

European Policies Toward HDTV

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■ Introduction

The international politics of HDTV standards began with an effort by Japan to internationalize its domestic HDTV standard by taking it to an international standards forum. After NHK initially gained the upper hand in Japanese domestic standard-setting, it tried to consolidate its position through ties to American users of the new technology (the television networks and Hollywood studios) whose behavior would affect the attractiveness of NHK's standard among its domestic partners and rivals. NHK then used that transnational coalition in an attempt to globalize its specifications in the CCIR, which would have further strengthened its position at home. Compromises made in order to secure American collaboration backfired, however, as they alerted the European Commission to the potential threat to European competitiveness.

As the guardian of the "Community interest", the Commission played up the potential harmful consequences of global adoption of a Japanese standard for the market position of European electronics and audiovisual producers. The Commission then forged a blocking coalition with producers and PTT's that enabled Europe to forestall a choice on global standards.

The European delay activated American interests which had hitherto been passive about the issue, sparking debate in America with respect to the technology's consumer and strategic implications and rekindling a competitive standards-setting process in the US (1). Eventually the results of the American HDTV "contest" helped change the perceived range of options in Europe, bolstering the position of opponents of the original EC coalition's standard. Technological setbacks and innovations during the course of negotiations helped recast players' interests and power, as did bargains struck to create or maintain coalitions in various arenas.

■ Japan's HDTV Headstart

The story of HDTV in Japan began in 1964 with the decision of Japan's national broadcaster, NHK (Nippon Hoso Kyokai or Japan Broadcasting Company), to begin research on next-generation television technologies. Prior to and during the 1964 Tokyo Olympics, there was a major jump in TV sales in Japan. NHK's revenues depend directly on the number of Japanese households with television receivers. The dissatisfaction of engineers at NHK's Technical Laboratories with the quality of television coverage of the Tokyo Olympics, combined with the improved ability of NHK to finance television research, was the main reason NHK Labs began research on advanced television technologies in 1964.

From that point on, NHK remained the key actor pushing for HDTV in Japan. NHK's leadership depended critically on its control over the core technologies for Japan's version of HDTV. Because NHK enjoined by law not to engage directly in manufacturing activities, it began in 1970 to assemble a coalition of manufacturers to support its work on HDTV technologies. It succeeded in this task and then used the coalition to win support for national HDTV standards as early as 1984.

After this, NHK began to build bridges to powerful American interests who could serve as a base of foreign support for NHK's efforts to internationalize Japan's HDTV standards. One of NHK's principal interests in doing this was to reduce the cost of obtaining high quality programming for HDTV broadcasting in Japan. It made sense to work with the Hollywood studios who would have to agree at minimum to allow their film libraries to be converted to HDTV video formats for broadcasting and VCR viewing.

(1) The most important of these were consumers, local broadcasters, and electronics manufacturers.

The US television networks and the independent film and video studios were major potential sources of new programming material as well, and would also be purchasers of HDTV production equipment.

Part of the NHK strategy for internationalizing its Hi-Vision standard was to argue for the need to have a single global standard for HDTV, in contrast to the multiple standards for color TV (NTSC, PAL, SECAM and the MAC standards). This was a concern strongly shared among the network and film production communities, especially as the costs of converting from film to video and across different video standards has had an important effect on the profitability of internationally-oriented media businesses. People who made films or video for a living were tired of having to worry about compatibility problems and paying the costs of conversion across regional standards boundaries. In addition, they were eager to reduce the post-production costs associated with editing films and adding special effects to them, a goal they hoped to accomplish by shooting more of the original "footage" in HDTV formats. In sum, NHK's vision of a unified, global standard for HDTV had a lot of appeal in America.

NHK argued that the unified, global standard for HDTV production should be Hi-Vision because all the existing equipment for HDTV was being built (in Japan) to those standards - theirs was the only game in town. After all, when standards had been adopted for color TV years earlier, the American standard, NTSC, prevailed in Asia and America because US producers dominated the market. If the relevant technologies were predominantly Japanese now, why not follow their lead?

NHK's dealings with American broadcasting and film-production interests did nonetheless result in an important adjustment in the Japanese approach to HDTV. NHK came to the United States with a Hi-Vision system that had (among others) the following parameters: 1125 scanning lines, 59.94 fields per second for interlaced displays, and a 5:3 aspect ratio for displays. American film and video engineers convinced NHK to alter these parameters somewhat. The former argued that a field rate of 60 fields per second was more likely to be acceptable to the Europeans than the proposed rate of 59.94 because it was different from both the current European and the American field rates. In addition, they suggested an aspect ratio of 16:9 was more appropriate than 5:3 for display of wide-screen motion pictures (see Table 1) (1). NHK altered the Hi-Vision

(1) Based on interviews by Ellis Krauss with Masao Sugimoto, Managing Director of NHK Labs in May 1991 and US representatives to the CCIR in March 1989 (KRAUSS, 1992)

parameters accordingly and the American National Standards Institute (ANSI) approved the modified 1125/60 system -now also designated as SMPTE 240M- as a "voluntary consensus standard" (JOHNSON, 1990, p. 7). As it turned out, this effort at compromise would come back to haunt NHK as others came to see the modifications as efforts to make Hi-Vision totally incompatible with NTSC and PAL/SECAM systems.

Table 1 - Aspect Ratios for Various Video and Film Systems

Name of System	Aspect Ratio
NTSC, PAL and SECAM	4:3 or 1.33:1
35 mm photographs (4 "by 6")	3:2 or 1.50:1
Initial Hi-Vision	5:3 or 1.67:1
Modified Hi-VBision	16:9 or 1.78:1
Vistavision	1.85:1
70 mm Wide Scope	2.20:1
Cinemascope and Panavision	2.45:1

Source : Talk delivered by Eijhi KANEKO, Director of Giant Technology Corporation at the annual meeting of the Society for Information Display, Anaheim, California, May 7, 1991 (JOHNSON & JOHNSON, 1992, p. 116).

NHK developed close agreement with the main US bodies involved in HDTV, the Society for Motion Picture and Television Engineers (SMPTE) and the Advanced Television Systems Committee (ATSC) (1). Together this alliance helped convince officials at the Department of State to formally adopt the modified Hi-Vision approach to HDTV production as the US position in April 1985, despite objections from at least one large American manufacturer, RCA (SCHREIBER, 1989, p. 5). The State Department later led the US delegation at the plenary meeting of the CCIR (Consultative Committee on International Radio) in Dubrovnik in 1986 (see the next section). At the meeting, the US government supported the Japanese proposal for making Hi-Vision a global HDTV production standard (2).

(1) This latter group included SMPTE, the National Association of Broadcasters (NAB), the Electronic Industries Association (EIA), the Institute of Electrical and Electronic Engineers (IEEE), and the National Cable Television Association (NCTA).

(2) For a detailed analysis, see CHAMBLIS NEIL, 1988.

■ The EC Blocks Adoption of a Modified Japanese Global Standard

In international standards forums, the Japanese government adopted a stance of global leadership, arguing for the need to replace the divisive multiple standards of the contemporary color TV world (NTSC, PAL and SECAM) with a new unified global standard based on Hi-Vision. Although important allies in the US backed the proposal, other influential groups in Europe and the United States perceived the Japanese proposal to be part of a general effort to consolidate Japan's dominance in consumer electronics and therefore proceeded to block the NHK initiative. Nevertheless, the rapid rise of Japan to dominance in the consumer electronics industry recast perceptions of the issue of global standards, particularly for Europe.

At the CCIR meeting in Dubrovnik, the Europeans strongly opposed acceptance of Hi-Vision as a global standard. The reasons for this are complex, but in essence, they sprang from European concerns that their consumer electronics, film and television production firms would lose out to US and Japanese producers by the acceptance of a Japanese production standard for HDTV.

The Europeans believed that even though the CCIR was being asked only to endorse the Hi-Vision production standard, such a decision would eventually translate into a general adoption of Japanese HDTV transmission and reception standards. Their own earlier strategy of survival in consumer electronics had depended on maintaining incompatible regional color TV standards (PAL and SECAM) (1). Consistent with its focus on the single market, the Commission was trying to get beyond multiple standards within Europe by migrating away from both PAL and SECAM to a new set of standards based on the idea of multiplexed analog components (MAC). The MAC standards were well-suited to signal delivery via direct broadcast satellites -the preferred method for both France and Britain- and they could be upgraded easily to produce higher resolution and wide-screen images. But the MAC standards were incompatible with Hi-Vision, because they were based on multiples of 625 scanning lines and a field rate of 50 fields per second, as opposed to NHK's respective parameters of 1125 and 60 (2).

(1) On this topic, see CRANE, 1979.

