Part II

Comparison of Interlaced & Progressive Camera Source Material

Image #	Name/*Attribute*	1050 Interlaced	787 Progressive	1050 Interlaced	787 Progressive
S3	**Wavy Wall** *Luminance Rendition*				
S8	**Toys** *Chrominance Dynamic Range*				
S11	**Woman with Roses** *System-specific "Free-form" Viewing*				
M1	**Window** *Luminance Resolution, Low Acceleration*				
M14	**Co-channel "Texas Dude"*** *System-specific "Free-form" Viewing*				
M16	**Rotating Pyramids** *Electronic Graphics Sequence*				

*The official name of this image is "Co-channel".

Part III
Transconversion ("Xcon") of Images

		1035i-to-960i Lines (Active)				1035i-to-720p Lines (Active)				
Image #	**Name**/*Attribute*	*1035 cs*	*960 Xcon GI (1991)*	*960 Xcon GI (1993)*	*960 cs*	*1035 cs*	*720 Xcon GI (1992)*	*720 Xcon AT&T (1993)*	*720 cs*	*1035 cs*
M5	**Living Room** *Motion Rendition, Camera*									
M10	**Woman & Room** *Motion Rendition, Camera & In-Scene Movement Combined*									
M16	**Rotating Pyramids** *Electronic Graphics Sequence*			XXXXXX						

Xcon = Transconversion
cs = Camera Source

Part IV

Examples of "Transmitted Quality"

Image #	Name/*Attribute*	*1125 Reference*	*Best System**	*Worst System**	*1125 Reference*
S1	**Metal Table & Chairs** *Luminance Resolution*		3	4	
S6	**Sculptures** *Chrominance Resolution,* *System-specific "Free-form" Viewing*		3	4	
S8	**Toys** *Chrominance Dynamic Range*		2	4	
S7	**Fruits & Vegetables** *Color Gamut*		4	4	
S10	**Memorial Arch** *Depth Portrayal*		4	4	
M3	**Paint Store** *Dynamic Chrominance Resolution,* *Low Acceleration*		3	4	
M14	**"Texas Dude"**** *System-specific "Free-form" Viewing*		3	4	
M10	**Woman & Room** *Motion Rendition, Camera &* *In-Scene Movement Combined*		3	4	

* "Best, Worst" as per subjective testing results (ATEL) on four original ATV systems (1991-92).
**The official name of this image is "Co-channel".

JEGI Doc.-053

ADVANCED TELEVISION TEST CENTER, INC.
1330 Braddock Place, Suite 200 • Alexandria, Virginia 22314-1650
703/739-3850 FAX: 703/739-3230

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COVER SHEET

No. of Pages: 3 (includes cover)
Date Sent: 9/29/93

TO: Distribution
FROM: Peter Pan[illegible], Alan Godber

Gentlemen:

Attached is the list of taped materials now planned for screening at ATTC on October 5 for the Joint Experts Group on Interoperability. It includes the four areas of interest identified by the Experts Group (via Messrs. Sanderson, Hearty, Reitmeier) and runs about one hour (including both the NTSC and ATV tapes).

Given the goals of the screening--e.g. familiarization with the considerable work that has already occurred, with the nature of the artifacts identified in the testing, and with the test materials--the presentation will not identify any system or seek to show/compare all four digital systems in all areas. It has also been agreed that the proponents of the original systems will be asked to avoid any discussion of the 'old systems.' Thus, to help in the neutral presentation and Q&A, we have asked those who participated in the February Special Panel screening to reprise their roles as presenters--Paul Hearty (OK), and George Hanover (request pending). Because Jim Gaspar cannot attend, we will pick up that role.

We plan two screenings (one starting at 3:00 p.m. and the other at 4:30), and will adjust the times and/or increase the screenings if the numbers who sign-up get sizable.

Please let one of us know ASAP if you have suggestions or problems with the attached. We have begun to assemble the tape and will present it as described unless requested otherwise by the Experts Group.

