM Corp., Advanced Workstation Division</td>
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<td>Branko Gerovac, Digital Equipment, Workstation Division.</td>
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<td>Don Nelson, Digital Equipment, Workstation Division.</td>
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<td>David Trzcinski, Hewlett-Packard Corp., Graphics Technology Division</td>
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<td>Mark Urdahl, IBM Corp., Advanced Workstation Division.</td>
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<td>Consumer Electronics</td>
<td>Robert Hansen, President, Zenith Consumer Products</td>
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<td>Joseph Donahue, Executive Vice President, Thomson Consumer Products</td>
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<td>Larry French, Vice President, North American Philips</td>
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<td>Entertainment</td>
<td>Ed Bleier, President, Warner Pay Television, Animation, &amp; Network Features</td>
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<td>Linda Carpenter, Paramount Pictures</td>
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<td>Alan Cole-Ford, Vice President. Paramount Communications Inc.</td>
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<td>Birney Dayton, President, Nvision</td>
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<td>Gary Demos, President, DemoGraFX</td>
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<td>Greg Thagard, Director of Special Projects, Showscan</td>
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<td>Academics</td>
<td>V. Michael Bove, Jr., Associate Professor, MIT Media Lab</td>
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<td>Jae Lim, Director Advanced TV Research Program, MIT</td>
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<td>Andrew Lippman, Associate Director, MIT Media Lab</td>
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<td>Alan McAdams, Cornell Business School, IEEE, Economic Strategy Institute</td>
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<td>Lee McKnight, Fellow, MIT Center for Technology Policy and Industrial</td>
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<td>Suzanne Neil, Senior Associate, MIT Audience Research Group</td>
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<td>W. Russell Neuman, Director, MIT Audience Research Facility</td>
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<td>William Schreiber, MIT Advanced TV Research Program</td>
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<td>Richard Solomon, MIT Media Lab</td>
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<td>David Tennenhouse, MIT Laboratory for Computer Science</td>
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<td>Telecom</td>
<td>Kenneth Phillips, Vice President, Citicorp and President, Corporate Committee of Telecom Users</td>
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<td>Bruce Sidran, Bellcore</td>
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Source: Ad Hoc High-definition Display and Television Working Group, "Memorandum to the U.S. National Committee to the CCIR Study Group 11 on the: U.S. Position at the March IWP 11/6 in Atlanta on the "single worldwide standard for HDTV programme production and international program exchange," 22 February 1990
The COHRS supports argued in the proposal and in the meeting itself that their position had the support of Secretary of Commerce Mosbacher and of Al Sikes, the new FCC Chair and former head of the National Telecommunications and Information Administration (NTIA), as well as of Paul Misener, at that point at NTIA.\textsuperscript{209} Misener would reappear towards the end of this story as an important figure. The outcome of the meeting was that the US position at the CCIR would be to keep all parameters open and to continue negotiations into the next 1990-1994 CCIR study cycle, or as participant reported it to his colleagues,

To those who have not yet gotten the word: we beat the pajookies out of 'em on Friday. NO PRODUCTION STANDARD at this time, no numbers (save color, we like color TV), no lines, no Hz, no interlace, no pixels, no nuttin'.\textsuperscript{210}

COHRS was the quintessential virtual organization. It had no building, no papers of incorporation, no official membership. The MIT Digital Open High Resolutions System Program functioned eventually as its unofficial secretariat. COHRS was, however, effective at buying time so that forces supporting interoperability could try to become part of the ACATS process or to develop alternative standards or hardware. Its influence in the HDTV debates lay in the non-trivial size of the computer industry compared to television broadcasting and in the technological appeal of the COHRS principles.

\textsuperscript{209} Email from Richard J. Solomon to Suzanne Neil and others, February 25, 1990.

\textsuperscript{210} Email message from Richard J. Solomon to Suzanne Neil and others on February 25, 1990.
The COHRS Principles

Two beliefs animated the COHRS group. One was the argument that imaging technologies were in the middle of a particularly fertile period of innovation and that it made no sense to lock in a descriptive standard at that time. The second was the demise of the US consumer electronics industry - Zenith was the only remaining US owned company out of an industry born and developed in this country. Even RCA, the quintessential American company, born out of a partnership with the US Government, General Sarnoff's pride and joy, was for sale and would in fact eventually be sold to the French firm Bull. Meanwhile, the Japanese had bought Rockefeller Center and Columbia Studios and seemed to be inexorably expanding. These twin beliefs, that technology was on the cusp of developing in ways no one could anticipate and that good US ideas would fly into foreign control, were the bookends of COHRS activities.

Underlying the COHRS assessment of technological change was the belief that knowledge of future technologies was limited and therefore standards should strike a balance between enabling companies to design products for the current market and enabling smooth transitions to newer technologies as they developed. The way to do that in a digital world was to use an “architectural” approach to standardization. William Schreiber wrote an early and influential paper on a “Friendly Family” of television standards in which he set a way of applying the architectural approach of computer design to television technology.

David L. Tennenhouse, of MIT's Laboratory for Computer Science also argued for a similar approach. 212

In March 1990, Tennenhouse made a presentation at the Media Lab about an architectural approach to interoperability in high resolution systems across industries. This system rested on five key concepts: scalability, extensibility, de-coupling of stages, abstract digital representation, and very simple subsetting. 213 Extensibility and scalability are defined above. De-coupling of stages refers to viewing capture, production and post-production, transmission, display, and storage of images as separate steps, each of which could be handled in multiple ways. What was innovative in Tennenhouse’s work was not that he specified the characteristics of each step but rather that he specified the interfaces between each one. One way to do that was through agreeing on a digital representation system.

Under the new, proposed architecture it would be possible to specify the parameters which applied at the time of capture of an image, those which were modified through the production process, those that were introduced at the post-production stage, those that correspond to the intended transmission medium, those which identify the display media that are supported, as well as those that identify the storage media that are supported. Once again, the virtually infinite combination of attributes which this procedure implies must be reduced through mutually agreed, pre-established very simple subsetting. Each of the very simple subsets must be identified with an equally simple abstract digital representation. In other words, a “standard” would represent agreement on what each of the elements in the process represents, as well as on the abstract representation for that element. 214

212 Report on the Video Harmonization Workshop, MIT, November 14, 1991
These notions of multiple layers or modules of functionalities identified through abstract digital signs of some sort were the basis of the COHRS approach to HDTV and eventually reappeared as standards in the “header/descriptor” work of David Staelin and Gary Demos for SMPTE described below. They were the mechanisms for achieving scalability and extensibility, which led to interoperable systems.

COHRS also focused on the economic context of the process. As in the previous phase, there remained a widespread fear and respect for Japanese accomplishments in successfully bringing new technological ideas to the market. The 1125 standard was still, in this view, just another step in the juggernaut that had already produced Japanese dominance in a range of microchip technologies, consumer electronics, and automobiles. This perception was reinforced by the work of several writers in addition to Chalmers Johnson, who was the most famous.215 David Kahaner was an Office of Naval Research official, based in Tokyo in the late 1980s and early 1990s; Kahaner reported on Japanese high technology developments, especially in high performance computing and cutting edge semiconductor and component research; he was also an occasional Ad Hoc participant. Clyde Prestowitz was a former Reagan administration Department of Commerce official; he wrote Trading Places,216 an argument that the close institutionalized relationships between the Japanese government and major corporations enabled the country to turn (mostly American) technological innovations into successful products gaining dominant market share. Robert

Cohen, an economist associated with Prestowitz’s Economic Strategy Institute, published numerous economic analyses of the Japanese “miracle.” These and associated writers found the key to Japan’s economic success in the proactive involvement of the Japanese government in developing new technologies through a broad array of direct investments, contracts, tax relief for applied research, and support for “pre-competitive” R&D arrangements such as consortia and public-private partnerships.

COHRS agreed with this assessment and argued that the way to counter the Japanese threat was for cross-industry cooperation among American firms and for a greater role for the US government in technology development in this country. The COHRS Mission Statement signed in Dallas in May, 1991, stated that

There is an inexorable convergence of computers, communications, imaging information technology, and consumer electronics....(but) the current process is uncoordinated, chaotic and often redundant. Individual companies and even industries cannot bring about convergence on their own. Cross-industry cooperation which brings about coherent standards reduces risk and cost for all providers of products and services....(and) will deliver substantial social and economic benefits in the United States.218

During this period, COHRS members used three mechanisms to get its ideas into the HDTV standardization process. One was the continuation of the long series of off-the-record Ad Hoc meetings on Capitol Hill to influence the political process. The second was to hold a series of workshops under the auspices of the IEEE and the National Research Council to identify specific ways to harmonize technologies across industries. The third

218 COHRS Mission Statement
was to become active in the international process within the ITU, especially through CCIR IWP 11/9, the Task Group on Harmonization that the Dusseldorf Plenary established.

