

Digital
Multimedia
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Series

MPEG VIDEO COMPRESSION STANDARD

Joan L. Mitchell,
William B. Pennebaker,
Chad E. Fogg, and
Didier J. LeGall

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MPEG Vendors and Products

This chapter provides a sampling of vendors and MPEG products. As the reader is undoubtedly aware, there is tremendous commercial interest in MPEG, and this list was obsolete even before the data collection was complete.

17.1 Vendor Participation ○

The information presented here was solicited from vendors attending the international MPEG meetings. A standard form was supplied for the information we needed for this chapter, but the actual information was supplied by the vendors themselves. Since we necessarily had to massage this information, final versions were returned to the vendors for approval. We believe, for this reason, that the information presented here is accurate, but we cannot guarantee this. In addition, although we made an effort to keep the information in this chapter complete and up-to-date, inclusion in this chapter required an active effort on the part of the vendors themselves. If a vendor failed to respond to our requests for product and company information, no information about those products will be found here.

The worksheet provided to the vendors is reproduced here in Figure 17.1, in part to give the reader an idea of exactly what information might be found in this chapter. The absence of a given product — say an MPEG encoder — under a vendor would indicate that the vendor had no encoder offering at the time the worksheet was filled out. However, in such a dynamic marketplace, product offerings will be changing almost continuously and the reader should contact the vendors directly to get the latest information.

-
1. Section heading (what version of your company name would you prefer as the section name?) (e.g., IBM):
 - 2.* Company legal name (e.g., International Business Machines Corporation):
 - 3.* Company short name (e.g., IBM):
 4. Company mission statement (one sentence!):
 5. Brief history (suggestions below-none required):
 - a. Date founded:
 - b. Type of company founded (consulting, SW, HW, chips, boards, an application):
 - c. Original primary product:
 - d. Current primary product:
 6. Preferred corporate-level contact if different from 8 (probably will be included as a footnote):
 - Name:
 - Title:
 - Company name:
 - Street:
 - City, state, ZIP:
 - Country:
 - Telephone:
 - Fax:
 - E-mail:
 7. A paragraph describing your application and the person quoted, if desired (likely to appear as an edited quote):
-

Figure 17.1: (a) Vendor Worksheet for MPEG product information.

8.* Repeat 8a through 8e for each MPEG video or MPEG video-related product that has a different contact person (use as much room as needed):

- 8a.* Complete name of MPEG video product(s)/MPEG video application(s)/etc.:
- 8b.* Type (consulting, SW, HW, chips, boards, OEM, applications):
- 8c.* Description of the MPEG video function supported and environment (MPEG-1, MPEG-2, encoder, decoder, I-frames only, I+P, I+P+B, etc. on which machines, platforms etc.):
- 8d. Additional information (e.g. audio and systems supported?)
- 8e. What resolutions, bit rates, frame rates are supported?
- 8f. What other standards do you sell? (JPEG, H.261, JBIG, MHEG,...)?
- 8g. If you support MPEG-2, what profiles and levels?
- 8h.* Preferred contact:
 - Name:
 - Title:
 - Company name:
 - Street:
 - City, state, ZIP:
 - Country:
 - Telephone: Fax: E-mail:

9. If you have any trademarks included in this material, please list them here with the appropriate words (e.g., XXX is a registered trademark of YYY Corp.):

10. Any additional comments/special instructions:

11. Is this complete information? (Yes/No)

12. Contact person to receive draft copy for review, revised versions, and/or for questions (not for publication):

- a.* Name:
- b.* Telephone:
- c.* Fax:
- d. e-mail:

Note: There is no guarantee that any of your responses will be used. Include no proprietary or confidential material, please.

Figure 17.1: (b) Vendor Worksheet for MPEG product information.