(2) At first the Europeans claimed that downconversion was impossible, but then argued -after seeing working Japanese prototype downconverters- that it was just too expensive.

Beyond the technical costs was an overriding political concern: it would be difficult to continue the strategy of harmonization of broadcasting within the region while excluding foreign TV manufacturers if the EC went on record as supporting Hi-Vision as a global production standard. The European manufacturers did not want to make things easier for their Japanese competitors in consumer electronics. Notably, though, it was not the manufacturers but rather officials from the European Commission who flagged the CCIR discussions of HDTV standards as an important issue for the Community. The European delegates to the CCIR were instructed to delay the acceptance of Hi-Vision as an international standard by calling for "more studies". They also submitted a proposal for an alternative "standard" based on speculation about Europe's ability to build a system with 1250 scanning lines and 50 fields per second. This effectively postponed further CCIR consideration of the Japanese proposal for four more years (1).

■ The European Approach to HDTV

The Europeans were concerned that adoption of 1125/60 as a world production standard would damage their chances of participating in HDTV equipment markets. The largest European consumer electronics producers -especially Philips, Bosch and Thomson- therefore supported a European response to the Japanese HDTV initiative. There were two main thrusts to this response: 1) negotiation of an agreement to do away with the multiple television standards within Europe and 2) new funds for collaborative R&D in high definition technologies.

As of the mid 1960s, Europe had two main color TV standards -SECAM (*Séquential à mémoire*) and PAL (Phase Alternative Line). SECAM was invented in France, PAL in Germany. While both PAL and SECAM have the same number of scanning lines, 625, the two standards are incompatible at the signal level (need to check accuracy of this -get info on problems of building multistandard equipment). Most of Western Europe adopted the PAL standard, while France and the Soviet Bloc adopted SECAM (CRANE, 1979 ; NOAM, 1991, pp. 294-296).

(1) It should be noted that a modified version of the Hi-Vision 1125/60 was adopted as SMPTE 240M by the American National Standards Institute (ANSI) in 1988. However, ANSI withdrew its approval of SMPTE 240M in 1989 after Capital Cities/ABC appealed the original decision (JOHNSON, 1990). The CCIR met again in 1990 to consider HDTV production standards and again delayed a decision for four more years.

When new standards were developed for satellite transmission, the attempt to improve upon the old technologies inherent and PAL and SECAM resulted in a further proliferation of incompatible standards in Europe. By the early 1980s, renewed momentum behind a single market meant that there would be support for negotiating unified European television standards for the various delivery media. An additional factor was the expiration of the patents for PAL and SECAM technologies and the subsequent entry of Asian electronics firms into European markets for color televisions. Efforts to create a genuinely European market for television equipment and services without making it easier for Asian firms to dominate equipment markets had a major impact on strategies for HDTV. To understand how this happened, we need to go back to the standards originally developed for satellite transmission, the MAC standards. We also need to place the standards question in the context of the Community's move toward use of the single market as the cornerstone of industrial policy.

■ The origins of MAC

The MAC (multiplexed analog components) standards were developed originally by the Independent Broadcast Authority (IBA) in England (1). MAC signals are suited to satellite delivery because they are analog and fit within the bandwidth limits of existing satellite transponders (27 Megahertz). One cannot receive MAC signals on existing PAL and SECAM sets, however, and direct reception in homes is impossible without the use of higher power satellites at the transmission end, and of a satellite dish and decoder at the reception end.

MAC was designed to be consistent with an international standard, CCIR 601, negotiated in 1982 at the CCIR plenary. One version of MAC, C-MAC/Packet, was adopted as a European standard by the European Broadcasting Union (EBU) in 1982. While Britain adopted C-MAC, France and Germany balked at the cost of C-MAC receivers and adopted a D-MAC standard deliverable by cable. The French and the Germans then developed yet another type of MAC, D2-MAC, which like D-MAC could be delivered either by cable or by satellite, but which could be easily upgraded to higher levels of picture resolution. D2-MAC/Packet was adopted as an EBU standard in April 1985. Distinctive variants of the MAC standard

(1) The IBA was privatized in October 1991 and renamed National Telecommunications Ltd (NTL).

(B-MAC, C-MAC, D-MAC and D2-MAC) were adopted for use by public broadcasters in Britain, France, Germany and the Netherlands, but few MAC receivers were sold initially and there were problems with the launching and/or operation of new DBS satellites. Nevertheless, unlike PAL and SECAM, MAC was designed in such a way as to make it relatively easy to upgrade signals to higher resolutions without losing backward compatibility. This made it possible for Europeans to envision a gradual evolution from PAL and SECAM, to MAC, to enhanced MAC (with wide-screen capability and better sound) and finally to HD-MAC (JURGEN, 1991, p. 28 ; WATSON-BROWN, 1987, pp. 3-11, 1988a, pp. 21-24, 1988b, p. 70).

■ EC Policies for Technological Competitiveness: Frameworks for an HDTV Response?

Although analyses of the Single European Act sometimes point to the importance of the "new approach", moving from mandatory harmonization to mutual recognition of national regulations, it is important to recognize that the number of common standards has grown significantly as part of the creation of a single market (Commission of the European Union, 1991 ; SANDHOLTZ, 1993, pp. 242-70). Since standards help define markets for producers and consumers they are particularly important where the incentive to invest in expensive new technologies would be severely dampened without the prospects of exploiting scale economies in a genuinely single European market. In addition, severe limits on the Commission's fiscal resources make regulatory policies such as standards particularly attractive.

The Commission's formal powers in industrial policy have been limited since the origins of the Community. The Treaty of Rome reflected the German interest in free markets and the French interest in retaining planning instruments at national levels only. The most notable power delegated to the Commission was its ability to negotiate common external tariff levels, although it also was empowered to monitor and correct restrictive or monopolistic business practices and state aids to industry (1) (TSOUKALIS & SILVA FERREIRA, 1980, pp. 357-58 ; BUIGUES & SAPIR, 1992). The Commission's relatively small staff and untidy overlap of internal mandates poses another challenge, which is well illustrated in the area of industrial policy. Core components of industrial policy making are

(1) Despite the inclusion in the Maastricht Treaty of European Union of a specific title on industry, the Commission's ability to devote new resources to "competitiveness" projects remains at the mercy of a single national veto in the Council.

distributed between DG III (Internal Market and Industrial Affairs) and DG XIII (Information Technology), but at least three other departments have some say (1).

Given these administrative properties, it is not surprising that the Commission has

"developed and elaborate machinery for consultation in the policy formulation phase and for political management when general ideas are translated into firm proposals".

The Commission has been fairly careful not to overstep its legal bounds, and its

"effectiveness is immensely enhanced in a function-oriented Community... (where) the commitments of the member states to specific policy ends are precisely spelled out" (LUDLOW, 1991, pp. 102, 118).

The case of completing the single market illustrates that policy successes stem from specific enumeration of tasks and by establishing a firm calendar of action. Under these circumstances the Commission has managed to "anticipate spillover" and exercise its powers of initiative more fully (LUDLOW, 1991, p. 118). In research and development, the Commission has been careful to situate its narrow role of facilitating interfirm collaboration in the broader context of a "Community interest" in international economic competitiveness (2).

The first suggestion of Commission leadership for inter-firm collaboration on new product technologies can be traced to a 1970 Commission communication on industrial policy by Internal Market and Industrial Affairs Commissioner Guido Colonna. In subsequent years a legal basis for Commission involvement emerged, but the crucial political entrepreneurship was orchestrated by Viscount Etienne Davignon. Davignon's direct contacts with firms in the steel industry in the early 1980s allowed him, he argued, to obtain a consensus among industrialists and thus help to head off problems at the level of the Council, because he was able to counter objections from government ministers with direct support from national industrialists (3).

(1) These include DG IV (Competition), DG XII (Research and Development), DG II (Economic and Financial Affairs), and perhaps DG I (External Affairs).

(2) It was Davignon who, recognizing that the Commission's credibility was being undermined by apparent support for "lame duck" industries during the 1970's, linked up with key European firms to lobby for comprehensive structural adjustment policies that would "aim" at either promoting research and development in high technology sectors or restructuring weak sectors of the economy" (SHARP, 1993, p. 205 ; TSOUKALIS & FERREIRA, 1980, pp. 375-76 ; SHANDHOLTZ, 1992).

(3) Interviews of Jeffrey Hart with Davignon in Fall, 1982.

Davignon's belief that direct talks with industry representatives were helpful influenced the decision of the Commission to formalize its commitment to consultation in subsequent statements regarding industrial policy in general and HDTV in particular. In 1979, Davignon initiated "round table" talks directly with twelve leading European firms in information technology (IT). This consultative grouping took on more explicit policymaking or "public" status after the Council of Ministers approved funding for the pilot phase of the European Strategic Programme for Research and Development in Information Technology (ESPRIT) (SHARP, 1993, p. 209.).