**IEEE/NRC Meetings**

The Institute of Electrical and Electronic Engineers-USA (IEEE-USA), together with the American Television Systems Committee and the National Research Council, continued the series of workshops on digital video systems that began in May 1990.\(^{219}\) At the first meeting, the participants agreed to create several sub-groups responsible for on-going work. One was the "Header Group," and its task was to design a digital identifier or "header" that would contain all the information necessary to permit scalability and extensibility in video signals. The Header Group merged with a SMPTE group in the spring of 1991. Under the leadership of David Staelin, an MIT professor of electrical engineering, the Header Group developed a system which was published late that year as an official SMPTE standard. Gary Demos led a similar effort that resulted in specifying digital descriptors and became a SMPTE standard in 1992.\(^{220}\)

The SMPTE Header/Descriptor Task Force set out eight qualities for the identifying information, the header or descriptor, that would enable the flexibility COHRS wanted. See Appendix 2 for those qualities and their purposes. With such a system in place, the

\(^{219}\) Email from Will Stackhouse, to header-group, April 28, 1992

SMPTF task force and COHRS members believed that it would be possible to bring to new
television and other imaging technologies the kind of explosive technological and
economic growth that computer technologies had been experiencing.

**HDTV, Computers and Interoperability - The Clinton-Gore Years**

During the mid-1990s, in addition to the threat of spectrum auctions, the broadcasters had
to deal with the digital convergence team's demands for progressive scan, interoperability,
scalability and extensibility. In 1993, there was a battle was over whether and how to
incorporate HDTV into the National Information Infrastructure. During the previous
several years, most activity around HDTV focused on the development and testing of the
proponent systems, a process full of delays and frustrations but contained within a narrow
broadcast engineering world. During the same time, the computer industry and academics
who had been active in trying to re-conceptualize HDTV in 1988-1990 had turned their
focus to the development of the Internet, the World Wide Web, and, with the Clinton-
Gore election, to the emerging National Information Infrastructure. However, ACATS
Chair Wiley's success in convincing the four remaining ACATS proponents to join in the
Grand Alliance raised the prospect that the team would develop system parameters in the
near future. Here was another opportunity to bring television into the wildly innovative,
exciting, and potentially hugely productive world of the information revolution. The
problem, however, remained the pulpit, that is, what forum would give attention and
weight and legitimacy to these outsiders' arguments. Their answer was to enter the
ACATS process itself.
The Joint Experts Group on Interoperability

In July 1993, just after the formation of the Grand Alliance, Michael Liebhold, the Apple Vice President for New Technologies, spearheaded an effort among computer manufacturers, filmmakers, and potential NII applications users to make the Grand Alliance system truly interoperable with the NII. He had numerous meetings with congressional leaders and with Alfred Sikes, who at that point was the outgoing FCC chair, as well as with Wiley. The result of these meetings was that Wiley agreed to form an ACATS Joint Expert Group within the Planning Subcommittee (the most important part within ACATS) to investigate questions of interoperability. In July, Wiley appointed the Group. He named Liebhold, with whom he had notoriously poor relations, as Vice-Chair and Robert Sanderson of Kodak, whom he found more congenial, as chair. Liebhold and Sanderson recommended nominations to the committee. They included:

Robert Hummel, Vice President, Walt Disney Television Animation, Interactive TV
Larry Smarr, Executive Director, National Center for Super Computer Applications, University of Illinois, Champaign-Urbana
Tom DeFanti, Chair, ACM SIGGRAPH Editor, founder of the SIGGRAPH,
Carl Fleischhauer, Library of Congress
Craig J. Birkmaier, President - Professional Products & Promotions (PCUBED)
Neil Izenberg, M.D., Director, Nemours Foundation, Center for Biomedical Communications, DuPont Institute Children's Hospital, Wilmington Delaware
Russ Little, Senior Systems Analyst, National Geographic Society, Washington D.C.
Tice de Young, Director, Scalable Imaging Systems, Advanced Research and Planning Agency, Department of Defense
Robert Kahn, President, CEO, Corporation for the National Research Initiative
Roy Pea, Learning Sciences Program, Northwestern University

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221 Michael Liebhold, letter to Richard Wiley dated July 28, 1993
On October 6-7, 1993, the Joint Expert Group on Interoperability met in Georgetown, with Wiley, representatives of broadcast networks, and academics, for two days of presentations and stormy meetings. The purpose of the meetings was to make recommendations on criteria for interoperability between HDTV and the NII. The timeline was, from the perspective of the computer people, quite rushed, because the full report and presentation to the ACATS technical committee was to be on October 21th.

Michael Liebhold argued that

...the relationship between the NII, electronic publishing, film and ATV is too important to be so quickly considered and dismissed. The formal Interoperability process should be extended to enable additional explicit recommendations on minimum, film, electronic publishing, and NII ATV Interoperability. ASC, DGA, SIGGRAPH and the Cross Industry Working Team, (XIWT), chaired by Bob Kahn are all important forums for such recommendations.

There was considerable acrimony among the different camps, but the contenders still believed that they might really be able to influence the development of the new system.

The draft report of the meeting says “Despite the context of terrestrial-only, HDTV-only, a lot of progress has been made toward emerging/converging uses of ATV and NII.”

However, in retrospect, it is clear that the areas of real contention were over precisely those areas that affected the interoperability of HDTV and the NII. Though the arguments were not cast in those terms, the effect was clear. There were eleven areas under discussion.

They were, along with the notes on status in the secretary’s draft report, the following:

222 Author’s observations
223 Email from Mike Liebhold to farnsworth.mit.edu, October 14, 1993
224 Email from B. Gerovac to farnsworth.mit.edu, October 14, 1993
225 Email from Branko Gerovac to Robert Sanderson, et. al., October 8, 1993

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- An all-digital implementation based on a layered architecture model [ok]
- The use of universal headers and descriptors [MPEG with hooks to universal h/d P registry tbd]
- Transmission of the signal in progressive scan format [only] [still an issue]
- Use of a flexible, packet data transport structure [ok]
- Viewer transparent channel re-allocation (limited picture and sound while most of the channel capacity is devoted to data transmission for conditional access addressing or other purposes) [ok in principle, needs detailed specification]
- Ability to implement lower performance low-cost ATV receivers (comparable price/performance options to current NTSC receivers) [not at early HD introduction, though a cost/performance family is possible; due to decreasing electronics costs, the expectation is that at NTSC turn off, baselevel costs will decline to acceptable levels]
- Ability to implement low cost ATV consumer VCR [ok, for compressed input; vcr trick modes an issue with AC leak]
- System architecture and implementation that will allow improvements and extensions to be incorporated as technology advances while maintaining backward compatibility [ok; through new packet types (at a minimum) given available data capacity]
- Square pixels or at least the option to select square pixel presentation [addressed by 1280x720, still some open issues with certain other formats] <original recommendation did not anticipate the extent of multiple formats present in the proposal>
- Compatibility with relevant international standards or commitment to this objective [actual and required level of conformance with MPEG-2 (video, audio, transport) /ATM /Internet protocols /etc. an issue]
- Easily implementable and user-accessible "still/motion multi-window transmission" [feasible via multiplexed program streams; needs further requirements definition]

As the notes in parentheses suggest, all of the issues were either unproblematic or amenable to reasonably straightforward solutions except for two: the question of transmission in progressive scan format, and the question of pixel shape. The question of MPEG-2 subsequently became controversial but was (a) resolved fairly quickly and (b) never a huge problem. The question of interlace and the related question of pixel shape,
however, remained serious impediments to making HDTV a well-integrated part of the NII. Pixel shape was an issue, because non-square pixels made progressive scan vastly more difficult; they were, in that regard, a back-door means to keeping interlace.

Gary Demos, head of the postproduction company DemoGrafx, was one of the leading opponents to maintaining interlace in the Grand Alliance system. He argued that, within the context of the NII, the Grand Alliance system was useless, because the fierce competition to minimize costs in consumer electronics equipment would inexorably push toward the lowest common denominator in equipment, which was at that point interlace.