Vendor	Video		Audio	Product	Page
	Profile	Enc			
Array	1+	y	y	H,S,B	367
AuraVision					368
C-Cube	1,2	y	y	H,C,B,S	369
CRS4					370
CompCore	1,ML+		y	D,S	369
Digital	1	y		S	371
DiviCom	1,MP,ML	y	y	B,S,T	371
ESC				T	372
FutureTel	1	y	y	B+	372
GI	MP,SP,ML,LL,+	y	y	C,B,E	373
HEURIS	1,2	y	y	T	374
HMS	1		y	S,P,T	374
Hughes	1			B	375
IBM	1,MP	y		C,B	375
Imedia	MP,ML	y	y+	H,S	376
Logician	1,2		y+	D,T	377
LSI	1,MP,ML+		y+	C,B	377
Siemens	MP,SNR	y		E	379
StellaCom	1,2	y	y	T	379
Sun	1+	y	y	S,B	380
TI	1+		y	S,B	380
Zoran					381

Table 17.1: Table of MPEG vendors in this chapter. Product codes are: H = hardware, S = software, C=chips, B=boards, D=chip design, E=end products, P=programming material, T=technical services (consulting, testing, design, etc.). If a "+" is shown, additional capabilities are offered.

17.2 Vendor overview ○

Table 17.1 summarizes the information provided in the individual sections describing each vendor. This summary is necessarily brief and incomplete (and in some cases may be out of date), but the reader can refer to the individual sections for more details. Most of the vendors supplied the name of a contact where more information can be obtained.

17.3 Array Microsystems ○

Array Microsystems, Inc. (Array) was founded in 1990 to “design, market, and manufacture chips and boards for high-performance DSP applications”. Its original primary product was the a66xxx family of vector processing chips and VME/ISA bus boards for high-performance FFT-based spectral processing applications. Its current primary product is a a77xxx *VIDEOFLOW* family of multi-standard, programmable compression chips, ISA/VL/PCI bus boards, and software development tools for PC multimedia, video authoring, and video conferencing applications. “Array’s corporate mission is to become the leading supplier of low cost digital motion video chip set solutions for professional and consumer multimedia markets [Kop94a].”

Array’s a77100 Image Compression Coprocessor (ICC) and a77300 Motion Estimation Coprocessor (MEC) chips, a77500 *VIDEOFLOW* Hardware Evaluation Kit board, and a77800 *VIDEOFLOW* Software Development Tool Kit software support MPEG-1, H.261, and JPEG encoding and decoding. The software runs on Unix workstations. The Hardware Evaluation Kit’s ICC/MEC-based circuit board runs on IBM-compatible PCs and plugs into either the VL or ISA bus. It encodes and decodes MPEG-1 video and systems in real time. With optional additional software, it also performs real-time MPEG-1 layer 1 or layer 2 audio encoding and decoding when used in conjunction with off-the-shelf sound cards based on the Analog Devices Personal Sound Architecture (TM). The ICC and MEC chips embody a unique vector dataflow computing architecture (patents applied for) which Array is using as the foundation for creating future programmable chip sets serving applications such as real-time MPEG-2 video encoding and very low cost video conferencing.

Dr. Bang W. Lee, DSP Manager, Micro Devices Business, Samsung Electronics Co., South Korea writes: “Due to its programmability, flexibility, and high performance, the initial *VIDEOFLOW* ICC/MEC chip set serves a range of high-end applications such as video authoring, video conferencing, and digital video broadcast. The *VIDEOFLOW* technology is also well suited for the quick development of a range of derivative products for many emerging applications. Samsung participated in the *VIDEOFLOW*

development due to Samsung's need to serve a variety of applications such as HDTV, digital CATV, video CD players, videophones, digital VCRs, and camcorders [Kop94b]."

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E:vroomen@array.com

17.4 AuraVision Corp. ○

The AuraVision Corp. (AuraVision) was founded in July, 1992 to develop large-scale integrated circuits that bring full motion video and audio to life on the PC. AuraVision's first video process, the VxP500 provided video capture with built in compression and full screen playback. AuraVision's mission is "to provide the enabling technology that will launch the next wave of the computer revolution by integrating full-motion, full-screen video with the processing power of today's computers [Sey94]."