ESPRIT has been important for both organizational and economic reasons. It provided something of a prototype for later collaborative R&D and technological diffusion frameworks, including RACE (Research and Development for Advanced Communications Technology in Europe), BRITE (Basic Research in Industrial Technologies for Europe) and EUREKA (European Research Coordination Agency). A new element of this model was the emphasis on "demand-led" rather than top-down projects, monitored by small task forces incorporating Commission officials, industrialists, and research institute personnel. ESPRIT was important as a "channel for cooperation" between European firms that facilitated self-fulfilling "convergent expectations about the future". By facilitating greater coordination of responses to external competition, ESPRIT also helped mobilize a powerful constituency in favor of a single market unified by single standards (SHARP, 1989, pp. 8-10).

One factor facilitating Commission leadership has been the severe competitive weakness of European information technology companies. The Community's overall trade balance in information technologies had been positive in 1975; by 1980 it had a deficit of \$5 billion, and this continued to grow during the 1980's, reaching nearly \$22 billion by 1987 (Commission, 1989, p. 11). Competitiveness was clearly perceived as a problem as early as 1982, when the Commission published a dossier on the subject and called for "positive actions" to promote productive investment and innovation by European firms. Even before the Single European Act relaunched progress on a single market, the Commission asserted the need for pan-European efforts:

"In view of the pressure of international competition through innovation, the Community must ensure that industrial R&D is underpinned and enhanced by exploiting the advantages offered by the European dimension-advantages in economic scale (markets), industrial application (innovation) and the breadth of legislative provision (standards etc.)" (Commission, 1982, p. 99).

The Commission has consistently argued that "the European dimension" required a larger core of common European standards in emerging product markets (Commission, 1982, pp. 23-24). More recently, in its important communication on industrial policy in the 1990's (the so-called "Bangemann paper"), it is acknowledged that common standards "are also becoming a key item for the promotion of industrial competitiveness" (Commission, 1982, pp. 15-16).

The main problem with harmonizing standards stems from the costs of changing products and services to accord with new rules. The distribution of these costs affects negotiations over the appropriate rule to adopt and also influences the likelihood of Community-wide compliance.

One way to prevent distributional issues from derailing common standards is to incorporate as many affected actors as possible in negotiations. Indeed, the 1990 bangemann paper on industrial policy called for consultation with business and other "interested parties". The Commission stated that coherent industrial policy necessarily stems from:

"active partnership between all the interested parties (firms, social partners, scientific bodies, local, regional, national and Community authorities)" (Commission, 1982, p. 7).

The commitment to a wide-ranging and inclusive network did not, however, amount to equal time for all:

"In developing policies and guidelines, it is particularly important that the representatives of industry be fully consulted at the earliest possible stage" contrasts with "employee representatives must be given sufficient opportunities to make comments" (Commission, 1982, p. 21).

The main problems in setting HDTV standards in Europe arose from the difficulty of reconciling the interests of public broadcasters, private broadcasters, national manufacturing champions, and other users and producers of HDTV equipment and services.

The commitment to consultation reflects the Commission's political-administrative needs for expert information and help in securing implementation. Though wider consultation generates more information as well as consensual legitimacy, its price is slowness and substantial variation in the ability of "partners" to deliver the goods, increasing the level of policy uncertainty (MAZEY & RICHARDSON, 1992, pp. 23-26, 29). In the case of HDTV standards, as time passed and the number of parties grew, it became increasingly difficult for the Commission to exercise the "tight coordination of the strategy and tactics... (of) the European parties" (Commission, 1990, p. 60).

■ The Eureka EU95 Program

Intergovernmental bargains underwrote some of the early phases of the joint HDTV effort. In June 1986, the Eureka EU95 program was inaugurated at the first ministerial conference of Eureka in London, at the initiative of French President François Mitterand. EU95 was one of the first research programs announced under the Eureka rubric (CAWSON, MORGAN, WEBBER, HOLMES & STEVENS, 1990, p. 335) (1). The heads of state of the members of the European Community decided at their summit conference in Rhodes in December 1988 to make EU95 and HDTV a high priority issue in Europe. The German Chancellor, Helmut Kohl, and President Mitterand had their own bilateral agreement to push for a European answer to the Japanese HDTV challenge. In April 1989, the EC Council of Ministers adopted a Decision on HDTV, which outlined a comprehensive strategy for the launch of HDTV service in Europe starting in 1992 (2). EU95 itself was renewed and expanded in 1990 when its first phase ended.

The funding for the program was to have been 190 million ECU for the first four years, from a mixture of public and private sources. The actual expenditure for the first phase of the program, ending in December 1989 was 270 million ECU (approximately \$350 million). The second phase began in 1990 and was budgeted at 350 million ECU (around \$ 500 million) for three years. The total estimated spending for HDTV in Eureka between 1986 and 1993 was 635 million ECU. This figure does not include money spent by individual firms to develop HDTV technologies. Philips, for example, spent between 350 and 400 millions guilders (\$194-222 million)

(1) Eureka began in July 1985 with the membership of 19 European nations as a way of pooling research efforts across Europe. Eureka was seen as a less bureaucratic alternative to the mechanisms established by the European Commission to conduct joint European research in high technology. The larger EC countries liked Eureka because they were not required in Eureka programs, as they were in official EC programs, to take into account the needs and desires of the smaller and less technically able EC member states. Eureka was also, to some degree, a response to inducements from the Reagan Administration to involve Europeans in research for the Strategic Defense Initiative.

(2) The decision is labeled 89/337/EEC in European Community documentation. It states five objectives: (1) making sure that European industry develops all the technology needed for HDTV services; (2) promoting the adoption of 1250/50 as a global standard; (3) promoting the widespread use of 1250/50 globally; (4) promoting the introduction of HDTV services in Europe as soon as possible after 1992; and (5) making every effort to ensure that the European film and production industry occupy a competitive position in the HDTV world market. For commentary, see WATSON-BROWN (1989, pp. 312-315).

between 1986 and the end of 1992 on HDTV technologies (The Reuter European Community Report, 1993). Total European spending for HDTV development during that period was estimated to be around \$1.4 billion (1).

The most important participants from the beginning were Thomson, Philips and BTS (a joint venture for the development of advanced television technology created by Bosch and Philips in 1986). Piet Bögels of Philips was named the head of the EU95 HDTV Directorate in Brighton, England in 1986 and remained its director through 1993. Philips directs the program's activities in the Netherlands, Thomson in France, BTS in Germany. Nokia, a Finnish electronics firm with extensive holdings in Europe, was added to the inner circle of program directors in October 1989 (2).

The purpose of EU95 was to develop technologies and prototype equipment for the processing of high-definition video images and stereo sound. From the very beginning, EU95 focused on the development of HD-MAC. HD-MAC video images have 1250 lines per frame (double the 625 lines of PAL and SECAM, the current standards in Europe), an aspect or width-to-height ratio of 16:9 (the aspect ratio of PAL and SECAM is 4:3), and scanning is progressive or non-interlaced (the current standards are interlaced) at 50 frames per second (3). HD-MAC signals are backward compatible with MAC receivers, so people who purchased MAC sets would still be able to view images produced for HD-MAC receivers. They would, however, have to purchase new decoders to receive HD quality images on their MAC sets.

The European HDTV research effort, handled primarily in the Eureka EU95 Project, became linked to the European semiconductor research effort in 1987-88 through JESSI (the Joint European Semiconductor Silicon

(1) This is Jeffrey Hart's estimate based on the following sources: HILL (February 19, 1993, p. 16), and "Philips Postpones HDTV Launch". The former states that total public spending on HDTV was 625 million ECU or about \$700 million. The latter states that total spending by Philips was 350 to 400 million guilders, approximately \$200 million. The total in the text includes an expenditure by Thomson of some \$400 million, which includes investments in new plants to produce wide-screen picture tubes. All other firms connected with the HDMAC project spent approximately \$100 million.

(2) Philips planned to invest 11 billion francs, Thomson 9 billion. See Office of Technology Assessment (1990, pp. 32-34); SAMUEL (1990) and SWEET (1991, pp. 57-61)

(3) "HD-MAC" is frequently used synonymously with "120/50" in discussion of the European HDTV standard, because HD-MAC, which is a transmission and reception standard, requires a studio or production format of 1250 lines per frame and 50 frames per second. To be more accurate, however, one should note that the 1250/50 production format may produce digital signals that have not been encoded by HD-MAC encoding methods.