The obvious is that once interlace displays enter the marketplace, we will all have to produce our images to look acceptable on those displays. The resolution of those interlaced displays will be the lowest of any display for N.I.I. type uses, and for any interactive computer-like use. Because it is the lowest, and because it is about 540 lines (with equal energy), that is all the resolution we will have. That is no better than progressive scan PAL or NTSC in 24 or 30 fps mode. Thus, we have gained nothing by ATV, since we must create all new ATV material which is computer-like to this 540 line resolution.

That is problem 1. We must support the lowest quality format in the Grand Alliance, and for computer-like purposes, that is the interlaced format. We will not benefit from the 720 progressive format because some people will not be able to display this format, and we must compose for all receivers (the lowest common denominator). In addition, once interlace was present in the new receivers, we would face the same installed-base problem that the current NTSC system presented.

Problem 2 is that once we have interlaced receivers in the market, we cannot tell people to turn them off and quit watching them. So we will be stuck supporting these interlaced displays for as long as they last. If they last for 30 years, then we will be supporting them, and they will be dragging down the whole system, for that long. They become the anchor point for production as the lowest common denominator.

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226 Email from Gary Demos to hierarchy@farnsworth.mit.edu, October 26, 1993
The broadcasters argued forcefully that interlace had a place. They pointed out that interlace receivers were less expensive than progressive scan and that there were no progressive scan cameras available for image capture. One of the most thoughtful spokesman on their behalf was Peter Symes, with the Grass Valley Group. He argued that resolution meant different things to different people. For entertainment purposes, resolution was important for those sitting about nine feet from the TV set. For computer use, two feet from the screen was best. In terms of transmission, “[t]o date, no progressive system tested under controlled conditions has yielded acceptable quality,...(and) it would have made little sense - given the test results available today - to preclude the prototype GA system from having an interlaced mode.”227

The leaders of the Joint Experts Group knew that their arguments would not be compelling to Wiley and the ACATS committees, so they undertook a three-pronged strategy to increase their power.228 First, they sought support from entertainment, medical imaging, defense and other industry groups. Second, they suggested calling on James Quello, the temporary chairman of the FCC to give more time to investigate the interoperability aspects of the Grand Alliance. Third, they suggested raising the issue in other standards bodies and professional associations. In particular, Liebhold recommended American Society of Cinematographers, DGA, SIGGRAPH and the Cross Industry Working Team (XIWT) under the leadership of Robert Kahn. Though it seemed

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227 Email from Peter Symes to: hierarchy@farnsworth.mit.edu October 27, 1993
228 Email from Michael Liebhold to moredohrs@farnsworth.mit.edu, October 14 1993

THE DEVELOPMENT OF HIGH DEFINITION TELEVISION - 199
that neither ACATS nor the FCC itself took serious notice, the Grand Alliance included both interlace and progressive scanning parameters in the final standard in what became its infamous Table Three, with its confusing list of eighteen permissible scanning formats.

As Gary Demos had predicted, the result of including interlace was that broadcasters could use just it if they wished, making the transition to a flexible HDTV much more difficult. In addition, eighteen possibilities were simply too many to provide useful guidance. It was clear that the opponents' efforts were at best minimal: they were able to avoid settling on a single interlace standard, but they were not able to force the broadcasters to enter the proscan world.

The Camera

To show that a proscan camera was feasible, DARPA worked through MIT to fund the development of a progressive-scan camera. Polaroid was the recipient of the grant and developed a proscan camera with a Phillips CCD inside. By later winter 1995, the camera was ready. Its images were extraordinary; on the text photo of an enlarged dollar bill, one could see no scanning lines or artifacts; all the edges were absolutely crisp and clear. In addition, its potential applications were wide. It had obvious use for putting museum holdings onto the web, for intelligence, for medical imaging – and for advanced television. The designers introduced it at the April 1996 NAB conference, where it was a great success and the subject of accolades on the spot and in the press. The camera received the same
reception at a demo at the FCC. The message was clear: a progressive scan camera was possible and not prohibitively expensive.


The computer industries’ interest in HDTV intensified when in April, 1995, FCC Chair Reed Hundt visited Redmond, Washington, to meet with Bill Gates to discuss HDTV.229 Although nothing specific came out of that meeting, Microsoft started to become more active behind the scenes. Then Apple’s chief Washington lobbyist, Jim Burger, picked up the lead. It was clear that the Commission would soon decide on a standard, and Burger together with Gary Demos, then a consultant to Apple, formed the Computer Industry Consortium on Advanced Television Systems or CICATS, an industry group of ten leading computer companies, that included Compaq, IBM, and Microsoft, in addition to Apple. The purpose of this new group was to make the HDTV standard interoperable with computers. Their argument was that the FCC mandate a “low level protocols” as the basis of the standard.

CICATS proposes that the FCC not mandate video data formats for the new digital channels. CICATS proposes that the FCC institute a study group chartered to return a finding within one year on how to improve the low-level digital TV protocols by several orders of magnitude to accommodate error-free transmission of non-video or non-pictorial data. It is understood that a satisfactory solution might be precluded by proceeding with the low-level protocols before this study is made.230

229 Reed Hundt, So You Want a Revolution, New Haven: Yale University Press, 2000
The CICATS group met with broadcasters several times during the late summer and fall of 1996. The meetings were quite formal, with Donald Norman, Mike Liebhold’s successor as Apple’s Vice President for New Technologies, Craig Mundie, the Microsoft Vice President for Consumer Platforms, and Elliot Silverstein, of the Directors’ Guild, across the table from broadcasters, who were a mixture of network and independent representatives, including Michael Shurlock of NBC, with Paul Misener, the former Wiley aide and NTIA official, representing Intel and in the role of broker. The focus of the meetings was the question of scanning parameters and the “migration path” to an all prosan system. At one point, Norman reported, it seemed that there was a clear agreement on all points, but it evaporated overnight - killed, Norman thought, by the independents, who clearly were the least enamored of HDTV. The final deal, which came at the urging of Commissioner Susan Ness, involved removing Table 3 from the ACATS/ATSC recommendation—the broadcasters could use whatever scanning parameters each wanted. The computer industry representatives had favored this solution, because it would let the market decide which standard to adopt. In addition, the computer representatives promised to refrain from criticizing the standard, but they also obtained the promise that the FCC would not begin proceedings into regulating possible second channel data services. Norman argued that the broadcasters’ willingness to agree to

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231 The exception was that the Director’s Guild was concerned with the aspect ratio; it wanted to make certain that whatever standard won would display films and video in their original format.
these provisions was partially a function of their desire to reach an agreement before the
new Congress, with the possibility of more action on spectrum auctions, was sworn in. 232

Thus, in the longer run, the removal of Table 3 effectively allowed the interlace parameter
1080-I to remain viable, and broadcasters were still free to choose any of the 18 formats in
Table 3 parameters they wanted. The computer industry would be able to develop data
services, even though the price was the prohibition on commenting on the standard
proceedings. According to Misener, "[i]t wasn't something to be taken lightly, [b]ut the
computer industry's desire to speed digital-TV deployment outweighed the
concession....We want this to move forward....We want to see this take off as fast as
possible." 233

The CICATS agreement permits the establishment of a standard that does not give great
clarity, but it did permit the FCC to make a decision. On December 24, 1996, the FCC
adopted the ACATS/ATSC standard for Advanced Television. In April it adopted the
plan for allocating 6 MHz spectrum to the existing broadcasters for the transition to
HDTV. The long process of developing the next generation of television was,
fundamentally, for better or worse, finished.

Or so it seemed.

232 Conversation with author, February 21, 2002
accessed on January 16, 2002
In fact, there was still more than a decade before the final switch from analog to digital transmission. The transition was far from smooth. The broadcasters began to receive the allocations of the second channel in April 1997, along with the much vaunted “spectrum flexibility,” allowing transmission of both standard definition television and for-pay services, and they wanted to keep the channels as long as they could. In addition, they encountered the chicken-and-egg syndrome: few HDTV sets delivering few viewers to advertisers who were therefore reluctant to buy advertising time, leaving program producers reluctant to pay for new programming and therefore not attracting new viewers. Furthermore, competition from cable and satellite systems and the ever growing Internet meant both advertising revenues and market shares were down. At the same time, Clinton’s FCC wanted to retrieve the NTSC channels in order to auction the spectrum, as did Congress. The consumer electronics industry wanted to sell new equipment. The FCC decided that the switchover would have to happen when 85% of the households were able to receive HDTV. Congress set February 2009 as the date for the switchover. When that time came, however, many viewers were still confused, and Congress ended up extending the deadline four months.