The VxP201, VxP501 and VxP202 make up AuraVision's new generation of state-of-the-art multimedia processors. All three processors are pin compatible. The VxP201 MPEG Playback Processor & VxP501 MPEG Video Capture / Playback Processor is a video processor for a multiformat video playback and acceleration subsystem. Designed specifically for AVI and MPEG playback environments, the VxP201 incorporates full vertical and horizontal bilinear filtering with scaling, zooming, antialiasing and interpolation without the use of external line buffers or memory. The VxP201 has an optimized glueless interface to the most popular MPEG and JPEG audio and video decoders and contains on chip audio/video synchronization support to reduce host overhead. Offering full AVI compatibility, the VxP201 plays Indeo, Cinepak, Video 1, and all other AVI files without the need for additional hardware. For additional videoprocessing functions, the VxP501 can be a direct upgrade path for the VxP201.

AuraVision has developed reference designs for each of their MPEG video processors. These are designed to help computer hardware vendors deliver multimedial products to market faster and more cost effectively. A developers kit includes a board, schematics, or CAD files as well as a royalty-free software license for developing custom applications.

17.5 C-Cube Microsystems ○

C-Cube microsystems, Inc., a leader in digital video compression, designs and markets integrated circuits that implement international standards for the compression of digital video for consumer electronics, communications and computer applications such as Video CD, Direct Broadcast Satellite and multimedia computing [LG96].

C-Cube was founded in 1988 and is headquartered in Milipitas, California with offices in the United states, Europe and Asia. From its inception C-Cube has been entirely focused on complete solutions for digital video and has delivered many leadership products.

C-Cube's CL480VCD is the leading solution for consumer electronics application of MPEG-1 (Video CD). C-Cube's CL9100/9110 chipset for MPEG-2 decoding and transport demultiplexing is used in many broadcast applications. C-Cube is the leading supplier of circuits and software encoding MPEG, including the CLM4100 MPEG Multimedia accelerator, the CLM 4500 MPEG-1 encoder, and the CLM 4700 Broadcast encoder solution for MPEG-2. Further information about C-Cube products can be found on the World-Wide-Web at <http://www.c-cube.com>.

Contact: Mary Giani
C-Cube Microsystems
11778 McCarthy Boulevard
Milpitas, CA 95035
V:+1 408-944-8628

17.6 CompCore Multimedia ○

CompCore Multimedia, Inc. was founded in 1993 as a Silicon Valley hardware and software solutions company. Its original primary product was an MPEG-1 video decoder that required only 10K gates plus RAM. Its current primary product is a single-chip MPEG-1 system (video and audio) that requires only 20K gates plus RAM. Its current mission is "to develop and license the most optimal and fine tuned core technology for multimedia [Hab94]." "MPEG Are Us"™ is its trademark.

CompCore Multimedia, Inc. a "Chip-less Chip Company", provides technology licensing and design expertise for video compression based on the MPEG standard. Compcore's hardware products include both MPEG-1 and -2 gate level netlists for the complete (video, audio, and systems)

solution. Its software products include MPEG-1 Real Time Software for the Pentium, MIPS, and PowerPC platforms.

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E:mpeg@compcore.com

17.7 CRS4 ○

The Center for Advanced Studies, Research, and Development in Sardinia (CRS4) was established in November 1990 as a research center and non-profit consortium of public and private companies for the purpose of consulting, software and applications. The original emphasis was on know-how in mathematical modeling, high performance computing and networks, and scientific visualization. The emphasis has expanded to include know-how in multimedia and hypermedia authoring and applications, animation and picture/movie compression techniques, computational genetics, combustion, environmental modeling, parallel computer architectures, and computational chemistry and biology. "CRS4 is an interdisciplinary research centre developing advanced simulation techniques and applying them, by means of high-performance computing and networks, as well as scientific visualization and animation techniques, to the solution of large-scale computational problems [Fil94]".