Initiative). Lile Sematech, JESSI was focused initially on creating leading-edge semiconductor process technologies. But to demonstrate their power, they had to be applied to high-volume manufacturing of real circuits. No semiconductor manufacturer wanted to invest in the expensive new process technologies unless there was a fairly certain market for the final products. Thus was born the idea, similar to US Memories in the United States, to manufacture HD-MAC chips using JESSI technologies in a new Eureka project called Europroject HDTV. In Europroject HDTV, JESSI 35 micron line-width production technologies would be applied to the produce of HD-MAC chip sets. The chip sets would be available for use in low-cost HD-MAC receivers by 1995, the final year of Europroject HDTV (LINEBACK & DE BONY, 1992, p. 16) (1).

The participants in the Eureka EU95 Project had already agreed to pool the patents they received from work done on HD-MAC, including the patents on circuit technology. So it was natural for there to spring up a connection between the Eureka EU95 Project and JESSI for the construction of HD-MAC circuits. In this way, the consumer electronics manufacturers, especially Philips and Thomson, gained further support for their position on DH-MAC in the European Community from the major semiconductor manufacturers and semiconductor manufacturing equipment makers and became more deeply embedded in the highly visible Eureka R&D cooperation efforts (PETERSON, forthcoming).

■ The EC Directive of 1986

All users of high-powered direct broadcast satellites were required to broadcast in packetized MAC formats under the European Council directive on November 3, 1986 (2). This directive was brought to the European Council by the EBU with the intention of committing all European broadcasters to the idea of gradually upgrading DBS transmissions to high definition via MAC (the MAC to D2-MAC to HD-MAC path). The EBU's proposal was for a Council Directive to apply to DBS signals for both FSS (Fixed Satellite Services) and BSS (Broadcast Satellite Services) satellites, but the representatives of Britain and Luxembourg vetoed the inclusion of FSS satellites, and so the 1986 directive applied only to BSS satellites.

(1) For background of the Mega Project and JESSI, see HART, 1992, pp. 214-217.

(2) 86/529/EEC published in the *Official Journal of the European Communities*, No. L311, November 6, 1986, p. 28ff.

BSS satellites broadcast at higher power levels (230 watts) than FSS satellites (130 watts) and therefore require slightly smaller dishes for reception of TV signals (30 cm instead of 60 cm). They have national "footprints" (mandated under WARC '77 regulations), whereas some FSS satellites have footprints that were not so respectful of national boundaries. When the 1986 Directive was issued, it was not possible to broadcast TV signals from FSS satellites.

The supporting coalition behind the 1986 Directive has included the national governments, their PTTs, the major consumer electronics firms, and the public broadcasters. This coalition agreed to jointly finance the BSS satellites and related infrastructure. The governments and the PTT's paid for the building and launching of the satellites. The consumer electronics firms committed themselves to produce TV receivers for MAC signals. The broadcasters committed themselves to pay for new transmission equipment (which was not very expensive, as it turned out).

The governments supported the 1986 Directive in order to protect the European consumer electronics industry and to promote the nascent satellite launcher industry. The governments wanted also to preempt the use of American launchers and satellite for TV broadcasting in Europe and to preserve their control over national cultures which they associated with the continued dominance of public broadcasting. The governments of the smaller European countries has less to gain here than those of the larger countries, although the Netherlands was a key supporter because one of the consumer electronics champions, Philips, was a Dutch concern.

The PTT's supported satellite delivery of TV because they wanted to reserve their terrestrial facilities for telephone and data traffic. It was logical to use satellites this way because of the inherently one-way nature of TV broadcasting, the great bandwidth required for TV, and the heavy expense of building and maintaining terrestrial broadcasting antennas, especially in rural areas. Cable TV had not gotten much of a foothold in Europe outside the Benelux countries, and consumers had not yet been presented with the choice of more variety in programming via more channels vs. higher quality of signals and programs.

The public broadcasters went along with the 1986 Directive on the assumption that by doing so they would steal a march on private broadcasters and cable operators by offering an improved quality of signals to households while simultaneously reducing their own costs of

transmission. In addition, the 1986 Directive called for the encryption of MAC signals using a standard called "Eurocrypt" which would make it impossible for viewers to decode the signal unless they paid their satellite subscription fees. Unfortunately for them all, this strategy proved to be a bust.

■ Failures of the BSS Satellites

Problems with the launching and successful operation of BSS satellites and innovations in FSS satellite systems permitted several major private broadcasters to deliver television signals directly to European households in PAL and SECAM formats, while the public broadcasters had been committed by their governments to use the BSS satellites and had to broadcast in the MAC formats, which required the consumer to purchase a new TV set. In addition, the private broadcasters were able to offer more channels to their satellite customers than the public broadcasters (1). It is not surprising, therefore, that the private broadcasters were greatly strengthened in their efforts to compete -precisely the opposite of the result desired by the public broadcasters.

The first German DBS satellite, TV-SAT 1, was launched in November 1987 (see Table 2). It failed shortly after a successful launch, because the solar panels that provide power to the satellite failed to unfold. The second German DBS satellite, TV-SAT 2, was launched in 1989. It also experienced a series of technical difficulties. The German public broadcasters became understandably nervous about staking their futures on DBS delivery over the BSS satellites. In 1988, ARD and ZDF began to explore the possibility of implementing the Japanese HDTV system in Europe. Like the private broadcasters in Germany, they argued for the continued use of PAL formats in all major delivery media and supported the upgrading of PAL by working on improved definition and widescreen versions of that standard.

(1) The Astra satellite, for example, carried 16 channels, while the BSS satellites only offered 5 channels at the most. See below for further information on DBS satellites.

Table 2 - European DBS Satellites

Name	Date of Launch	Operator	Status
BSS Satellites			
TDF-1	October 1988	France Télécom	Four transponders inoperable
TDF-2	August 1989	France Télécom	
TVSAT 1	November 1987	Deutsche Telekom	Failed in orbit
TVSAT 2	May 1989	Deutsche Telekom	
Tele-X	April 1989	Nordsat	
FSS Satellites			
Astra 1A	December 1988	SES	
Marcopolo I	December 1989	BSB, later BSkyB	
Marcopolo II	June 1990	BSB, later BSkyB	
Astra 1B	March 1991	SES	
Olympus	April 1988	Italo-Europ. Consortium	Problems with ground control
DFS Kopernikus F1	May 1989	German group	
DFS Kopernikus F2	November 1989	German group	
Eutelsat I-F4	September 1987	Eutelsat	
Eutelsat I-F5	July 1988	Eutelsat	
Eutelsat II-F1	December 1990	Eutelsat	
Eutelsat II-F2	December 1990	Eutelsat	
Eutelsat II-F3	December 1990	Eutelsat	

Sources: LONG Mark, *World Satellite Almanac*, 2nd edition, Indianapolis, Sams, 1987 ; REES David, *Satellite Communications*, New Wiley, 1990, Appendix C.

The first French DBS satellite, TDF-1, was launched in October 1988. This launch was subsidized by the French government at a cost of around \$400 million (1). TDF-1 was supposed to permit the transmission of five TV channels, but several of the transponders failed early in the life of the satellite. TDF-2 was launched shortly after, and it also experienced problems with transponders. Out of the total of 10 transponders on TDF-1 and TDF-2, only 6 were working in 1990.

Much more important than the technical problems with the French satellites was the requirement that TV signals be broadcast in MAC

(1) *Satellite and Cable Report*, issue 1, 1990, p. 15, as cited in Paul SLAA (1992).

formats. Since there were very few MAC receivers in French homes, the broadcasters, including the public ones, were not interested in broadcasting in MAC formats. Programmers did not want to create programs in MAC formats for the same reason. Thus, the French government was obliged to coerce its broadcasters to live up to the 1986 Directive.

The French government twisted the arm of Canal+ to put its pay TV services on TDF-1 (the CEO of Canal+ -André Rousselet- was a close friend and political adviser of François Mitterand), but in doing so, had to agree to permit Canal+ to simulcast its programs in SECAM format. Canal+ was also permitted to encrypt its signals using a proprietary technology so that the company would be able to pay for its MAC conversions partly by charging its satellite customers not just for the satellite programming but also for the satellite decryption devices that were necessary to decode their pays-TV signals (LEWIS, 1986, p. D21).

■ The Successes of Astra and the FSS Satellites

MAC was challenged by a group of private broadcasters who committed themselves to prolonging the life of the PAL standard by moving to enhanced versions of PAL -PALplus and widePAL (1). Rupert Murdoch's Sky Television, for example, was able to win important increases in European audience shares by directly delivering PAL signals to homes and cable operators via privately-owned medium-power communications satellites owned by British Satellite Broadcasting (BSB) and the Société Européenne des Satellites (SES), as opposed to the high-power communications satellites owned and operated by the public telecommunications agencies of Europe.