When the last engineer pulled the last switch on NTSC broadcasts, the television world was vastly different from what the engineers in the NHK labs in the 1970s had expected. There was no HDTV analog to the switch from black & white to color, because in the new world, HDTV was simply one among many video systems, and over the air broadcasting
was only one among many transmission mechanisms. In 1960, one bought a television set and watched television. Fifty years later, at the dawn of the HDTV age, the definition of the service was as blurry as the actual pictures were sharp. Technological development, market choices, and new social patterns of using video had overtaken the formal FCC decisions.

AN ECOLOGY OF GAMES 1990-1996 AND BEYOND

Applying the ecology of games to this period helps sort out the actions. It shows, as Long had initially argued, that the HDTV system we finally got was not the product of a decision-making process that encompassed all the participants acting together in a rational process to develop the new system. Instead, as Long had argued, the participants were involved in smaller spheres of activity, such as a media game or a real estate game, to use Long’s original examples. Within those arenas their actions were quite understandable.

In the 1990s, the primary goals in this period for the players in the broadcast game were to protect their spectrum, keep it as long as possible, and develop and gain approval for a workable HDTV system. To achieve those goals, the players had to settle a number of contentious issues, such as obtaining spectrum flexibility or settling scanning parameters, and they did so from a position that over the course of this time period weakened in relation to the digital convergence game.
The primary goals for the players in the digital convergence game were to encourage the development of an interoperable digital video system and to preclude FCC acceptance of an incompatible HDTV standard. In the end, the players were able to achieve both. Their ability to do so, however, depended on an infusion of new power from forces initially outside the game.

The ecology of games model helps order these developments and explain their outcomes. In the rest of this chapter, the analysis will compare the two games in terms of the players and their goals, their strategies and tactics, and the legitimacy and salience of the games.

The Players and Their Goals

*The Broadcast Game*

In this game, there were five main sets of players, with different goals:

The broadcasters: Their objectives were to get and keep the second channel for simulcast; have maximum flexibility in using the channel to broadcast a mixture of television programs and profit-making or "ancillary" services and to fend off spectrum auction threat.

The FCC: As the literature on regulatory commissions would suggest, the FCC was supportive of broadcaster objectives, until Reed Hundt became Chair.

Reed Hundt: His objectives were to support development of digital networks and help the Clinton Administration's efforts to reduce the deficit through spectrum auctions.

Richard Wiley: As chair of ACATS, he was determined to push the process to produce a workable HDTV system the FCC would accept.

The Grand Alliance: The consortium of the final HDTV system proponents had to develop a working system in spite of technological problems and the difficulties inherent in cross-company collaboration.
The Digital Convergence Game

Unlike the players in the broadcast game, the players in this one were quite focused on one major goal, which was to promote the development of interoperable, scalable and extensible advanced video technologies. The team consisted of

Michael Liebhold: An executive with Apple Computer, Liebhold was the most public leader of this game. His objective was to develop advanced video technologies, for Apple and for the public good applications, especially educational.

COHRS: The research group at MIT, COHRS acted as the Secretariat for the digital convergence game and pushed development of an HDTV system that was scalable, extensible, and interoperable.

Alfred Sikes: As FCC Chair just prior to Reed Hundt, Sikes understood the benefits of interoperable video systems in terms of technological innovation, educational, medical, commercial, military and other applications, and jobs.

Reed Hundt: Unlike his predecessors, this FCC Chair had ties into this computer world and supported interoperable video systems.

CSPP: This consortium of computer company executives became active in Washington in 1993 and wanted an HDTV system that would work on computers and their networks.

CICATS: A group of computer executives and filmmakers, CICATS members wanted an HDTV system that was interoperable with computers and with digital filmmaking.

Microsoft: Bill Gates became interested in an interoperable HDTV system through Reed Hundt, and Craig Mundie, head of research, was a prime player in CICATS.

End Users: The medical, educational, manufacturing, film, and military groups these end users represented needed accurate video images for applications such as remote medical diagnostics, military reconnaissance, and distance education.

DARPA & NASA: These agencies supported COHRS and funded the development of the progressive scan camera.
Strategies and Tactics

The Broadcast Game

Applying the ecology of games model to this phase in the development of HDTV is useful in clarifying what the issues were, for they were particularly complicated for the broadcast game. In Table 10, the shaded areas indicate the issues active during this period and the players needed to resolve them.

<table>
<thead>
<tr>
<th>Overarching Goal</th>
<th>General Goal</th>
<th>Issues &amp; Fora</th>
<th>Primary Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect spectrum allocations</td>
<td>Protect spectrum allocations</td>
<td>Auction</td>
<td>Broadcasters&lt;br&gt;Members of Congress&lt;br&gt;Clinton Administration&lt;br&gt;Reed Hundt</td>
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<td></td>
<td></td>
<td>Spectrum usage</td>
<td>Broadcasters&lt;br&gt;Congress&lt;br&gt;FCC&lt;br&gt;Reed Hundt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transition timing</td>
<td>Broadcasters&lt;br&gt;FCC&lt;br&gt;Consumer electronics manufacturers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System proponent</td>
<td>Grand Alliance companies&lt;br&gt;Richard Wiley &amp; ACATS&lt;br&gt;ATSC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>International standardization</td>
<td>ATSC&lt;br&gt;Broadcasters&lt;br&gt;Equipment manufacturers</td>
</tr>
</tbody>
</table>

Table 10
The Broadcast Game

The primary tool the FCC used was its rule-making function. In the August 1990 First Report and Order, the Commission decided that HDTV would not have to be backwardly compatible with existing television signals but could be simultaneously broadcast, or
“simulcast.” To enable the simulcast, the FCC would assign new frequencies for the new HDTV service. The new system would, however, have to fit into a 6 MHz channel. Finally, the Commission would not consider “enhanced” systems until it had decided on an HDTV system. This decision effectively killed the enhanced system proposals, which had never been seen as more than a bridge to a wholly new system. With these decisions, the Commission established the parameters within which the proponents could develop the new systems. Then, in its April 1992 Second Report and Order, the Commission made the critical decision to allocate frequencies for the new HDTV system only to existing broadcasters, who would then relinquish their existing NTSC channels at the end of a designated transition period of fifteen years. Finally, the Commission decided to leave the other broadcast services in a secondary status. These decisions gave the broadcasters much of what they wanted, which was primary access to delivering the new service and a long transition.

The rules governing the system developers were both less and more straightforward, less straightforward in the sense that there was great competition among the proponents, and more straightforward because the ATTC testing criteria were explicit, both for proponents and for audience reactions. The upshot of all this work, however, was that by 1993, there was still no clear winning system, but Richard Wiley, ACATS chair, brokered an agreement among the remaining proponents to form a Grand Alliance and work out a merged system.
Beginning in 1993 and continuing for more than two years, the members of the Grand Alliance worked on developing and testing all the components of a new system. Despite the technical problems and the difficulties in managing a consortium, Wiley was able to use his formidable persuasive skills to keep the process moving forward until the Grand Alliance had a workable system to recommend to ATSC and the FCC.

Once the FCC decided on simulcasting the new system over a second set of broadcast channels, once the HDTV proposals became digital, and once the initial PCS auctions brought in $20 billion to the deficit-ridden government, the broadcasters were in a tricky spot: the rationale for giving them free spectrum was that spectrum was a limited resource and “free” over the air broadcast television was in the national interest. However, that rationale had become increasingly frayed as viewers switched from over the air television to cable and satellite systems offering hundred of channels. In the face of so many distribution channels, the prospect of allocating yet more “free” spectrum raised a red flag in Congress and with the FCC Chair Reed Hundt.

To strengthen their position, the broadcasters used two main strategies. Rather than asking for the flexibility to broadcast multiple services over the new channel, they now said that viewers had to have access to full HDTV. They lobbied Congress, and the Members who had supported auctioning the second channel backed down. They also pressured the FCC, though the other Commissioners had never supported Hundt’s call for auctions.
This interaction is a clear case of an iron triangle, that favorite political science model that explains policymaking in terms of stable relationships among Congress, the bureaucracy, and interest groups. The mutually supportive relationship between the broadcasters and the FCC, that Huntington, Stigler and Bernstein predicted, forms two legs of the triangle. The third leg was the power of a broadcaster over the Members of Congress from his or her district and the power of Congress over the FCC. The effect was effectively to counter the lure of proceeds from auctions.