The lack of documentation and prototype software tools greatly influences the acceptance of a new standard, but typically such information exists only in the form of informal Usenet News postings, press releases and miscellaneous papers and articles. This led to the birth, in 1992, of the MPEG repository, an archive freely accessible through the Internet, where most of the public-domain software, such as coders and decoders for many different architectures, is archived. When more written documentation about MPEG started to appear it became more critical to guarantee its access to a larger audience and in a more structured way. It was then decided to collect the list of frequently asked question (FAQ) related to the MPEG standard and to organize it as a hypertext document accessible through a World Wide Web browser. The collection, authored by more than 100 contributors and continuously updated, is maintained by Luigi Filippini, a researcher in the scientific visualization group of CRS4. This WWW site,

<http://www.crs4.it/luigi/MPEG/mpegfaq.html>

currently has more than 5000 world wide accesses per month.

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CRS4
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E: Luigi.Filippini@crs4.it

17.8 Digital Equipment Corporation ○

Digital Equipment Corp. (Digital) has a mission to be “the world’s leader in open client/server solutions from personal computing to integrated world-wide information systems [Bec95].” Digital Semiconductor’s mission is “to provide industry leading Alpha CPU and PCI-based peripheral components and technology to the marketplace.”

Digital has a full software-only MPEG-1 playback with compliant systems layer, 30 frames/s video and audio. High-quality, software-only, fully compliant MPEG-1 encode with throughput of 2 frames/s has also been developed.

Digital Semiconductor is investigating powerful silicon and software technology which will provide fully compliant support for MPEG-1, JPEG and H.261 codecs and a wide range of audio options on a single low cost PCI option card. The solutions will integrate into a wide range of desk-top platforms and support industry standard software application program interfaces.

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V:+1 508-568-6429; F:+1 508-568-4681
E:yost@pasta.enet.dec.com

17.9 DiviCom ○

DiviCom, Inc. (DiviCom) was founded in April, 1993 to make encoding and decoding systems. It provides software tools and consulting. DiviCom has as its company mission “the creation of exceptional products that merge video,

audio, and data with digital compression and communication technologies [Loo94].”

Among the DiviCom’s software tools are MPEG-1,2 encoding, decoding, multiplexing, and remultiplexing tools including editing, assembly, and format conversion. DiviCom is prepared to provide consulting in compression and communication system integration, MPEG, ATM, control, format conversion, and quality.

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V:+1 800-286-1600; F:+1 408-944-6705
E:bnatwick@divi.com

17.10 ESC Inc. ○

Encoding Science Concepts, Inc. (ESC) was established in 1994 by W. Pennebaker, one of the authors of this book. ESC’s mission is to “provide consulting services and contract research and development in the area of image compression [Pen96a].”

Several of the advanced chapters of this book are based on technical reports issued by ESC. These reports may be purchased from ESC; send a note to the e-mail address below for a current list of reports.

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Encoding Science Concepts, Inc.
RR #2 Box 84A
Shaftsbury, VT 05262
V:+1 802-375-1186; F:+1 802-376-2913
E:wmpenn@sover.net

17.11 FutureTel, Inc. ○

FutureTel, Inc. (FutureTel TM) was founded in 1993 as a manufacturer of digital audio/video and digital communications board products. FutureTel’s original primary products were its PrimeView TM real-time MPEG encoding board and its TeleMux TM ISDN/T1 network interface card. Since then it has added the MPEGWORKS TM comprehensive encode control applications and the Digital AV*C TM Software Developer’s Kit (SDK) to

its primary products. FutureTel's mission is "to promote standards-based MPEG and network communications products to ensure compatibility across platforms and with other vendors [Mak94]."

FutureTel offers PC-based digital audio-video MPEG compression and communications products. PrimeView [™] provides a single-slot solution for real-time MPEG digital encoding from NTSC or PAL analog sources, as well as from digital sources. The TeleMux [™] network interface card supports T1/ISDN and other network standards. Together with the company's software, the two products can deliver full-motion, TV-quality MPEG files over local- and wide-area networks. Applications include video databases, video distribution, remote viewing, distance learning, interactive multimedia, VIDEO CD, and video-enhanced enterprise networks. OEM plans are available. FutureTel also offers a Digital AV*C Software Developer's Kit (SDK) and MPEGWORKS [™], a comprehensive encode control application.