Non only did Murdoch steal a march on the PTTs and the public broadcasters by broadcasting in PAL, he also provided more international programming to Europeans, mainly from Britain and the United States, than the public broadcasters. Thus, many Europeans bought satellite dishes or subscribed to cable services offered by BSB and SES in order to get a greater variety of programs (2).

(1) PALplus is an improved definition version of PAL which makes the image clearer by correcting errors introduced in transmission of PAL signals. WidePAL is an enhanced definition version of PAL which makes the image wider by moving from the current 4:3 aspect ratio to the 16:9 aspect ratio of HDTV but without great increases in picture resolution.

(2) We are indebted to Adam WATSON-BROWN and Hans KLEINSTEUBER for explaining these details to us. See also CAWSON, 1990 ; SHAWCROSS, 1992, pp. 340-351.

When Sky Television merged with British Satellite Broadcasting (BSB) at the end of 1990 (both were losing money at the time), the new company, British Sky Broadcasting (BSkyB) announced that it would continue to broadcast in PAL and would drop BSB's former plans to convert its signals to MAC. From then on, Murdoch, together with his European allies, argued against EC efforts to require all high-powered satellite broadcasters to adopt the MAC standard, despite the counterargument of MAC supporters that PAL is incapable of being upgraded to high definition, and that failure to enforce uniformity of broadcast standards would confuse consumers and disrupt the future market for HD-MAC products. In essence, the argument concerns whether the already rather large investments in developing HD-MAC technologies should be written off, with a predictable cleavage between those who had invested already and those who had not.

■ Choosing a Successor to the 1986 Directive

The main result of this division was to severely complicate the Commission's task in preparing a successor to the 1986 Directive, which expired at the end of 1991. Community officials began in 1990 to examine the Community's options for salvaging the key elements of the deal worked out in 1986 in light of the disastrous failure of the DBS-MAC strategy. There was still a strong desire to promote a unified European standard for advanced television, to avoid dependence on non-European TV programs and technology, and therefore to protect European electronics manufacturers and program producers who would engage in risk advanced television activities. Since the Eureka EU95 program had focused on developing HD-MAC technologies, there was a strong desire among participants in that program to stay with MAC, despite the BDS failures. It was still possible that the United States would opt for the European approach to HDTV (although that possibility grew dimmer and dimmer over time), so planning for the replacement for the 1986 Directive focused on new methods for promoting the approach of gradually upgrading to HD-MAC via an intermediate MAC standard, D2-MAC.

D2-MAC permitted the display of widescreen images with an aspect (width to height) ratio of 16:9. Unlike HD-MAC, D2-MAC pictures would not be higher in resolution than PAL or SECAM, but D2-MAC receivers would include some new circuitry to reduce visual artifacts and thus could deliver somewhat crisper pictures. In addition, the D2-MAC sets would use displays that were progressively scanned. Progressively-scanned displays could be used for computer monitors as well as televisions. As before, the

strategy was to use the EC's control over satellite and cable-delivery standards to get the various parties committed to a unified European approach.

The European Council decision on April 27, 1989, on high definition television called for a single world standard for HDTV based on the European system. The decision did not mention HD-MAC specifically but focused instead on the 1250/50 production standard. This document highlighted the Council's concern for the continued health of the European consumer electronics and programming industries. It called for an "action plan" for the success of HDTV in Europe. The fourth objective stated in the plan was particularly noteworthy: "To promote the introduction, as soon as possible -and in accordance with a suitable timetable from 1992- of HDTV services in Europe" (1).

In 1990, Commissioner Filippo Maria Pandolfi, who was at that time Vice President of the Commission and head of the Directorate General for Information Technology (DG XIII), initiated discussions for the follow-on strategy for the 1986 Directive, partly in response to urgings from Philips and Thomson. Pandolfi widened the bases of consultation somewhat in an effort to arrive at a consensus on how to replace the 1986 Directive. Pandolfi conferred directly with manufacturers, broadcasters, and satellite and cable operators in plenary meetings on February 28 and March 27, 1991, and subsequently in smaller subgroups, as part of the overall consultation effort.

The Commission's use of direct industry consultation of HDTV policies resulted in a more inclusive mechanism for deciding what to do next than was available to the Commission before the 1986 Directive. It gave the private broadcasters much more say than they had had earlier, and as a result diluted the power of the consumer electronics manufacturers. The manufacturers, having invested considerable sums of their own money in HD-MAC development, wanted the HDTV decision-making process to proceed as quickly as possible and with minimal changes from the earlier decision to back HD-MAC. The broadcasters, especially the private ones, wanted to slow down the process and to reexamine the choice of HD-MAC as the favored transmission and reception standard. They were particularly concerned about the reliance on DBS satellites to make the transition to HD-MAC given the problems with the BSS satellites.

(1) 89/337/EEC, published in the *Official Journal of the European Communities*, No. L142, May 25, 1989, p. 1.

The private broadcasters began to argue for the idea of transmitting HDTV signals digitally, especially after the FCC began to tilt toward an all-digital HDTV for the United States, partly because they thought that the analog/digital hybrids like HD-MAC would quickly become obsolete but mainly because they wanted to delay their own expenditures on HDTV equipment. They did not like the fact that HD-MAC signals could not be delivered via terrestrial antennas, but only via DBS satellites and cable. They argued that digital TV could be delivered by all three methods and that it was more likely than hybrid HDTV to generate adequate revenue streams. The private broadcasters and some of the public broadcasters, including the ZDF in Germany, argued for improving existing color TV standards like PAL and SECAM before going to digital HDTV.

The manufacturers argued that delays in moving to D2-MAC would result in delays in upgrading to HD-MAC and would confuse consumers. They also believed that it would be quite a long time before all-digital TV could be developed and thought there was a reasonably large window of opportunity for a hybrid HDTV system like HD-MAC. Finally, they argued that it was too late to retreat from the MAC strategy, since so much time and money had already been invested in HD-MAC technology.

Pandolfi's strategy was to insist upon consensus and to avoid majority voting in the Council. A variety of draft directives was circulated and revised. On June 3, 1991, Pandolfi presented a draft directive that reflected his attempt to extract a consensus from the industry consultations. On June 26, the Commission sent a draft proposal for a directive to the Council and the European Parliament. This was a much more qualified document than the June draft directive, with over 200 amendments appended. The draft required all new satellite transmissions to be in D2-MAC format by January 1992. It also stated that "all set-top satellite receivers must incorporate D2-MAC circuitry, either on its own or with additional PAL circuitry". All PAL and SECAM transmissions would be phased out by 1994 except in Britain where the phase-out date was extended to 1996. During the interim, all broadcasters using PAL and SECAM would be required to "simulcast" in D2-MAC. To help the broadcasters pay the costs of simulcasting, the EC was prepared to pay up to 100 million ECU in subsidies (FOX, March 1991, p. 14 ; June 1991, p. 26 ; November 1991, p. 17).

On July 24, the Commission sent both the Council and the European Parliament a memorandum setting out its analysis of the issue. In that document, the Commission provided information it gained from further

consultations with the television-program-producing industry. The latter asked that arrangements for making the transition to HDTV take into account the cost of converting library material to HDTV formats, the need to gradually phase in production of material in HDTV formats that are only to be viewed once (like news programs), and the desirability of encouraging experimentation in multimedia technologies (which combine television and computer technologies (DONDELINGER, 1992, p. 1) (1).

■ The Memorandum of Understanding

In the meantime, Pandolfi found that it was necessary to go beyond the Directive to maintain a supporting coalition for HDTV. Not all the required elements of an HDTV launch could be contained in the Directive, which after all was a public document legally binding only on the member states of the EC. To get the cooperation of the growing variety of HDTV private interest groups in the EC's plan, Pandolfi discovered it was necessary to supplement the Directive with less public and more informal undertakings. Thus arose the idea of a "Memorandum of Understanding" (MOU) to be signed by the enterprises (public and private) connected with the various HDTV launch activities. The MOU laid out explicit expectations of the broadcasters, cable operators, and equipment manufacturers, specifying dates by which broadcasts and receivers would be available in D2-MAC format. It also affirmed that HD-MAC would be the sole European standard (within 10-15 years). Agreement on these specific goals would be facilitated by subsidies to the players amounting to 500 million ECU over the next five years (MEYER-STAMER, 1992, p. 9).