The broadcast game issue was how long the broadcasters could keep two channels. The game was framed in terms of the percentage of the country able to receive HDTV. In this case, the FCC supported the broadcasters. The consumer electronics industry, for whom the final switch-over would open a huge market, and Members of Congress, who wanted to auction the old channels available after the switch-over, pushed for a short transition. The broadcasters' coverage argument for a long conversion period did have some merit, though, for there is always a chicken-and-egg problem in reaching the tipping point for a new network.

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The Digital Convergence Game

After the demise of Craig Fields, the AEA HDTV initiative, an US Memories, the goals in the digital convergence game narrowed to promoting interoperable, scalable, and extensible video systems, as Table 12 shows.

<table>
<thead>
<tr>
<th>Overarching Goal</th>
<th>General Goal</th>
<th>Issues &amp; Fora</th>
<th>Primary Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital convergence</td>
<td>Enhance international economic competition</td>
<td>Revitalizing consumer electronics</td>
<td>Computer companies CSPP &amp; CICATS DARPA COHRS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Industry-government relations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Promote interoperability, extensibility &amp; scalability</td>
<td>Computer interoperability</td>
<td>DemoGraFX Steven Spielberg Disney</td>
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<tr>
<td></td>
<td></td>
<td>Film interoperability</td>
<td>COHRS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public goods (for medical, educational uses)</td>
<td>Ad Hoc Membership</td>
</tr>
</tbody>
</table>

Table 11
The Digital Convergence Game

During this period, the digital convergence game players were active on a variety of fronts, including:

The establishment of COHRS

The objective was to foster development of HDTV as an interoperable video technology. The strategies were to run or participate in workshops and Ad Hoc meetings to keep momentum going, to confer with team members, and to monitor FCC, ACATS, and US National Committee for the CCIR developments.
The establishment and support of Ad Hoc meetings

The objective of the Ad Hocs, which ran from 1989 through 1993, was to ensure widespread distribution of information about HDTV to representatives of interested industries and senior level figures from Congress, DARPA, NTIA, other federal agencies, and often the White House. There was always information sharing during the formal session and even more during breaks. It is difficult to assess the importance of these meetings. However, senior level people from government academic, and industry continued to attend over the span of several years.

Working with FCC Chair Albert Sikes

Though Sikes had shown support for developing an interoperable HDTV while head of NTIA, the digital convergence objective here was to gain FCC support for interoperable systems as part of the ACATS process. The computer company CEOs, active through CSPP, supported that action. 235

ACATS Joint Experts Group on Interoperability (October 6-7, 1993)

The purpose of this meeting was to identify areas of commonality and remaining problems in developing an interoperable HDTV system. The leadership was in the hands of key digital convergence players, Robert Sanderson of Kodak and Michael Liebhold of Apple. Presenters covered a wide range of broadcasters, ACATS

235 Personal conversation with Michael Liebhold, June 4, 2010
members including Wiley, systems developers, end users, and computer scientists, including Larry Smarr, then head of the University of Illinois Supercomputer Lab and Principal Investigator on Marc Andreessen’s Mosaic (later Netscape) project. The meeting took place with the approval of FCC Chair Albert Sikes and over the objection of ACATS Chair Wiley. Sikes had long supported an interoperable advanced video system, and had come under pressure from CSPP and Apple to bring interoperability into the ACATS considerations.

Holding this meeting was an important step in getting the digital convergence requirements into the ACATS process. The outlines of the ultimate HDTV standard were, according to Liebhold, set there. The draft summary from the meeting shows issues framed in technical language that played to the strengths of computer networking specialists and not to the broadcasters’. There was, for example, no mention of spectrum.

The development of headers and descriptors

Under the leadership of David Staelin of MIT and Will Stackhouse of Jet Propulsion Laboratory, a large group of computer scientists from industry and academia designed “headers” and “descriptors.” The purpose was to show the

237 Personal conversation with Michael Liebhold, June 4, 2010
238 Email from Branko J. Gerovac to Suzanne Neil and others, October 14, 1993
feasibility of interoperability by designing actual digital instructions to video bit streams. Both projects became formal SMPTE standards.

The development of the progressive scan camera

As with the headers and descriptors project, the intent in designing the digital camera was to show that proscan HDTV was commercially feasible. This project combined the technical expertise of Polaroid and MIT, with funding from DARPA and NASA. Though Polaroid never made the commitment to commercializing it, the project was immensely successful in all its demonstrations.

The involvement of Bill Gates and Microsoft

The involvement of Bill Gates and his chief technology developer Craig Mundie came about through the initiative of Reed Hundt’s initiative and was critically important in strengthening the position of the digital convergence game. It also provided the gravitas that CICATS needed in order to bargain with the broadcasters in November 1996.

Clearly the digital convergence players were active in a number of fronts. They kept alive the possibility of joining HDTV to the National Information Infrastructure, as it was called during the Clinton administration. They pushed notions of interoperability with Albert

239 Reed Hundt, So You Want Revolution, New Haven: Yale University Press, 2000, especially pp. 105-106
Sikes at NTIA and then the FCC, with Congressmen George Brown and Edward Markey and their staffs on the hill, with submissions to and membership on US delegations to CCIR meetings. Under the auspices of the IEEE, NRC, MIT, and particularly the ACATS Joint Experts Group on Interoperability workshop, they ran or helped arrange workshops. They were people on a mission. They had passion, technological savvy, corporate and academic credentials, and sheer energy, which they married with close connections to federal officials. NASA/DARPA funded the MIT Digital Open High Resolutions Program. NTIA was willing, especially under Albert Sikes, to listen to William Schreiber of MIT and Michael Liebhold of Apple. Congressmen Brown and Markey and their staffs worked with COHRS on crafting legislation and shaping congressional hearings.

241 Memorandum to: U. S. National Committee to the CCIR Study Group 11 From: The Ad Hoc High-definition Display and Television Working Group Subject: U.S. position at the March IWP 11/6 in Atlanta on the "single worldwide standard for HDTV programme production and international program exchange" Date: 22 February 1990
Salience and Legitimacy

**Broadcast Game**

The legitimacy of this game was unquestionable. The FCC was engaged in its traditional rule-making function. The system-testing was explicit and mostly transparent. The competition between the broadcasters and the spectrum auction supporters took place in established and legitimate fora.

The salience of the FCC decisions and the characteristics of the new HDTV system was likewise unquestionable. Spectrum is the lifeblood of the broadcast industry; the Commission was established to regulate private use of airwaves. For all the players in this game, the development of a new successful television system was centrally important, either for corporate profits or for the agency’s reputation and authority or for individual professional reputation, which was clearly true for Richard Wiley. That salience also gave power to these players, because they were not going to disappear when the debate got boring or apparently futile.

**The Digital Convergence Game**

The players in this game still did not have an established and legitimizing forum, but they were twice able to gain entrance into the FCC process with importance, running the 1993 Interoperability Panel for ACATS and participating through CICATS in the 1996 final standards negotiations. They gained credibility from the support of a broad range of industries and groups. The signatories to the 1990 CCIR State Department letter
represented the broadcasting, cable, computer, consumer electronics, movie, and telecom industries, as well as academia. These same industries, and often the same people, remained active in pursuing their vision of a high resolution digital system at the Interoperability Panel in 1993, and some were present at the final 1996 negotiations with CICATS. The federal presence was also consistent, though with a lower profile. Officials from DARPA, NTIA, NSA, NASA as well as Congressional staffs were active in the Ad Hoc group meetings. NASA and DARPA supported the MIT program that ran COHRS and funded the progressive scan camera. The involvement of all these groups in developing an interoperable video system gave the enterprise credibility and a sense of legitimacy, even if informal. The greatest source of strength, however, came from the support of Reed Hundt, Bill Gates and senior officers at Microsoft.

While this game had no formal legitimacy, and while to Wiley the digital convergence players were simply rabble-rousers, they gained legitimacy as it became apparent that they had an accurate reading of where technology was heading. They articulated a view that a number of officials found compelling. Ed Andrews characterized Al Sikes’ mission at the FCC as wanting to enable

... a world in which people could use satellites and high-speed fiber-optic communication lines to take college courses at home, have television sets double as multimedia computer work stations, use communication networks to transmit the contents of an entire library in seconds and track down a person anywhere on the globe to deliver the data.

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218 - The Development of High Definition Television
The kind of technological flexibility that would make that world possible was exactly what the COHRS people were advocating, and that vision, coupled with academic and corporate credentials, gave their views credibility, however grudgingly.