***Distribution (FAX#):**

Bob Sanderson	716/253-6284	Paul Hearty	613/592-4398
Irwin Dorros	201/285-0679	Glenn Reitmeier	609/734-2124
Joseph Flaherty	212/975-3646	Dick Wiley/ Paul Misener	202/429-7207
George Hanover	202/457-4985		

Presentation for Joint Expert's Group on Interoperability
Tuesday, October 5th, 1993.

The presentation will include four general topics as detailed below. The total running time of the presentation will be approximately 40 minutes plus time for any questions and reruns of any portion of the presentation. Each image or sequence lasts for approximately 15 seconds.

"Training".

This presentation is to familiarize the audience with the types of impairments which may appear in or be caused by an ATV system, and with the range of impairments and basic quality of images represented by the CCIR rating scales used for subjective assessments.

ATV into NTSC Impairments.

1. An example of NTSC into NTSC transmission impairment and various types of transmission impairments from ATV into NTSC will be shown.
2. The degree of impairment of ATV into NTSC for the 5 CCIR levels will be demonstrated.

Coding and Transmission Impairments into ATV

3. A number of 1125I reference images will be shown followed by a demonstration of various types of coding and transmission impairments to those images.
4. The 5 levels of the CCIR impairment scale will be illustrated by appropriately impaired images. The images chosen were judged to have the degree of impairment on the CCIR scale based on non-expert viewer judgements at ATEL.

Quality Levels of ATV.

5. The CCIR levels of image quality will be demonstrated by a number of images chosen based on the ratings determined by non-expert observers at ATEL.

Interlace versus Progressive.

This presentation will use 6 source images presented alternately in 1050 interlace and 787 progressive formats, with each image repeated once. The images will be as follows:

Wavy Wall	- Still.
Toys	- Still.
Woman with Roses	- Still.
Window	- Camera generated moving image.
Co-Channel	- Camera generated moving image.
Rotating Pyramids	- Electronically generated graphic moving image.

Presentation for Joint Expert's Group on Interoperability

Transconversion

This presentation will use a sequence of moving images showing camera original images in 1125I, 1050I and 787P, and transconverted outputs in 1050I and 787P formats. The transconverted outputs used will show examples of conversion using the NHK/GI transconverter and the AT&T transconverter.

Two different images will be presented as detailed below. In addition, a third image will be shown in two modes as 1125I graphic source and transconverted to 1050I by the NHK/GI transconverter.

1125 Camera, 1050 TC GI (1991), 1050 TC GI (1993), 1050 Camera, 1125 Camera, 787 TC GI (1992), 787 TC AT&T (1993), 787 Camera, 1125 Camera.

Living Room.

Woman and Room.

1125 Graphic, 1050 TC GI (1991).

Rotating Pyramids

Quality.

Several still and moving images will be shown to demonstrate image quality. The presentation will show the 1125I source, followed by the Proponent output image with the best performance based upon the official results of the first round of testing. Next the Proponent output image with the worst performance will be shown followed by the 1125I source. This presentation will be repeated for all of the following images.

1125 (Reference), Best Proponent, (1050I or 787P), Worst Proponent, (1050I or 787P), 1125 Source.

Metal Table and Chairs	Still
Sculptures	Still
Toys	Still
Fruit & Vegetables	Still
Memorial Arch	Still
Paint Store	Camera generated moving image.

Other images to be determined?