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17.12 General Instrument Corporation ○

General Instrument Corp. (GI) was founded in 1923 as a components manufacturer for the emerging radio electronics industry. It is a "leading supplier of systems and associated equipment for broadband communications networks. [Tay94]" Its current primary products are Jerrold addressable cable systems (cable and wireless), VideoCipher® addressable satellite systems, DigiCipher® digital television communications systems and associated equipment (satellite receiver/decoders, cable/wireless set-top decoder), broadband amplifiers and cable-head end equipment, and coaxial and fiber optic cable.

GI's DigiCipher II system incorporates MPEG-2 video and MPEG-2 transport. The primary application for these products is for distribution of digital television signals to cable and satellite television subscribers [Eng94]. These chips, boards and end-products encode and decode MPEG-2 with dual-prime motion estimation, as well as some DigiCipher II extensions which support additional motion estimation techniques.

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E:mtayer@gi.com

17.13 HEURIS Logic ○

HEURIS Logic Inc. (HEURIS Logic) was founded in December, 1991 as an MPEG services company with expertise in software, hardware, and consulting. Its mission is "to provide digital video encoding service of the highest quality, as well as creative and technically sound solutions for all of your MPEG encoding needs [Qua94]".

HEURIS Logic's Digital Audio/Video MPEG Encoding Services remains its primary product. It is a proprietary in-house system for MPEG-1 encoding with multiplexed audio and video from virtually any format. The compressed bitstreams are returned in virtually any format. Its proprietary technology includes optimization of the MPEG algorithm. In the future MPEG-2 encoding will be offered. In addition, its staff provides hardware/software development or consulting for multimedia or interactive video.

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E:quandt@umrgec.eec.umn.edu

17.14 Hartmann Multimedia Service ○

Hartmann Multimedia Service (HMS) was established in 1994 to provide consulting services and MPEG hardware, and software. Its original primary products were the Digital Video Mixer Box MFB-901, the TBC MFB-1000, the Picture in Picture processor MFB-802, and the distribution of XingCD™ software. Currently it has added VideoCD mastering on CD-ROM compliant with the White book for MPEG movies. HMS's mission is to "get the best Multimedia Service to the customer [Har94]".

HMS has produced an MPEG INTERNET CD-ROM which features all of the available MPEG movies and MPEG audio songs (Internet Underground Music Archive; IUMA) in an HTML Hypertext document, ready to

browse directly via CELLO-browser from the CD-ROM drive. The effect is as if the reader were browsing on Internet via WWW. PCs are used to encode MPEG-1 system streams via XingCD TM MPEG-1 encoder from VCR tapes and other video sources. Its interactive CD-ROM discs use the CELLO shell for Hypertext application and information browsing and are compatible with most computer platforms.

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E:harti@contrib.de or leo@zelator.de

17.15 Hughes Aircraft Co. ○

The Visualization and Information Systems Laboratory of Hughes Aircraft Company (Hughes) developed several MPEG-related products. The MPEG Video Codec Card is a VME circuit board with software drivers and subsystem level applications. This circuit card is a real-time MPEG-1 codec which is capable of simultaneous encoding and decoding. The encoding process captures NTSC video and after MPEG-1 encoding, writes the bitstream to the VMEbus. The decoder accepts the MPEG-1 bitstream from the VMEbus and converts it to an NTSC signal. Hughes also developed software tools to facilitate the use of this circuit card with different communications network and mass data storage environments.

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Hughes Aircraft Company
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E:0061753@ccmail.emis.hac.com

17.16 IBM Microelectronics ○

The Digital Video Products (DVP) Group in the International Business Machines Corp. (IBM®) Microelectronics TM Division in Endicott, N.Y. was

established in October 1992 with a mission “to develop the core competencies required to compete in the digital video arena and develop applications applying these competencies to the areas of cable TV, computers, telecommunications and regional Bell operating companies (RBOC) and broadcast [Kor94].”