Essentially the draft Memorandum of Understanding was a payoff to the private broadcasters and the program producers to go along with the earlier agreement among the governments, the PTTs, the public broadcasters, and the electronics firms to adopt HD-MAC as the European HDTV standard. Some concessions were made on timing and on the continued use of PAL and SECAM for smaller TVs, but the basic idea was to make it worth everyone's while to go along with the original program. Unfortunately, it was this payoff element of the revised deal that was eventually to be its undoing.

(1) Dondelinger was the Commissioner in charge of the Directorate General for Audiovisual Information, Communications, and Culture (DG X). Dondelinger and Pandolfi were the two Commissioners primarily responsible for HDTV policies.

■ The Third Pillar of the HDTV Bargain: The Action Plan

The Memorandum of Understanding (MOU) was a private document and was a "declaration of intent", not legally binding on the signatories. SES and the German satellite operators had insisted on this order not to get locked into broadcasting in MAC formats. However, acceptance of both the Directive and the Action Plan by the Council and the Parliament were made conditional on the acceptance of the Memorandum of Understanding by its signatories. Thus, there was no way to avoid the MOU itself. In addition, the subsidies mentioned in the Memorandum could not be authorized by the Commission without formal approval by the Council and the Parliament. So was born a third document called the Action Plan. Thus, Europe's HDTV strategy was to be built on "three pillars", the Directive, the MOU, and the Action Plan.

The private broadcasters continued to resist the program because of the uncertainties about consumer acceptance of D2-MAC and HD-MAC equipment, a key factor in the success of the launch. The Commission, as a result, asked two consultant groups to conduct studies on the impact of the proposed Action Plan on future markets for HDTV receivers and HDTV programs. The results of these studies showed much slower development of the markets in the absence of an ambitious action plan. These two studies convinced Pandolfi and the Commission to push hard for subsidies totalling 850 million ECU, 350 million ECU higher than the 500 million ECU mentioned in the earlier draft of the Action Plan (1).

In May 1992, the Council adopted a new Directive on television standards stipulating that:

"Only HD-MAC may be used for HDTV transmissions that are not fully digital; new programs and satellites launched after 1995 will be required to use D2-MAC (a transitional standard), in certain cases in simulcast with current standards (PAL/SECAM); [and] existing operators (television channels, producers, cable and satellite operators) will encourage the use of D2-MAC with the Commission's financial support" (2).

The importance of the second provision was that it backed off the earlier demand for all satellite broadcasters to simulcast in D2-MAC, instead requiring it only under certain circumstances. Financial support to enable compliance in those cases would come from subsidies to be

(1) For information on the content of the two studies, see *Tech Europe* (1992).

(2) 92/38/EEC.

provided in the Action Plan, yet to be approved. New drafts of the Memorandum of Understanding and the Action Plan accompanied the new Directive. The revised version of the MOU affirmed the "strategic importance" of HDTV for Europe's consumer electronics and audiovisual producers and also cited the virtues of satellite delivery. It made a distinctly weaker case for adoption of the D2-MAC standard, however:

"Rapid implementation of common technical specifications (namely the 16:9 aspect ratio) simplifies the broadcasting of television programs in all countries of the European Community (the "EC") and makes a significant contribution to the development of a true European audiovisual market. In this context, the D2-MAC standard is available and offers an immediate means, compatible with the Directive, to implement 16:9 aspect ratio transmissions by satellite and cable" (1).

Accompanying the statement of principles were guidelines on the tasks facing each of the players (or "Entities") involved in creating the market for the new technologies. Additional paragraphs detailed the role of the Commission, the Broadcasters, the Industrial Manufacturing Companies, the Satellite Operators, and the Cable Network Operators. The interaction among these players would be guided by the notion that the Directive's goals could be achieved "only through the overall synchronization of the activities of the Entities, facilitated by the Commission". The main goal of EC-level activity outlined in the MOU would be "to create minimum market conditions enabling the major investments which are implied by this cooperative action and the Directive". The signatories of the Memorandum agreed to become members of a consortium to promote the general principles stated above. The Memorandum would remain in force "as long as EC financial support is made available according to the Action Plan" (2).

The Memorandum of Understanding was signed in Brussels by the "existing operators" in June 15, 1992, even though initial consideration of the Action Plan in May had resulted in deadlock. Signatories included the three major consumer electronics firms (Thomson, Philips, and Nokia), major broadcasters (BBC, MTV Europe, Super Channel, BSkyB, ARD, ZDF, RAI, A2, FR3, Canal+, etc.), and major satellite operators (SES, France Télécom, and Deutsche Bundespost Telekom) (see Table 3 for the complete list). Commissioner Pandolfi said that the MOU "will lead to enormous benefits for operators, manufacturers and consumers" (3).

(1) Final Draft of the Memorandum of Understanding, signed in Brussels on June 15, 1992. The text was obtained via the NEXIS online database.

(2) Final Draft of the Memorandum of Understanding.

(3) "EC TV Broadcasters, Programmers, makers Agree on Moving to Single TV Standard", *International Trade Reporter* (Bureau of National Affairs), June 24, 1992, text obtained via Nexis online database.

Table 3 - List of Organizations Represented at the Meeting on the Memorandum of Understanding in Brussels, June 15, 1992

<p>Broadcasters BSkyB - A2 - Canal+ - NOS - TV Plus - CLT - Première - RTP Plus - ZDF - ARD - RAI - Super Channel - Filmnet - ETN - Lyonnaise - RTI/FININVEST - Ellipse Cable - VOX/Westschiene Kanal - TV3 Broadcasting Ltd. - MTV Europe - BBC World Service Television - PTT Telecom NL - Thames Television - EBU - Pro 7/Der Kabelkanal - VPRT.</p>
<p>Satellite Operators Eutelsat - SES - Deutsche Bundespost Telekom - France Télécom - Hispasat.</p>
<p>Cable Operators Lyonnaise - KTAS Kabel-TV - Tele Denmark - Compagnie Générale de Vidéocommunication.</p>
<p>Equipment Manufacturers Philips - Thomson - Nokia.</p>

Source : Memorandum of Understanding.

■ The Meeting of the Telecommunications Council in Luxembourg

The next hurdle was to be a discussion of the action plan at a meeting of EC telecommunications ministers in Luxembourg on November 19, 1992. The objectives stated in the draft of the Action Plan presented at that meeting were to achieve, before the end of 1996:

"A critical mass of satellite television services in D2-MAC in 16:9 format, or in HD-MAC; a significant and constant increase in the number of cable television networks providing high-quality D2-MAC programs in 16:9 format to their subscribers; [and] adequate and growing production of programs in 16:9 format and of high technical quality, in terms of both image and sound."

This draft of the Action Plan included a package of incentives totalling 850 million ECU. Prior to the meeting, the ministers had agreed that the funds should be divided roughly as follows: 5-15 percent would go for distribution of programs by cable, 30-50 percent for satellite broadcasts, 5-15 for adaptation of studios, and 30-40 percent for production and conversion of programs.

Approval of the expenditures was clouded, however, by member state reservations. The governments of Italy, Greece and Spain opposed any reference to financing in the Action Plan until more was known about changes in the overall EC budget, and particularly what would be in the "second Delors package". Portugal also expressed concern. Ireland and Denmark wanted to reduce the proposed funding by half, Britain preferred no funding at all. The Germans wanted subsidies to go not just for D2-MAC and HD-MAC programs but also for the PAL Plus programs they intended to broadcast via terrestrial antennas. The Germans wanted the Action Plan to be flexible enough to accommodate any format that presented images in a 16:9 format.

The meeting was chaired by Edward Leigh, the Minister of Telecommunications in the British Ministry of Trade and Industry. At the meeting on November 19, Britain and Denmark both opposed funding of the Action Plan, even on a conditional basis. Because the vote had to be unanimous, British and Danish opposition effectively blocked approval of the Action Plan. Leigh went further to oppose the convening of a special meeting of the telecommunications ministers to follow the EC Summit in Edinburgh in December.

Pandolfi was furious. He blamed the British for holding up the process. He noted that "Everything is ready for an agreement, except the financial position". The Dutch Minister of Telecommunications, Hanja Maij-Weggen, criticized Leigh for "sabotaging the Council" by blocking the special meeting in December. The French and the Dutch representatives accused Leigh of conducting the meeting on the basis of national interests and failing to respect his commitment as President of the meeting to act in the interests of the Community (1).

The British claimed that six other member-states supported their position, even if they had not openly voiced their opposition to the proposed funding of the Action Plan. It is quite likely, in fact, that the representatives of Italy, Ireland, Spain, Portugal and Greece were not as enthusiastic as Belgium, France, Germany and the Netherlands about the Action Plan because they had less to gain in either electronics or television programming. They were probably holding out for some special compensation, such as

(1) It appears that Leigh had gone beyond his legal mandate in attempting to bar the special meeting, as such a request had to be honored under Article 1 of the Council's Regulation, and as a special meeting of the Telecommunications Council was scheduled, as requested, for December 15.

additional regional aids, prior to granting their approval for the Plan. In the following weeks, however, the collective fury of the HD-MAC supporting coalition was focused on the British government (*Tech Europe*, 1992).