DRAFT
asg 9/29/93

Remarks on NII

- CORE - Generic Portion
- MANTLE - Domain Specific Portion

Systems & Applications from the outermost shell

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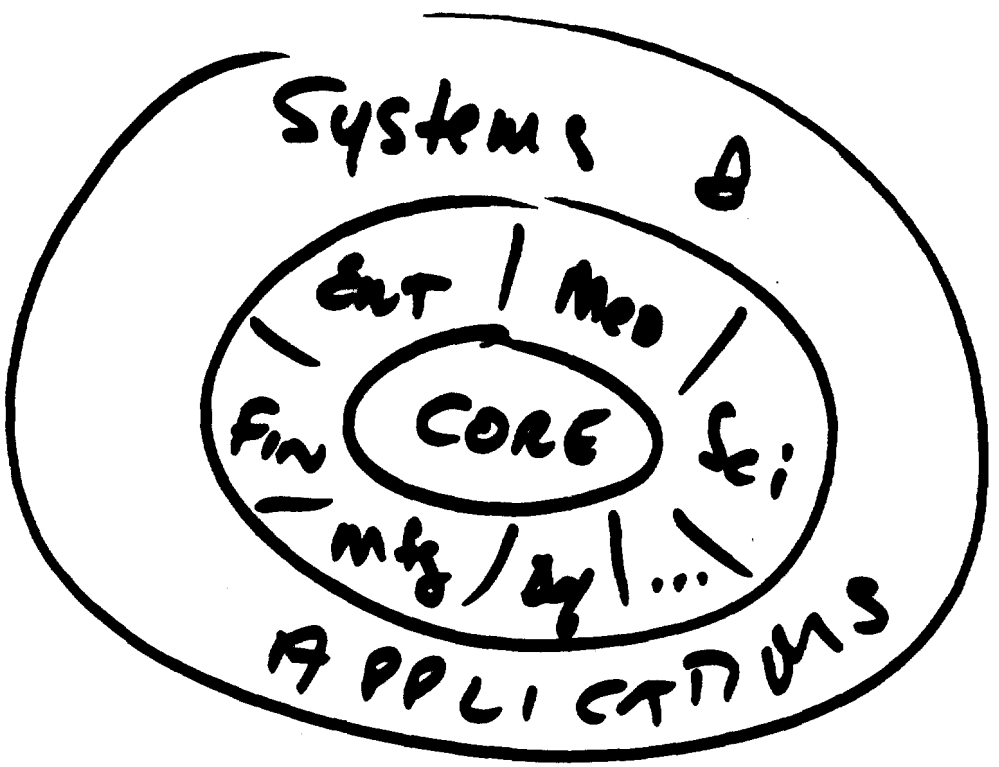

- Networks & Computers & Other I/O are <u>lowest</u> <u>level</u>

- Key <u>new</u> element is the <u>MIDDLEWARE</u>!

- ARCHITECTURE Depends ~~critically~~ Karmacly on Process for Mgmt of NII Evo

- STANDARD interfaces (servers particularly)
  STANDARD objects
  Degrees of Active Agent Behavior

- Organic Evolution
  Models economic developments & Activity

- Information Marketplace

SETTING THE CONTEXT

Needs BACKGROUND & RATIONALE
CURRENTLY STATED

ISSUES TO DISCUSS

- How to interpret Modularity
- What is & what is not Scalable within the Architecture
- Scope of Presentations & Environments
- Architectural vs Efficiency Considerations
- Internal vs External Capabilities (including internal visibility)
- Sequential, Non-Seq, Best Effort transmission, Delivery, Presentation
- Burst Management for Catch-up
- Public & Private & Dedicated Channels

what can over-air receiver do

How to Incorporate

1. Last Mile as "General purpose" distribution mechanism (as well as special purpose)

2. Relation of proposed approach (apm to NII and Info. Marketplace

3. International developments (somewhat gracefully)

4. Storage & Retrieval of Multi-Media works (wrt specific formats and contents)

5. Knowledge Attachments

6. Rights Management in Network Environment (Automated or Semi-Auto)

7. Role of Internet

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Joint Experts Group on Interoperability - Attendance List (6 & 7 October 1993)
[* = 6th Only, ** = 7th Only]