Those sources of legitimacy were sufficient to overcome the more problematic issue of salience. None of the COHRS people's professional careers depended on the success or failure of their venture. No one would get rich or famous. Indeed, since they had no critical stake in the outcome, their involvement was always at the whim of changing interests, funding sources, or corporate goals. For the broadcasters, equipment manufacturers, and Richard Wiley's Advisory Committee, the future of HDTV was supremely salient. For the players in the digital convergence game it was important but not critical.

However, neither the legitimacy not the salience of the broadcast game was enough for its players to ignore an FCC Chair who supported the development of interoperable network and who involved Microsoft in the HDTV process. In an increasingly networked world, it was no longer possible to ignore CICATS with its insistence on a proscan system. The time for compromise had arrived.

The compromise was to agree not to agree on scanning systems, and the effect was to throw the decision about the final shape of HDTV into the marketplace. There, minus the protection of the FCC, the broadcasters had to develop new business models.
Conclusion

While the ecology of games posits an internal coherence within any one of the games, it also posits a lack of over-all coordination of results. Applying the model to the activities after 1990 certainly shows the lack of an over-all rational process that included all parties deciding together on the new technology, but it does show that there was coherence within each of the games. The reactions of the broadcasters and the FCC (minus Hundt) to the possibilities of spectrum auctions are clear examples of the iron triangle at work. Richard Wiley’s drive to push the ACATS process to a successful conclusion is equally understandable in terms of the game metaphor: Wiley was the team captain exhorting his players forward as they lagged or softened focus. Likewise the model explains how the strategy of the digital convergence team played to their strengths: technological expertise and professional standing. Using those strengths, the team was able to build allies among powerful sources: CSPP and FCC Chairs Sikes, who worked within the system, and Hundt, who did not. Those allies enabled the team to gather increasingly weighty support for an interoperable HDTV system, so that in the end, with the involvement of a broad group of senior computer company executives plus Bill Gates and Craig Mundie from Microsoft, the digital convergence team were able to become part of the actual FCC negotiations.

Comparing the two games in terms of the strength of their positions is illuminating. The sources of support for the broadcast game diminished over time: corporations began tiring
of funding their Grand Alliance research.\textsuperscript{245} Congress and the FCC Chair Hundt called for spectrum auctions. Competition from cable and satellite delivery systems increased,\textsuperscript{246} and by the time of the cross-over, YouTube was popular.

During the same period, however, sources of support for the digital convergence game increased. The team’s abilities grew from the 1990 success in forcing the State Department to withdraw support for 1125 in the CCIR. It continued to grow through developing increasingly large areas of consensus in IEEE and other workshops and then bringing these areas of consensus – and disagreement – into the ACATS process. It culminated in the CICATS compromise. However, their ability to become part of the official and final deliberations on the standard required more than alliance building and solid technological work. It required the kind of external infusion of power that Bill Gates and Microsoft and the Internet explosion provided.

The essence of the digital convergence game was to show how HDTV interoperability could work and build external support for that position. There was freedom to establish new organizations (COHRS, CICATS), hold meetings to develop and share new

\textsuperscript{245} Joel Brinkley, \textit{Defining Vision}, see Chapter 4, especially “Limping to the Finish Line”
\textsuperscript{246} In 2006-7, of the households with television sets, 15% received their signals over the air, 58% from cable, and 27% from satellite. OECD, \textit{Communications Outlook}, 2009, Ch. 6, p. 6; see especially Chapter 6, “Broadcasting,” for an interesting comparison of the multiple video distribution systems available now. In 2009, cable’s share of the US market 60.6%, and over the air television broadcasting was 32.1% . Among 21 to 49 year-olds, cable’s share was 56.3% and broadcast television’s share was19.0%. Source: Agata Kaczanowsk, \textit{Television Broadcasting in the US}, IBISWorld Industry Report 51312, May 2010.
perspectives (Ad Hocs, IEEE cross-industry workshops), and when possible poach players from the other side (Hundt). There was energy and a forward momentum in this process.

The essence of the broadcast game during this period was more conservative. In Downs' terms, the players needed to protect their heartland (spectrum) and develop an HDTV system which, understandably enough, would leave the broadcasters still in business. Understandable, but the energy was not on their side.

Chapter 5

Conclusion

When all was said and done, when all the demos were over, when the engineers had left their labs and lawyers returned to their offices, when all the sniping and invective ceased, what was left? Why and how did we end up with the standard we got? Norton Long’s ecology of games goes far, if not all the way, in answering those questions.

To begin with, though, it is useful to ask just what did we get? To the undoubted surprise of the engineers of the NHK Labs in the 1970s, HDTV ended up as part of a flexible interoperable system. It could work on devices that show digital family pictures, let one use the Internet and watch American Idol in utter clarity. Ultimately HDTV became part of an interoperable, scalable, and extensible system, though it did not assume that form until almost a decade after the 1996 FCC decision.

The ecology of games explains a great deal about the process of designing that system. It predicts well the overall shape of the development process. It shows that apparently unorganized actions become understandable when seen as part of smaller contests. In this case, it shows the existence of two major games, one centering on the television broadcast industry, the other centering on proponents of digital networked systems. It shows – as Long predicted – that the ultimate outcome was the result of messy uncoordinated decisions within and between the games. A review of the goals, players, strategies, and
legitimacy of the games in each of the time periods of the study illuminates the usefulness and limits of the model.

Goals

Prologue - 1986  HDTV had a clear instrumental value in this period. Diana Dougan used the attempt to agree on the standard as a way of increasing her stature within the bureaucracy and used her increased leadership in international communications to promote 1125. CBS and Sony both supported agreement on 1125 to gain control of the international television program market of patent ownership. For the European Commission communications section, 1125 provided a (trans)national unifying device.

1987-1990  Within the broadcast game, HDTV provided broadcasters with a shield against the reallocation of spectrum. For Richard Wiley and ACATS it was an opportunity to be centrally involved with the creation of a big and important new system. For the system developers, it also provided a chance to develop an extraordinary new technology and reap profits from patents.

For the digital convergence game, the effective if unspoken goal was to reframe HDTV from being a question of picture quality to being part of a larger, flexible, digital system. The more specific goals were to stop acceptance of 1125, let the period of innovation continue before solidifying on a standard, and use public support for HDTV as a mechanism for enhancing the country’s technological and economic competitiveness.

1990-1996  The goals in the broadcast game multiplied during this period. For the broadcasters themselves, the goals were to protect their spectrum allocations from the threat of auctions, maintain as much flexibility in the use of that spectrum as they could, and hold onto the allocation for as long as possible. For the FCC (minus Hundt), the goal was to protect the broadcasters. For Hundt, the goal was to support digital systems development and reap the quite large profits from auctioning the spectrum. For Richard Wiley and ACATS, the goal was to develop a workable HDTV standard.

While the goals of the broadcast game multiplied during this period, the goals of the digital convergence game narrowed to ensuring that
interoperability, scalability and extensibility became part of the HDTV standard.

Strategies

Prologue-1986

In the bureaucratic game, Diana Dougan used HDTV as a means of increasing her position as the coordinating point for international communications policymaking in the executive branch. She also used her support in the administration, especially with the Secretary of State, to solidify her leadership. In the standardization game, she, along with Joseph Flaherty of CBS, took control of the domestic standardization process through adroit parliamentary maneuvers (such as the “recommendation for a proposal” rather than a “proposal”). On the international front, she and her colleagues used persuasion to promote the US position on HDTV. The European Commission’s strategy was to cobble together an alternative proposal the 1125 opponents could support.

1987-1990

Within the bureaucratic game, the broadcasters used the FCC process to protect their spectrum allocation. The FCC supported the broadcasters by framing HDTV as only over-the-air broadcast television. The effect of that frame was to exclude new ideas (and their proponents), such as open architecture or end user preferences. Setting up ACATS and the testing process was not only an obvious and necessary step in developing a new system but had the effect of setting in motion a train with specific characteristics: it is hard to argue for computer interoperability when the testing is on an entirely separate basis.

Within the digital convergence game, the strategies were to make HDTV a public policy not a technical issue and use that power to create public-private partnerships that would develop advanced video systems. Had the digital convergence team been successful at that point, it is possible that they would have been able to bypass the FCC process, but they failed. Therefore, the FCC was the only legitimate forum for approving the HDTV standard, and the digital convergence team had no alternative but to bring their game into the FCC process, as they did during the next period.