■ The EC Summit in Edinburgh

At the EC summit meeting in Edinburgh, on December 12, Pandolfi circulated a "compromise" for the Action Plan that had been suggested to him by Tim Sainsbury, the new British Minister of Telecommunications. The proposal was also presented by Pandolfi at the special meeting of the Telecommunications Council in Brussels on December 15. Under Sainsbury's proposal, funding would be limited to 80 million ECU for 1993, the Commission would have a study done of the technical feasibility of all-digital HDTV prior to February 1993, after which the Action Plan could be revised, and the discussion of the funding of the Action Plan after 1993 would be postponed until a meeting of the Telecommunications Council in May 1993.

Accounts differ on what actually took place at this meeting: several participants seemed to get the impression that the British compromise proposal was serious and that progress had been made, while others considered the proposal to be a sham. It does appear that a better climate for cooperation was created by the replacement of Leigh with Sainsbury. But also, the British government seemed to be willing to let the proposed study on digital TV determine whether the Action Plan was worth the proposed expenditure. This did not prevent others from believing that the British government was simply "stonewalling" the Action Plan.

On December 16, Jacques Delors and John Major were interviewed while both were en route to a summit meeting with Canadian Prime Minister Brian Mulroney. Delors, in an unscheduled interview with Peter Bale of the Reuters News Service, claimed that Major has agreed to approve the Action Plan in Edinburgh late on Saturday night, December 12, in exchange for an agreement by the Dutch Prime Minister, Ruud Lubbers, to put aside his objections to EC institutions being divided up between France, Belgium and Luxembourg. Said Delors:

"My understanding is that Mr Major gave his agreement to HDTV as a Community consideration in the research programs of the EC... For me it is part of the global agreement [reached at the Edinburgh summit]."

The British government quickly denied that any such agreement has occurred. Major himself said that he did not agree to accept the Action Plan, despite attempts by François Mitterand and Prime Minister Lubbers to persuade him, brushing it off as "detail". He admitted to giving the impression of flexibility by saying the issue should be discussed further at the December 15 special meeting of the Telecommunications Ministers in Brussels, but nothing more. Tim Sainsbury said that Major had never suggested that Britain would support an agreement regardless of its content. A senior British official said that the British government could not justify spending taxpayers money on a technology that may become obsolete in only a few years time. In short, the British reiterated the sentiments that were implicit in Sainsbury's compromise proposal of December 12 (PERRY, 1992; BARBER, 1992, p. 2; BALE, 1992; *International Trade Reporter*, 1992).

■ Europe Reacts to the British Veto

French and Dutch officials, whose manufacturing giants had so much at stake, continued to complain about Britain's delay tactics. In the meantime, however, an important change within the Commission helped revive movement toward closure. This change was the installation of Martin Bangemann of Germany as Commissioner with portfolio for information technology (replacing Pandolfi) and Joao de Deus Pinheiro of Portugal as Commissioner in charge of audiovisual and cultural affairs (replacing Jean Dondelinger) in January 1993.

Bangemann was much more willing than Pandolfi to accept the British arguments about the limited potential lifespan of the hybrid HD-MAC system and of the desirability of seeking an all-digital HDTV. For example, on February 2, Bangemann said:

"At this stage, we don't see any signs of the UK showing more flexibility... In those circumstances, the Commission might have to revise its strategy, taking into account that digital technology could become a feasible alternative to HD-MAC within three to four years".

Bangemann also suggested that a revised Action Plan might concentrate funds on the development of widescreen TV equipment, liquid crystal displays (LCDs) and the production and conversion of programs in widescreen formats (HILL, February 4, 1993, p. 2 and HILL, February 9, 1993).

In short, Bangemann's strategy was to reduce the costs for the HD-MAC coalition of making a shift toward a digital approach by pushing for widescreen television standards without mandating that widescreen TVs or

programs be in the D2-MAC format. The total subsidies package was reduced from 850 million ECU to 500 million.

Philips had announced suspension of its plans to mass produce HD-MAC receivers at the end of 1992 because of the British veto of the Action Plan. Both Philips and Thomson made it clear, however, that they would continue their plans to market widescreen television equipment, but would probably not be able to produce any receivers with MAC decoders until the Action Plan was approved (1). Both firms expressed regrets about the shift away from MAC standards, but also clearly signalled their intent to market a new generation of widescreen equipment. Thus, Bangemann's strategy fit quite well with the plans of the two largest consumer electronics firms.

Britain remained opposed to the size of the subsidy package, even after it was reduced to 500 million ECU. A very negative report on future HD-MAC markets was published in Britain in December 1992 by a group of researchers at National Economic Research Associates (NERA) and at Brunel University. This report highlighted the problems of consumer acceptance of HDTV by focusing on the high initial costs of receivers, problems of developing large, but also inexpensive and compact, high-resolution displays, and of developing systems for terrestrial over-the-air delivery of HDTV signals to complement satellite and cable delivery systems. The NERA/Brunel study was very optimistic about the prospects of developing an all-digital HDTV system for Europe, pointing to the US HDTV competition and the Swedish prototype system called HD-Divine (digital video narrow-band emission). The NERA/Brunel study suggested that Europe should seriously consider adopting the US all-digital approach rather than pursue further the HD-MAC strategy (2).

Bangemann seemed to be leaving this option open when on February 19 he said: "A digital standard doesn't need to be set [by the EC]. Global standards are always the best solution". This position got a considerable

(1) A consumer survey conducted by BIS Strategic Decisions showed that consumer preferred widescreen TV to conventional TV by a margin of 56 percent to 40 percent. This was particularly true of French and British consumers; German consumers appeared to be somewhat more satisfied with their current sets. Those favoring widescreen sets felt that they would be better for viewing films than their current sets. The survey is discussed in HILL & ADONIS (1993, p. 19).

(2) (BRADSHAW, KEHOE & NAKAMOTO, 1993) It seems quite likely that British authorities had a copy of this report prior to the December 12 EC Summit and that its contents had played an important role in their position at the Summit and the Telecommunications Council meeting of December 15. Also, it seems likely that the report itself was shown to the press and to Martin Bangemann in early 1993.

boost when the Advisory Committee on Advanced Television Standards (ACATS) to the US Federal Communications Commission (FCC) said that it could not choose among the proposals for an American HDTV system, and entertained the possibility of a "grand alliance" of proponents to solve the remaining problems with all-digital approach. The successful negotiation of just such an alliance, announced on May 25, meant that Philips and Thomson would definitely play a central role in the development of the US HDTV system. Knowing that they would eventually receive considerable revenues from their US HDTV operations, the two European firms became more willing to renegotiate the bargain they had struck in Europe (ANDREWS, 1993).

■ Endgame in Europe

On April 1, Bangemann and de Deus Pinheiro published a communique stating that adoption of the HDTV Action Plan was essential to the future of the European television industry. The communique suggested that funding be directed toward encoding techniques, digital compression, modulation techniques, and LCD technology. It left open the possibility of adopting the standards of other regions, or of using at least some of the same technologies and standards. In a press conference, Bangemann said:

"The intention to introduce the D2-MAC or HD-MAC as the obligatory standard for HDTV in Europe would be a mistake to my mind -and more or less everybody is now acknowledging it would be a mistake" (1).

The new Danish President of the Council continued to talk with representatives of the member states about the Action Plan, with the hope of settling the remaining disputes before the May 10 meeting of the Council.

At the May 10 meeting, a new version of the Action Plan was presented. It proposed the abandonment of D2-MAC and HD-MAC as obligatory standards and the funding of research on digital HDTV technologies. As suggested by Bangemann earlier, it focused on the promotion of widescreen TV equipment and programming in the short term and digital HDTV in the long term. The proposed funding level had shrunk

(1) There were news stories at this time about efforts of Philips and Thomson to arrive at common standards with Japanese firms for HD-VCRs. At the press conference on April 1, Bangemann suggested that the EC and Japan should work together to produce a standard global digital format for HDTV "that would be acceptable to the United States". See *Agence France Presse*, 1993.

from Bangemann's 500 million ECU to 60-80 million ECU per year for four years. The reduced funding was intended to win British support for the Action Plan. No action was taken at the May 10 meeting because Britain firmly opposed spending more than 150 million ECU. The decision was to be delayed at least until the next meeting of the Telecommunications Council on June 16 (*European Report of the European Information Service*, 1993).