NAME	AFFILIATION	TELEPHONE/TELEFAX
Baron, Stan	NBC	212-664-7557/212-664/5219
Baylor, Dave	Direct-TV	310-535-5051/310-535-5224
Beasley, Roy*	Howard Univ.	202-806-1609
Bellisio, Jules	Bellcore	908-758-2959
Bretl, Wayne	Zenith	708-391-8386
Bronson, Barry	HP	415-857-3033
Cloutier, Leo*	Comsat	301-428-4080/301-428-9287
Connolly, William	Sony Pictures	310-280-6902/310-280-1866
DeFanti, Tom	Siggraph	312-996-3002
Demos, Garry	DemoGrafx	310-837-2985/310-837-1576
DeYoung, Tice	ARPA	703-696-226x/703-696-2202
Donahue, Joe	Thomson	202-872-0672/202-872-0674
Dorros, Irwin*	ACATS-Tech.Subc.	201-285-1266
Elliott, Dennis	Elliott Communic.	703-759-7456/703-759-6828
Fannon, Peter	ATTC	703-739-3850/703-739-3230
Fenimore, Charles*	NIST	301-975-2428
Fleischhauer, Carl	Library of Congress	202-707-6233
Fowler, Thomas*	MITRE	703-883-7912/703-883-5914
Fuhrer, Jack	Hitachi-Amer.	609-520-1320/609-520-8953
Gerovac, Branko	Digital	617-253-0669/617-489-5917
Godber, Alan	Consult.(ATTC)	908-846-4476/908-846-4476
Gravel, Arthur	Delta Info. Sys.	215-657-5270/215-657-5273
Greebe, C.A.A.J.**	Philips Labs	914-945-6102
Hack, David**	Library of Congress	202-707-7067/202-707-7000
Haley, Mike	IBM	914-894-4723/914-892-6799
Hamalainen, Jukka	Matsushita	609-386-5995
Hanover, George	EIA	202-457-4979/202-457-4985
Hearty, Paul	ATEL.CRC	613-592-1727/613-592-4398
Hopkins, Robert	ATSC	202-828-3130/202-828-3131
Hummel, Rob	Disney	818-754-7259
Hurst, Norm	DSRC	609-734-2925/609-734-2901
Izenberg, Neil	Nemours Found.	303-651-4049
Johnson, Clark**	DOHRS	612-377-2329/617-377-1704
Kahn, Robert	CNRI	703-620-8990
Kalil, Thomas**	White House	202-456-2801/202-456-2223
Keeler, Bob	AT&T	908-949-7982/908-949-5775
Lechner, Bernard*	Consultant	609-924-7545/609-924-7547
LeGall, Dedier	C-Cube	408-944-6353/908-944-6314
Liebhold, Michael	Apple	408-974-6025
Longbottom, Jeff**	ATTC	703-739-3850/703-739-3230
Maddocks, J.A.*	UTC	617-864-0201/617-864-5855
Melmed, Arthur*	Rand	202-244-9056
Misener, Paul	W,R,&F	202-828-7506/202-429-7049
Monteith, Don	Rogers Cable.	416-442-2845
Neil, Suzanne	MIT	617-253-4138/617-253-7326
Parulski, Ken*	Eastman-Kodak	716-477-4652
Patten, Tom**	Philips	202-962-8550/202-962-8560
Radwill, Bill	AT&T	908-221-5165/908-221-8484
Rast, Robert**	GI	619-535-2532/619-535-2486
Reitmeier, Glenn	DSRC	609-734-2523/609-734-2149

Roberts, Mike*	Educom	202-331-5347/202-872-4318
Rodgers, Quincy	GI	202-833-9700/202-466-3295
Sanderson, Robert	Eastman-Kodak	716-726-7763/716-7253-6284
Smarr, Larry	NCSA	217-244-0078
Solomon, Richard**	MIT	617-253-5159/413-267-5172
Sproull, Bob	Sun Microsystems	508-442-0353
Symes, Peter	GVG	916-478-3437/916-478-4195
Tanner, Craig	CableLabs	303-939-8500/303-939-9189
Tawil, Victor**	MSTV	202-462-4351/202-462-5335
Uyttendaele, Tony	CC/ABC	212-456-1227/212-456-6089
Van DeGrift, Craig	NIST	301-975-3828
Walsten, Douglas	NCSA	217-244-6390
Weaver, John	Liberty TV	212-864-4999/212-864-1771
Wedam, Werner	Sharp	201-529-8618/201-529-8425
Weitzner, Daniel*	Electronic Frontier	202-347-5400/202-393-5509
Widoff, Joe*	ATTC	703-739-3850/703-739-3230
Wiley, Dick*	Chairman, ACATS	202-429-7010
Zou, William	PBS	703-739-5475/703-739-8938