1990-1996

The broadcast game strategies at this point were protective. The broadcasters used political leverage to avert spectrum auctions. They excluded the ideas of all of the digital convergence players unless forced to include them, as happened with FCC Chair Sikes and the
Interoperability Panel. Richard Wiley used organizational momentum to keep the ACATS process going, even when all the proposals turned digital or no clear winner emerged from the testing process; the creation of the Grand Alliance is a testament to his will.

FCC Chair Reed Hundt was a player in the broadcast game, though in opposition to much of the broadcast agenda. He used extensive public appearances to argue for spectrum auctions and interoperable systems, but his support was somewhat limited, as HDTV was not as much his priority as children’s television.

The digital convergence strategy during this period was to gain access to the formal FCC process. The players strengthened their position by using technical expertise to create serious proposals, by developing hardware (the proscan camera), and finally by finding powerful allies.

Legitimacy and Salience

Both of these issues are particularly interesting in the case of HDTV. Legitimacy is interesting because, after the failure of the digital convergence game in 1990 to establish an institutional base for developing HDTV within some sort of consortium or industry-government partnership, the FCC was the only existing legitimate forum for approving an HDTV standard. Therefore, the digital convergence players had to enter the broadcast arena in order to influence the new standard. That they succeeded is the result of strategy and circumstance.

The role of salience in this process is, at the end, a surprise. Salience seems a useful tool in predicting outcomes, but in this case it did not accurately do so. The development of the HDTV standard was obviously of greater importance to the participants in the broadcast game than to those in the digital convergence game. Yet in the end, the FCC and
broadcasters were not able to control the process, and the standard we got was much more open and flexible than the broadcast team proposed.

It is only fair, in that case, to ask whether the standard would have developed as it did without the digital convergence game. The answer is: probably no. First, at no point did the broadcast game players ever claim they wanted progressive scan or interoperability. When forced into a corner, they would agree that those qualities were desirable, but in the distant future. Second, the broadcast game only accepted the digital convergence players when forced to do so. The creation of the Interoperability Panel only happened after FCC Chair Sikes agreed to it, and that happened only after the computer company CEOs had reached him. The final compromise between the broadcasters and CICATS members only happened after Bill Gates and Reed Hundt expressed support, seconded by the dramatic growth of the Internet in the outside world. Third, Richard Wiley, consummate Washington insider, polished and genial, was truly furious with the digital convergence players, whom he saw as spoilers, people who in whack-a-mole fashion kept popping up and diverting momentum towards a new standard.

Applying the ecology of games to the development of HDTV explains a great deal about the system developed. It shows clearly that the process was messy and highly subject to changes in external conditions. It shows that the process was partially one of reframing the

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248 Joel Brinkley, *Defining Vision*, reports Wiley's attitude in some depth, and Wiley also made this point clearly in personal communication to the author, October 16, 1993.
issue from television-only to HDTV as a component in an interoperable system. It illuminates the defensive strategies of the power-holders and the strategies and tactics the outsiders used to enter the legitimate process.

However useful the ecology of games is as a clarifying tool, its usefulness as a predictive model on a more precise level is limited. Though it can explain in an interesting way how outsiders gain power, and though it is a real help in illuminating the ways external forces can change power relationships within and between the games, it cannot offer a way to assess in advance the importance of those outside forces. The strength of the ecology of games is at the same time its weakness. Its ability to show how policy outcomes are undirected is the flip side of its inability to predict new outside forces. It could anticipate neither the occurrence nor the effect of such game changers as GI’s decision to submit a digital proposal to ACATS in 1990, the election of a computer networking proponent as Vice President in 1992, or Microsoft’s interest in the proposed standard in 1996.

We live in a time of rapid technological innovation and industrial restructuring. Those vivid pictures the delegates saw in that ITU conference room in 1985 are now available on devices unimaginable at that time. What processes made this abundance possible? Why did we end up with the HDTV we go? The ecology of games helps answer that question.
**Appendix 1**

**Glossary**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACATS</td>
<td>Advisory Committee on Advanced Television Systems - the FCC advisory committee responsible for organizing the development of HDTV</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Organization</td>
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<td>ATSC</td>
<td>American Television Systems Committee - the association that would recommend an HDTV standard to the FCC.</td>
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<td>ATV</td>
<td>Advanced Television</td>
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<td>CCIR</td>
<td>Consultative Committee on International Radio - the part of the ITU that dealt with broadcast communications of all kinds, including satellite transmissions. Now called ITU-R. The telecommunications side of the ITU was the CCITT (telephone and telegraph) and is now ITU-T</td>
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<tr>
<td>CICATS</td>
<td>Computer Industry Coalition for Advanced Television Services</td>
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<td>CIP</td>
<td>Office (or Bureau) of Communications and Information Policy. Part of the US Department of State</td>
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<td>CSPP</td>
<td>Computer Systems Policy Project - an informal association of senior level computer manufacturers</td>
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<td>DRAM</td>
<td>Dynamic Random Access Memory - a memory chip</td>
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<tr>
<td>DTV</td>
<td>Digital television - can be high or the lower quality “standard” definition</td>
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<tr>
<td>FCC</td>
<td>Federal Communication Commission</td>
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<td>HDTV</td>
<td>High definition television</td>
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<tr>
<td>IEEE-OUSA</td>
<td>Institute of Electrical and Electronics Engineers, the international professional association for electrical engineers. IEEE-USA is a unit within IEEE and focuses on public policy</td>
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<td>ITU</td>
<td>International Telecommunications Union, the United Nations organization headquartered in Geneva and responsible for coordinating international communications systems</td>
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<tr>
<td>MAC</td>
<td>Multiple analog component - a technique for combining television signals; the basis for one of the European systems, D2-MAC.</td>
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<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<td>MST</td>
<td>The Association of Maximum Service Telecasters - the television broadcasters’ association</td>
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<tr>
<td>BAB</td>
<td>National Association of Broadcasters</td>
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<td>NHK</td>
<td>The Japan Broadcasting Corporation</td>
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<td>NRC</td>
<td>National Research Council</td>
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<td>NSF</td>
<td>National Science Foundation</td>
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<td>NTIA</td>
<td>National Telecommunications and Information Administration - the communications point office within the Department of Commerce</td>
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<tr>
<td>NTSC</td>
<td>National Television Systems Committee - the name for the color television system in the United States and, with only minor differences, Japan (which used NTS-J)</td>
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<tr>
<td>SMPTE</td>
<td>Society of Motion Picture and Television Engineers - a major private sector standardization organization which dealt largely with video standards</td>
</tr>
<tr>
<td>SRAM</td>
<td>Static Random Access Memory - a memory chip</td>
</tr>
</tbody>
</table>
Appendix 2 – Notes on Video Systems

HDTV vs. ATV vs. HRS vs. HRI vs. DTV vs. SDTV – vs. NTSC

HDTV stands for “high definition television,” which is the new television system that would make television pictures look like 35 mm film. The early proposals for this new system were analog; subsequently they became digital. The Federal Communications Commission (FCC) referred to the new television system as “Advanced Television,” or ATV. In a similar fashion, High Resolution Systems (HRS) is the term the computer industry representatives and their allies used to refer to much improved television pictures, but those pictures were to be the result of a video system compatible with computer technology as well as with television. HDTV, in this compatible format, was to be just one subset of these high-resolution systems. Occasionally the computer and related industry representatives also used the term High Resolution Images or Imaging (HDI) to mean the same thing. Last, when in the 1990s, HDTV proponents changed their proposals from analog to digital systems, the terminology changed as well. Digital Television (DTV) referred to the entire universe of digital TV systems; SDTV referred to standard definition television, technically the rough equivalent to traditional old television, but with a cleaner, crisper picture. The following sets out the various terms:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Name in full</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDTV</td>
<td>High Definition Television</td>
</tr>
<tr>
<td>ATV</td>
<td>Advanced Television</td>
</tr>
<tr>
<td>HRS</td>
<td>High Resolution Systems</td>
</tr>
<tr>
<td>DTV</td>
<td>Digital Television</td>
</tr>
<tr>
<td>HRI</td>
<td>High Resolution Imaging</td>
</tr>
<tr>
<td>SDTV</td>
<td>Standard Definition Television</td>
</tr>
<tr>
<td>NTSC</td>
<td>National Television Systems Committee</td>
</tr>
</tbody>
</table>

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Video Technologies

Film and video are fundamentally different technologies. Film is an emulsion on celluloid; video was analog information captured on magnetic tape. For television viewing, video signals were shot by an electronic gun line by line through a cathode ray tube onto a screen. Until last 2009, the US television system, called NTSC, had 525 lines to each picture. NTSC was developed in 1938 and had only minor fundamental changes since then (the addition of color information was actually not a fundamental change). Because of technical limitations at that time (over sixty years ago), television engineers decided to split the transmission of the video signal, sending first all the even lines and then the odd ones. Since this was all done within a 60th of a second, the human eye would combine the two pictures, or fields, to make one image in the mind’s eye. This system of scanning is known as interlace.