On May 26, 1993, Armin Silberhorn, German Minister of Posts and Telecommunications said that a group of European broadcasters, satellite operators, manufacturers and public officials would soon announce the formation of a new organization called the European Launching Group for Digital Video Broadcasting. The group included representatives of the European Commission, the British Department of Trade and Industry, Philips, Thomson, ARD and SES. An unidentified participant said that the group had been meeting on an ad hoc basis for over a year, and that it would focus its efforts on terrestrial delivery of digital HDTV. Silberhorn said that the group hoped to sign a memorandum of understanding on June 2 (PERRY, May 1993).

Yet another draft of the Action Plan was circulated before the June 16 meeting of the Telecommunications Council. The subsidy package had now been trimmed to 228 million ECU, again in an attempt to win British support. The British government reiterated its view that it wanted no more than 150 million ECU in the package. But pressure from the British programming industry to accept the Action Plan shifted governmental criticisms away from the size of the subsidy package to the question of the availability of funding for non-European firms. The British government now wanted the Japanese consumer electronics companies which had established manufacturing facilities in Britain to be qualified for HDTV funding. Sony, for example, had a television assembly plant in Wales (PERRY, June 1993; HILL & ADONIS, 1993, p. 19; FAGAN, 1993, p. 26).

At the June 16 meeting of the Telecommunications Council in Luxembourg, an Action Plan was finally approved. The subsidies package was set at 228 million ECU, Japanese firms were permitted to apply for funding, and the idea of pursuing widescreen equipment in the near term and digital HDTV in the longer term was endorsed. Many commentators believed that Europe would be likely, as a result, to copy many aspects of the US digital HDTV approach. The French and Dutch consumer electronics firms were miffed about the last-minute inclusion of Japanese firms in the deal. Said an unnamed official at Philips: "We are utterly

amazed. How many European companies have access to Japanese research programs?" (NUTTALL, 1993; JOHNSON, 1993). The general mood, however, was one of relief that an agreement had finally been reached.

■ Discussion: EC Policy Networks and International Competition

The EC HDTV standard-setting process resulted in an outcome closest to the preferences of private broadcasters and rather remote from those of the original HD-MAC coalition of the Commission, consumer electronics producers, and PTT's. In this concluding section we discuss what this outcome illustrates about the effectiveness of the EC policy process in facilitating cooperation between competing interests and the way global economic rivalry among Europe, America and Japan links into the politics of industrial policy in each locale.

The evolution of HDTV standards policy demonstrates the limits inherent in the Commission's organizational and political relationship with member states and private groups. Faced with the task of securing harmonization and building consensus, the Commission initially focused its energies on direct consultations with a few large producers of equipment and services, but eventually was obliged to enlarge the scope of discussions as it learned that technological change had broadened the range of private actors whose behavior would affect the shape of the HDTV market and that political legitimacy required their inclusion in negotiations of European rules. In the end the Commission lacked the fiscal and ideological resources to win acquiescence by those parties who had least to gain from adoption of a common MAC standard.

The Commission's manifest inability to overcome the resistance of private broadcasters and skeptical governments can be cited as evidence for the view that it remains essentially the instrument of member states and/or transnational capital (1). It is true that the Commission's reliance on firms and governments for implementation confers substantial influence on them throughout the policy process. But it is also true that national governments and transnational firms require the Commission to play a

(1) See, for instance, GARRETT (1992, pp. 533-60) and STREECK & SCHMITTER (1991, pp. 133-64).

"facilitating" role, particularly when there are differences among them about how to improve on a threatening status quo, as it has been for the European electronics and audiovisual industries. International competitive pressures heighten the strategic interdependence between firms, member states, and the Commission, and when none of these actors can realize its interests without some cooperation from the others the Commission's calls for "synchronized" pursuit of Community interests carry greater weight.

Around what position are these interests to be "synchronized"? Is the "Community interest" merely a reflection of the preferences of powerful states?" (KRASNER, 1991, pp. 336-66; GARRETT, 1992). Such a conclusion is problematic in the case of HDTV; it would imply that Britain "won" the bargain, which is surprising considering that none of the principal industry players was British. In other words, the outcome appears strangely skewed toward a state with relatively small material interests at stake. In fact, France, Germany and the Netherlands appear to have had internally contradictory pressures at play with respect to the broadcast and manufacturing rules.

The fact that the Commission's original (and privileged) partners (state-backed PTT's and national champion manufacturers) failed to secure their preferred outcome reflects both the Commission's capacity for an autonomous vision and its structural weaknesses. The particularistic motives of these "European" parties' -to maintain barriers to competition from private broadcasters and foreign manufacturers- were commensurable with the Commission's view that the Community's competitiveness would be further threatened by the globalization of NHK's Hi-Vision standard. Thus the Commission welcomed their participation in a relatively closed industrial policy network. However, as EC efforts to secure a common European standard raised the stakes for private broadcasters and consumers, incorporating these interests became important for bolstering both the technical and political foundation for a common standard. Although widening the number of participants frustrated the Commission's ability to ensure coordination around a single proposal, it also effectively prevented its clientelistic capture.

Although wider-ranging "consultation" both reflected and compounded the Commission's inability to secure early and final agreement, it also promoted greater openness to signals coming from the market. Although manufacturers and broadcasters whose investments were tailored to anticipation of an HD-MAC world suffered some losses, it could have been worse. The ability to block global adoption of Japan's standard staved off

further decay of a European manufacturing presence in consumer electronics, which was perceived to be at a critical state. The inability to zero in on a MAC standard spared EC producers exclusion from American (and possibly global) markets that eventually turned toward a digital standard. Japan's "misfortune" illustrates the fact that market evolution is conditioned by the standards adopted to guide investment and consumption; Europe's insistence on rethinking standards changed the fortunes of NHK's HDTV gamble.

The "irony of state strength" applies well to the Commission's experience with HDTV: the quality of a policy network rests not only on the capacity of public actors to intervene in the market but on their ability to adapt to market signals and negotiate retreat from planned interventions (IKENBERRY, 1986, pp. 105-37; 1988, pp. 151-77). Had the EC remained locked into the HD-MAC bargain it may not have faced the disaster some British opponents predicted, but it is clear that the HD-MAC bargain inherited the same vulnerabilities to technological change as earlier agreements, such as the 1986 Directive on using MAC for satellite transmissions. It is quite likely that the Europeans would have pursued the same near term strategy of deploying widescreen technology before high-definition technology, and that there would have continued to be a mix of MAC and non-MAC standards. Thus the shift toward digital HDTV represented by the may 1993 Action Plan actually represents a timelier adjustment to the changing technological and political environment than one might have expected.

The losses to major electronics firms like Philips and Thomson were lessened by the fact that HD-MAC technologies were largely digital to begin with and they could therefore avoid extensive write-offs. Europe had some important advantages in the delivery of digital signals via terrestrial antennas, which they might put to good use in solving both their HDTV delivery problems and those of the United States. Finally, the central role that Philips and Thomson would play in the HDTV Grand Alliance in the United States gave them some additional options in future competition with the Japanese consumer electronics giants.

Meanwhile, NHK and the Japanese manufacturers were obliged to adapt to the new world of digital television. The money and time spent on developing MUSE/Hi-Vision has produced technological strengths which could be carried over into the digital TV era. While some of the MUSE/Hi-Vision equipment sitting in warehouses might have to be scrapped, Japanese mass consumers should eventually respond well to equipment

with wider screens, stereo sound, and higher picture resolution. There would be a window for the sale of MUSE/Hi-Vision products for industrial applications not just in Japan but also in the United States and Europe until the onset of digital HDTV signal delivery, which, by NHK and MPT estimates, remained between five and ten years away (POLLACK). So all was not lost for Japan's consumer electronics industry. The biggest damage was to NHK's prestige.

Some Japanese observers complained that Japan should have been acknowledged as the country best prepared to build the new system and therefore accorded the right to set standards, much as the US was in monochrome and color television after World War II. In the case of HDTV, however, the underlying international competitive environment was particularly unfavorable for producing a harmonious response to Japanese leadership. Most importantly, the issue was framed by the European Commission as relevant to the survival of consumer electronics manufacturing in Europe; it also came to be viewed by American producers as an opportunity for reentry into consumer electronics production.

The conflict that arose over global standards in HDTV contrasts with the relative agreement over broadband telecommunications standards. The main reason for the different outcomes is that the relative competitiveness of each region's telecommunications equipment and software producers was more equal than in the case of television. The superior position of Japan in consumer electronics, and of the United States in video programming, and the inferior status of Europe in both, combined with the increased perceived importance of participating in consumer electronics markets in all three regions, made it harder to engage in the sort of international log-rolling that yields agreement among capitalists rivals.

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