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October 12, 1993

Dear Robert:

This letter is a follow-up to the October 6-7, 1993, meeting of the Interoperability Panel ("panel") associated with the Federal Communications Commission (FCC) development of the transmission standard for the Advanced Television System (ATV) proposed by the Grand Alliance (GA). This letter is my statement (as a panel member) to the chair of the Joint Experts Group on Interoperability.

Two factors make it difficult for me to compose a response. First, my technical knowledge is at a layman's level and, in any case, the Library of Congress has less of a stake in the details of a transmission standard than do participants from the industry.

Second--and more important--there is a disjunct between the panel's "charge" and my perception of a greater "need." A strict interpretation of the charge would limit commentary to the technical details of the transmission standard. At the same time, the meeting of this panel and the Joint Experts Group appears to provide the only formal opportunity for comment on the connections between ATV development and the emergence of an effective National Information Infrastructure (NII). The perception of the need to discuss this connection motivated the remarks offered by several panelists at the meeting and also motivates my follow-up letter.

The Library of Congress has a profound stake in nurturing the rapid and complete development of the NII. The Library feels a strong need to ensure the most widespread dissemination of both information (software) and access tools (hardware) to the American people. The American Memory project is one of several Library of Congress activities that will employ the NII to provide reference, historical, and other educational materials to the American people.

The Library's role, of course, is that of an information creator and--in some cases--provider. We have created an extensive catalog of our holdings and provide access to it via Internet. We have begun digitizing important historical collections and look forward to working with other organizations to provide national access to these materials. We view national electronic access as the logical expansion of the reading-room access we have offered in Washington for two centuries. We believe that effective presentation of Library of Congress information will depend upon several technical features discussed at the panel meeting: progressive scan for clear reproduction of text and images, s

pixels, imbedded headers, conformance to standard approaches like MPEG-2, etcetera.

We understand that the GA has proposed a modular and versatile system that includes the above-named technical features as optional elements. The GA states their sympathy with the desire to ensure the presence of an NII-capable display monitor in most American homes, but argues that the current discussion is limited to the transmission standard. Demands pertaining to hardware, the GA argues, ought to heard in another forum.

My counterargument is that the discussion of the transmission standard is, in fact, part of a broader negotiation within the nation and that this occasion is a reasonable one for the articulation of broad ideas. The case for stating "policy" positions at this time reflects the lack of other ATV forums devoted the convergence of what is called "television" with the other forms of data-dissemination. In this regard, I endorse the October 4, 1993, letter to the Joint Experts Group from Bob Myers of the Hewlett-Packard Company. Myers's technical commentary is very thorough and persuasive but, in this context, I commend the following three sentences:

> As the GA report itself notes, what is being discussed is a transmission standard--not a production standard and not a display standard. However, while it is true that production, transmission, and display are decoupled in a digital system, we cannot neglect the impact that standards in any of these areas will have on the other two. They are decoupled but cannot be considered unrelated.

Thank you for inviting me to be a member of the panel; I hope my remarks are of assistance. I have sent copies of this letter to some of my Library of Congress colleagues, inviting them to review the documents you and the GA provided. If any of them have particular comments, I will suggest that write to you. Meanwhile, please let me know how else I can be of service. Best wishes.