In partnership with the IBM T.J. Watson Research Center in Hawthorne, N.Y. DVP produced its first prototype MPEG-2 decoder chip in November 1993 and first DVP product, an MPEG-2 full function decoder chip, in March 1994. DVP is focused on the MPEG-2 marketplace and intends to introduce a full family of decoder and encoder products as well as application cards and systems so as to service the whole of the MPEG-2 market place. “An increasing number of applications today demand digital video techniques to display high-quality full-motion pictures. With the support of IBM’s T.J. Watson Research Center, we intend to deliver innovative products to this market early and often, serving the needs of a growing customer base seeking high-quality, low-cost solutions from a reliable source [Zur94].”

The decoder chip (IBM39-MPEGSD1-CF-A-40-C in the sales manual) decompresses MPEG-1 and MPEG-2 encoded video. The group also has an applications arm that develops card/board assemblies to specific customer requirements.

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E: zurla@gdlvm6.vnet.ibm.com

17.17 Imedia Corp. ○

The Imedia Corp. (Imedia TM) was founded in March, 1994, to develop and manufacture hardware and software solutions for the growing video-on-demand market. Imedia “develops and manufactures video compression, storage, and distribution systems using proprietary video coding, data formatting, and signal distribution technologies for video service providers to cost-effectively serve video to their viewers in an interactive manner [Tom94].” Imedia’s current product is a video server system and the provision of encoded video, for storage on disk, using Imedia’s concatenated interleaved format and variable bitrate allocation algorithm.

Imedia gives service providers the ability to offer the most popular, current hit movies in an enhanced, near video-on-demand manner. The Imedia

1000 Video Server and the Concatenated Interleaving Video Storage Format are hardware and software systems. They provide for maximum five-minute start-time intervals and VCR-functionality over a single 6-MHz channel. By combining its concatenated interleaving method with the encoding and compression process during data layout onto disk, Imedia is able to maximize picture quality while keeping the time from purchase to viewing to a minimum.

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E:atom@imedia.com

17.18 Logician, Inc. ○

Logician, Inc. (Logician) was founded in 1991 for chip design consulting. Logician's mission is the "development of portable and customer specific hardware designs for MPEG and multimedia chips and systems, specializing in high-volume low-cost applications [Pin94]."

In addition to continuing the chip design consulting, Logician has portable customer specific chip subsystem designs for MPEG audio, video, and systems using Verilog/VHDL/Synopsys design methodology. Portable designs are tailored to customer requirements to produce reliable and sophisticated MPEG implementations on very short schedules.

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17.19 LSI Logic ○

LSI Logic Corporation (LSI Logic) was founded in 1981 as a semiconductor design and manufacturing company. Its first primary product was an

application-specific integrated circuit (ASIC). Since then RISC Microprocessors and Digital Video Integrated Circuits for interactive compressed digital television source decoding and channel encoding and decoding have been added to their product portfolio. LSI Logic has developed a CoreWare TM methodology that enables customers to create Customer Specific Integrated Circuits (CSICs) that can include functional units such as Reed-Solomon Error Correction and/or MPEG-2 video decoding along with the customer's proprietary logic. "LSI Logic's goal is to provide complete I/C solutions for interactive compressed digital television systems [Man94]."

LSI Logic is shipping the L64002, a single-chip integrated MPEG-2 audio/video decoder including enhanced on-screen display (OSD). The chip allows full-screen 2 or 4 bits per pixel overlay while the chip is decoding. Graphic overlay colors can be selected from a palette of over 1600 colors. The chip supports pan and scan of both graphics and video. A complete PC system with LSI Logic L64002 evaluation boards and MPEG bitstreams installed is available. Also a credit-card-sized module can be purchased. This module includes the L64002 plus 16 Mbit DRAM with a surface mount connector that can be integrated into the user's system.

LSI Logic is also a Dolby TM AC3 licensee and can incorporate this functionality into customer specific I/Cs. The transport stream is demultiplexed by a separate I/C, the L64007 Transport Stream Demultiplexer. The L64007 will also provide clock recovery. This chip could be customized to meet individual system requirements or integrated with other logic.