Images on computer screens use a different form of scanning known as progressive. In that system, the lines of a picture appear in order. This technique uses more bandwidth, or room in the radio spectrum, but it produces sharper pictures with none of the problems, known as artifacts, of interlace. It is, for example, easier to read type on a video screen than on a similar-sized video monitor. Nor do spokes on car wheels appear to go backwards when moving forward. The difference is because of the progressive scanning system.

To increase the complexity, there is a difference in the number of lines among different national television standards. NTSC pictures have 525 lines, while the European systems, PAL and SECAM, have 625, also interlaced. There is also a difference in the number of cycles/second of the electrical pulse: US systems work on 60 (actually 59.94) and European on 50. Last, since interlace merges two fields into one frame, its notation is 2:1; for progressive scan, the field and frame rate are the same, and its notation is 1:1. Therefore it is possible to refer to NTSC as 525/60/2:1, meaning 525 scanning lines, 60 cycles/second/interlace. PAL and SECAM would be 625/50/2:1 The Japanese 1125 line systems was 1125/2:1, or often just 1125.

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## Appendix 3

### FCC DOCUMENTS IN MM 86-268

<table>
<thead>
<tr>
<th>Name</th>
<th>Date Adopted</th>
<th>Central Questions &amp; Decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notice of Inquiry</td>
<td>July 16, 1987</td>
<td>Initiated inquiry into Advanced Television Services. Asked about spectrum arrangements, compatibility with existing NTSC services, who should provide services</td>
</tr>
<tr>
<td>Tentative Decision/Further Notice of Inquiry</td>
<td>September 1, 1988</td>
<td>Commission decided that 1. terrestrial broadcast of advanced television services would benefit the public 2. existing broadcasters should deliver new service 3. no additional spectrum awarded for new service 4. viewers must be able to see NTSC during transition period 5. new systems must fit into 6 MHz channels 6. non-broadcast media could offer advanced services as they saw fit</td>
</tr>
<tr>
<td>First Report and Order</td>
<td>August 24, 1990</td>
<td>Commission decided that 1. new system would be simulcast 2. new system should fit into 6MHz channel 3. broadcasters will be lent 2nd channel 3. no consideration of EDTV until after decision on HDTV standard, if at all</td>
</tr>
<tr>
<td>Notice of Proposed Rule Making</td>
<td>October 24, 1991</td>
<td>Commission asked for responses concerning 1. who should initially be eligible for ATV frequencies 2. how the Commission should allot ATV channels to eligible applicants 3. how the Commission should resolve spectrum issues around noncommercial reserve, low power and translator stations, and broadcast auxiliary services 4. how it should regulate the conversion from NTSC to ATV 5. whether the Commission should require simulcasting during transition period</td>
</tr>
<tr>
<td>Second Report and Order</td>
<td>April 9, 1992</td>
<td>Commission decided 1. to restrict eligibility for ATV frequencies to existing broadcasters 2. to adopt a 2-year deadline for broadcasters to apply for ATV channel and 3-year deadline for construction of any facility after channel assigned 3. to leave LPTV with a secondary status 4. to require ATV broadcasters to surrender one of their two channels when ATV is designated as the prevalent medium and to cease broadcasting in NTSC at that time 5. that the firm date for conversion to ATV would be 15 years from selection of ATV system</td>
</tr>
<tr>
<td>Name</td>
<td>Date Adopted</td>
<td>Central Questions &amp; Decisions</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Second Further Notice of Proposed Rule Making</td>
<td>July 16, 1992</td>
<td>Commission asked for responses concerning specific terms on issues related to channel allotments, including what the broadcaster will be rewarded, where in the spectrum, for how long before surrendering a channel.</td>
</tr>
<tr>
<td>Memorandum Opinion and Order/ Third Further Notice of Proposed Rule Making</td>
<td>September 17, 1992</td>
<td>Commission decided on time frames for broadcasters to request additional spectrum, build HDTV broadcast facilities, make the transition to HDTV broadcasting, and finally, surrender their existing NTSC allotments.</td>
</tr>
<tr>
<td>Fifth Further Notice Proposed Rule Making</td>
<td>May 9, 1996</td>
<td>Commission proposed adoption of the ATSC standard.</td>
</tr>
<tr>
<td>Sixth Further Notice of Proposed Rule Making</td>
<td>July 25, 1996</td>
<td>Commission asked for comments about the system for allotment preferences and assignment methodologies for ATV channels.</td>
</tr>
<tr>
<td>Fourth Report and Order</td>
<td>December 24, 1996</td>
<td>Commission adopted ATSC standard without Table 3.</td>
</tr>
<tr>
<td>Fifth Report and Order</td>
<td>April 3, 1998</td>
<td>Commission gave broadcasters 6 MHz for transition channel with few restrictions on use.</td>
</tr>
<tr>
<td>Sixth Report and Order</td>
<td>April 21, 1997</td>
<td>Commission allotted broadcast spectrum for second channel.</td>
</tr>
</tbody>
</table>
Appendix 4

Petitioners to Open the HDTV Inquiry

ABC Television Network Affiliates Association
Allbritton Communications Co.
American Family Corporation
Association of Independent Television Stations, Inc.
Association of Maximum Service Telecasters
B & C Communications, Inc.
Belo Broadcasting Corp.
Bonneville International Corporation
Camellia City Telecasters, Inc.
Capital Cities/ABC Inc.
CBS Television Network Affiliates Association
Chronicle Broadcasting Co.
Columbia River Television, Inc.
Cosmos Broadcasting Corporation
Cox Communications, Inc.
Educational Broadcasting Corporation
Fisher Broadcasting Inc.
Fox Television Stations, Inc.
Gannett Co., Inc.
Gateway Communications, Inc.
Gaylord Broadcasting Co.
Gillet Communications Company
Group W - Westinghouse Broadcasting Company, Inc.
Harte-Hanks Communications, Inc.
Heritage Communications, Inc.
Hubbard Broadcasting, Inc.
Jefferson-Pilot Communications Company
King Broadcasting Co.
Knight-Ridder Broadcasting Inc.
Lee Enterprises, Incorporated
Malrite Communications Group
Meredith Corporation
Midwest Television, Inc.
Multimedia, Inc.
National Association of Broadcasters
National Broadcasting Company, Inc.
Nationwide Communications, Inc.
NBC Television Network Affiliates Association
Outlet Communications Inc.
Post-Newsweek Stations, Inc.
Pulitzer Broadcasting Co.
Ralph C. Wilson Industries, Inc.
Sarkes Tarzian, Inc.
Scripps-Howard Broadcasting Co.
Shamrock Broadcasting, Inc.
Spanish-International Communications Corp.
Spartan Radiocasting Co.
Storer Communications, Inc.
Sudbrink Broadcasting
Taft Broadcasting Company
Telemundo Group, Inc.
The Hearst Corporation
The New York Times Broadcast Group
The Providence Journal Company
Times Mirror Broadcasting Co.
Tribune Broadcasting Co.
WPSD-TV
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Keller, Douglas, “Globalization and the Postmodern Turn.” www.gseis.ucla.edu/faculty/kellner/papers


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Lewis-Williams, J.D. *Stories that Float from Afar: Ancestral Folklore of the San of Southern Africa*. College Station, Texas: Texas A&M University Press. Texas A&M University Anthropology Series Number Five. 2000


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US House of Representatives, Hearing before the Subcommittee on Science, Research and Technology of the Committee on Science, Space, and Technology, One Hundredth Congress, No. 102, June 23, 1988

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*Communications Daily*, January 3, 1984 - May 31, 1997

"Closed Circuit" *Broadcasting*, 21 July 1987

"Day of Decision for World HDTV Standard," *Broadcasting*, March 18, 1985,


"High Definition Standardization is Back on Track," Broadcasting, October 7, 1985

"Small Formats and HDTV Highlight Monteux," Broadcasting, June 17, 1985