Sincerely,

Carl Fleischhauer
Coordinator, American Memory

Mr. Robert L. Sanderson
Eastman Kodak Co.
Image Telecommunications Center
1447 St. Paul St.
Rochester, NY 14653-7102

cc: Mr. Michael Liebhold

JEGI Doc.-057

THE GRAND ALLIANCE[1]

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CAST Working File 1993-007
September 1993

Center for Advanced Study in Telecommunications
210 Baker Systems/1971 Neil Avenue
The Ohio State University
Columbus, OH 43210-1271

(614) 292-8444

1. Introduction

The announcement in May, 1993 that system proponents of a terrestrial, broadcast standard for advanced or high definition television (ATV, HDTV) in the United States were forming a Grand Alliance to propose a merged system to the Advisory Committee on Advanced Television Systems (ACATS) for its recommendation to the Federal Communications Commission (Commission, FCC) has all the appearance of placing the selection of a terrestrial HDTV broadcast standard for the United States in its end game. The proposed merged system integrates components from an interlaced (alternate line scanning) HDTV system proposed by the Advanced Television Research Consortium (Compression Labs, NBC, the David Sarnoff Research Center, North American Philips, Thomson Consumer Electronics), a progressive system (line by line scanning) proposed by AT&T and Zenith Electronics, and a progressive and an interlaced system developed by General Instrument and the Massachusetts Institute of Technology. As such, the Grand Alliance presents a single, merged system for Advisory Committee and FCC approval.

Despite the considerable and promising development of an alliance of proponents seeming to offer a tentative promise of industry peace, the end game for standardization of terrestrial broadcast HDTV technologies promises to be as turbulent as earlier disputes over NHK's MUSE systems, Eureka's HD-MAC program and contests in

the United States in the eighties for now abandoned analog HDTV systems.

Industrial interests in the computer, imaging, publishing and telecommunications industries, together with users in education and medicine, want to make as sure as possible that the United States's terrestrial HDTV system will transcode easily with media, data, video, graphics and voice they produce, carry or use. Computer manufacturers especially insist upon progressive scanning displays and square pixels to promote scale economies for subcomponent systems useful alike to the television and computer industries. In this sense, the computer industry and others are demanding that the consumer electronics and broadcasting industries recognized that imaging is much more than a fixed, point to multi-point system, and is instead modular and capable of many production, transmission and reception formats, and, as such, consumer electronics and broadcasting must accommodate requirements of these other interests for interoperable operation.

As a result, the HDTV end game for a terrestrial broadcast standard brings to the forefront a host of non-broadcast technical concerns and demands, specifically progressively scanned displays, square pixels and "interoperability." Progressively scanned displays present sequential line by line imaging rather than alternate line or interlaced imaging and

offer greater resolution with less eye fatigue. Square pixels enable greater graphic and computer generated imaging on HDTV displays. Both progressive scanning and square pixels have long been standards in the computer industry. The computer industry routinely manufactures progressive displays with square pixels with superior resolution to interlaced television receivers. The FCC defines "interoperability" as "the capability of providing useful and cost-effective interchange of electronic image, audio and associated data: among different signal formats, among different transmission media, among different applications, among different industries, among different performance levels."[2]

Industry and government must now decide the policy and technology trade-offs between and among these sectors and the public interest benefits and costs associated with them. Interests across all the affected sectors are jockeying for advantage in defining the technology of the proposed, merged system which the Alliance will propose.

This essay attempts to place the emergence of the Grand Alliance in a comparative perspective and to detail some key technological components of the Alliance's proposed system. It details some of the controversy surrounding the proposed technology. It contends that interoperablity, progressive scanning and square pixels serve the public interest better than interlaced scanning and a terrestrial, broadcast HDTV system, which is not interoperable

and does not have square pixels on the grounds that interoperability, progressive scanning and square pixels provide greater opportunities for economic growth through greater flexibility with the computer, imaging, publishing and telecommunications industries.