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17.20 Siemens ○

The Eikona® Encoding Services of Siemens Ltd. (Siemens) in Australia has a mission “to provide ‘worlds best quality’ MPEG standards based video and audio encoding services and products to the international market [Ste94]”. Siemens Ltd. is a wholly owned subsidiary of its German parent, Siemens AG.

The Siemens Eikona System does off-line MPEG-1 encoding of video and audio to any chosen bit rate on an SBus platform. The Block Motion Estimator (BME) is a single-slot SBus card specifically designed to calculate block motion vectors. Two SGS-Thomson block motion estimation VLSI chips produce a total of 124,000 block matches per second. Software associated with the BME implements both extended window and telescopic block motion vector searches up to ± 128 pixels (or greater in some cases). Its Serial Digital Interface (SDI) is capable of sustaining real-time video rates and controlling Sony (and other) Digital Video Recorders. Production companies use SDI to connect their existing serial digital equipment and produce digital compressed audio and video in either CD-I, MPEG-2, or other video compression standards.

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17.21 StellaCom ○

StellaCom, Inc. (StellaCom) has a mission “to provide products and services in digital video, advanced television and associated computer and telecommunications technologies [Bea94].” It was founded in 1985 as a research/development and consulting company. It originally offered primarily consulting, but now its primary product is software for measuring compressed digital video quality.

StellaCom offers digital video codec testing, consulting, and software. It supports all of MPEG and includes audio and system testing.

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17.22 Sun Microsystems, Inc. ○

Sun Microsystems, Inc. (Sun) was founded in 1982 to make Sun-1 Workstations hardware and software. Today its primary products are the SPARCstations™, servers, and Solaris. Sun's mission is "to be the world's premier supplier of open network computing solutions, ranging from desktops to super servers [Haa94]."

SunVideo™ is an SBus card for use in SBus-based computers such as the Sun SPARCstation™ family of products. The board utilizes the C-Cube CL4000 VideoRisc™ processor. It encodes MPEG-1 video. Software is available to create systems level streams in non-real-time using a real-time capture of both audio and video into intermediate formats. A Sun-developed algorithm CELL is also supported by the board.

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17.23 Texas Instruments ○

"Texas Instruments Inc. (TI), headquartered in Dallas, Texas, is a high-technology company with sales and manufacturing operations in more than 30 countries. TI products and services include semiconductors; defense electronic systems; software productivity tools; printers, notebook computers and consumer electronics products; custom engineering and manufacturing services; electrical controls; and metallurgical materials [Kro94]."

TI products include a variety of highly integrated compression/decompression devices optimized for high-volume applications in consumer electronics, computer, and telecommunications markets. In addition, TI provides semicustom solutions, standard dedicated-function digital signal processors (DSP) and programmable DSP devices. The TMS320AV220 Video CD MPEG Decoder is a dedicated hardware MPEG-1 video decoder. It supports Video CD and Karaoke standards, provides direct interface to Sony

and Sanyo CD-ROM decoders, direct interface to TMS320AV120 MPEG audio decoder and TMS320AV420 NTSC Encoder. It includes an integrated system layer decoder, audio input buffer and audio synchronization logic, and real-time horizontal pixel interpolation and frame duplication.

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17.24 Zoran Corp. ○

Zoran Corp. (Zoran) has a mission to “create value by developing, manufacturing and marketing high-quality, cost-effective VLSI solutions for digital image enhancement, image compression, and audio processing applications [Raz94].”

The ZR36100 MPEG I System and Video Decoder chip is an integrated MPEG-1 full motion video decoder. It also performs the function of a system-layer decoder and audio-video synchronizer. In this role, it demultiplexes the MPEG system bitstream, extracts the time stamps from the individual video and audio bitstreams, buffers both the compressed audio and video data, and provides the audio data to the input of an external audio decoder. The above task is performed while maintaining full synchronization of audio and video, and compensating for any differences in processing delay of the audio and video decoders.

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