2. Background

2.1 Europe

The situation and the politics surrounding high definition television in the United States, though distinct, can be usefully contrasted with those in Europe. At present, research and development in Europe, building on work on digital radio, is pioneering development of single frequency networks employing orthogonal frequency-division multiplexing (OFDM) for television. Highly efficient in terms of spectrum, OFDM offers the potential of greater programming of superior technical quality employing less spectrum. (Davies, Screiber) In Germany, PALplus, an improved version of phase alternate line (PAL) technology, is making headway, and seems to offer the strategic benefit of enabling simulcast HD-MAC and PALplus programming with 16:9 aspect ratios. The likely simulcast scenario seems to be satellite delivery of MAC signals and terrestrial, cable and satellite delivery of PALplus. (Reimers)

At the same time that Europe is pioneering OFDM, the European Community is promoting, although at a third estimated

projections, evolutionary steps toward High Definition-Multiplex Analog Component (HD-MAC) television by subsidizing new programming produced in a 16:9 aspect ratio. This spring, the Community set aside $200 MECUs through 1996 to promote 16:9 programming (625 or 1250 lines) for European broadcasters. Funds are to be allocated as a function of the number of hours produced and broadcast in a 16:9 format. Support will vary according to the effective cost of the type of program and its technical quality, and the EC will offer more money for new productions. (CTM) The EC's allocation builds on an earlier directive in May, 1992 specifying HD-MAC for all not fully digital HDTV satellite transmissions and D2-MAC for all not fully digital 625 line, 16:9 satellite transmission and mandating that 16:9 receivers, for sale as of January, 1994, will have to have decoding capacities for D2-MAC signals and that receivers with other aspect ratios will have to be equipped with D2-MAC decoders. (Reimers)

Earlier, in 1992, HD-MAC productions at the Winter Olympics in Albertville, France and Summer Olympics in Barcelona, Spain successfully showcased 1250-50 high definition television with five to twelve hours of broadcasts daily. For the winter games, a 1250/50 video signal with stereophonic sound and commentaries in four languages and for the summer games, monophonic sound with commentaries in five languages constituted HDTV programming. Producers encoded the video signal to HD-MAC, the signal was then multiplexed with international sound and commentary channels

employing Thomson and PKI encoders. The HD-MAC signal then went through combinations of satellite, dbs, fiber optic and microwave transmission for continental reach. (Oudin)

Europe arrived at this hybrid digital-analog situation of 1) developing single frequency networks employing orthogonal frequency-division multiplexing (OFDM), and 2.) sponsoring the evolution of simulcast HD-MAC and PALplus television, because technological advances in digital signal processing are obsolescing MAC technologies, because market forces, principally initiated by Rupert Murdoch's Sky TV, frustrated the planned roll-out of a MAC technologies, and because the EC is pursuing roll-out of programming and hardware with MAC-compatible aspect ratios. When the European Community sponsored Project Eureka to develop high definition television in 1986, technologists sensibly pursued then dominant analog technologies, and devised a high definition television chain capable of delivering 1,250 lines of resolution at 50 frames per second in 12 MHz of spectrum and thereby offered double the vertical and horizontal resolution of PAL and SECAM with a 16:9 aspect ratio. MAC technology uses a compressed analog transmission with digital sound. A digital information stream enables receivers to decode pictures and analog technology enables MAC to be downwardly compatible with PAL and SECAM. However, to mitigate technical problems with color and noise pollution (cross color and cross luminance) from interlaced PAL and SECAM technology, technologists selected

component rather than composite signals and digital audio. (Corcoran) Advances in digital source and signal coding technologies in the late eighties and early nineties now limit the utility of the 1,250/50 analog format.

In terms of market forces, in June, 1988, Murdoch's News Corporation combined with the Astra satellite, which offered 16 channels in different languages using 16 fifty-watt medium-power transponders, to deliver PAL programming by satellite. In the fall of 1989, Murdoch stepped up Sky marketing by offering a subscription package in the U.K. of 4.49 pounds sterling/week and by giving satellite dishes to targeted subscribers of News Corporation publications to spur neighbors to rent dishes to build a subscription base. By 1992, over 3 million subscribers were tuning to PAL satellite broadcasts delivered by Murdoch. The failed British Satellite Broadcasting (BSB) firm had been slated to bring D-MAC, the first of the evolutionary steps toward HD-MAC, to market. However, when BSB did air programming the competition with Murdoch interests was so cut-throat that a merger proved necessary and eventually gave Murdoch the upper hand, and forecast PAL, rather than MAC, satellite programming for the late eighties and early nineties as the dominant satellite programming.(Shawcross) Indeed, the evolutionary path to MAC technologies was so frustrated that one observer remarked in a 1990 study that "ten years ago there was a widespread expectation among MAC's proponents that by the early 1990s, there

would exist in Europe, through the growth in satellite broadcasting, a large installed base of 625 line MAC receivers, which would provide broadcasters with a sold platform on which to launch high-definition services in the MAC format. These hopes have clearly not been fulfilled." (Niblock at 104)

Additionally, the EC's evolutionary path to HD-MAC suffered a planning flaw. European consumers and broadcasters resisted two upgrades and the appearance of paying the capital costs of developing and commercializing HD-MAC by purchasing a generation of D2-MAC studio and consumer equipment. (Corcoran)

Coupled with a base of PAL satellite receivers, consumer and broadcaster reluctance for double upgrades set the preconditions for simulcast analog and digital HDTV. Therefore, in Europe, in 1993, hybrid systems defined by the interplay of technology, planning and market forces are producing both the most promising, spectrum efficient, digital HDTV transmission technology and the apparent emergence of simulcast analog MAC and PALplus television.

2.2 Japan

In Japan, NHK is broadcasting 8 hours a day of high definition television by satellite, and commercial broadcasters are transmitting enhanced NTSC programming. Japan developed high definition television through extensive research initiated

following the 1964 Tokyo Olympics. (T. Hamasaki, T. Fujio, and T. Ohtani, (1973); T. Ohtani, T. Fujio, T. Hamasaki, (1976); Y. Ninomiya and B. Prasada, (1979); T.Fujio, J. Ishida, T. Komoto and T. Nishizawa, (1980); T. Fujio, (1980); T. Fujio (1981); Y. Ninomiya and Y. Ohstsuka, (1982); Y. Ninomiya, Y. Ohstuka, Y. Izumi, S. Gohsi, and Y. Iwadate, (1987). Despite initial American encouragement, principally from broadcasters, Japan's HDTV system ran afoul of European consumer electronic interests just short of winning international approval as a television standard in 1986. Its demise loosed development on television technology in Europe and the United States. These developments are now producing significant innovation in digital technologies and prompting participation by non-broadcast interests in the terrestrial, broadcast HDTV standard.

As a result of its initial commitments to analog HDTV, Japan seems headed toward standardization and adoption of analog HDTV technologies for its domestic market. In August, 1993, Matsushita Electrical Industrial Corporation, Hitachi Ltd., Sharp Corporation and Mitsubishi Electric Corporation rebuffed a proposal from Sony Corporation for a digital video standard and announced that they would manufacture HDTV equipment for the Japanese market using an analog video system format that the Victor Company of Japan (JVC) developed for Japan's Hi-Vision system. JVC's W-VHS system is compatible with existing VHS components and production facilities. The compatibility enables

manufacturers to develop hardware at lower costs according to JVC. It seems that downward compatibility is driving Japanese decision-making for its domestic HDTV market, reflecting significant investments in analog Hi-Vision since 1964.

As to global markers, Japan's consumer electronics manufacturers are well prepared to contest digital HDTV markets. In the American market, for example, Japanese consumer electronics like their European competitors, are poised to manufacture digital HDTV. With the goal of international standardization of analog HDTV dashed in 1986, Japanese manufacturers have had plenty of time to plan for analog and digital HDTV formats in different regional markets and to adjust strategy accordingly. Therefore, downward compatibility for analog HDTV in Japan and competition in digital system formats elsewhere is emerging as Japanese consumer electronics industry strategy.

2.3 The United States

In the late eighties and early nineties, industrial policy for HDTV differed appreciably from the European scene of planners and technologists attempting fruitlessly to head off a quick-footed media maverick. In the United States, by contrast, a very public debate raged over the propriety of state selection of so called HDTV "winners and losers." The most notable study associated with the policy that state action would have been improper was Cynthia Beltz's High Tech Maneuvers: Industrial Policy Lessons of HDTV