

SMPTE Committee on Video Recording and Reproduction Technology: Working Group on Editing Procedures

By ROBERT LUND, Committee Chairman

Progress Report — April 1982

The VRRT Working Group on Editing Procedures was formed in 1978 to study the problems of edit decisions list (EDL) interchange. Most edit system manufacturers offer edit lists in the widely used "CMX"* style, but in fact the lack of a standard has deterred the reliable interchange of lists between different systems. Also, this format does not provide means to specify parameters of most ancillary post-production operations beyond source tape timing and basic switcher control.

Because the usefulness of any standard is highly dependent on the practical needs of the user community, participants were solicited from a wide range of professionals in the industry; during the last three years, over forty contributing members have included editors, managers, and engineers from manufacturers, networks, and post-production facilities.

Subdivision of the Task

Inter-system exchange of EDLs requires standardization of (1) the exchange media used for list transfer, and (2) the syntax used within the list.

Regarding the content of the EDL, the parameters of the editing process were divided into two general categories: those which can be specified in the form with which the industry has grown most familiar; and additional "special data," consisting of numbers quite often less meaningful to the human reader, such as might be transmitted to special effects devices, variable-speed motion controllers, audio consoles, and the like. The Working Group for Standardization of Digital Control of Television Equipment (T14.10) was formed two years ago to develop a uniform hardware control language. The special data format of the EDL will be modeled after the language specified by the Digital Control group.

The EDL has been specified in terms of the ASCII code, in a medium-independent form. While the use of papertape, audio cassette, serial data link, or other non-random-access media is straightforward, a standard is required specifying the means of recording and organizing EDL data on flexible discettes. Four separate documents are presently planned:

1. Recommended practice specifying data format of the basic EDL.
2. Recommended practice specifying the format of special data.
3. ANSI standard specifying 8-in flexible disc format.
4. ANSI standard specifying 5 1/4-in flexible disc format.

It is felt that ANSI standards are appropriate for those items that are expected to remain unchanged for a reasonable length of time, whereas the specification of the EDL content is more likely to be a living document, evolving with the rapidly advancing state of the art of post-production techniques.

As of this writing, items 3 and 4 have been prepared and are being submitted for approval. Item 2 will be undertaken after the Digital Control group releases their first efforts in the syntactical area. The work of the EDL group has centered around Item 1 above, and a detailed description is found below.

Discette Standards

Details of the proposed ANSI standards for discettes will be presented in a forthcoming issue of the *SMPTE Journal*; the following is a summary of that work.

The popular IBM 3740 single-density standard was chosen for the 8-in disc because of its widespread acceptance and reliability. For the 5 1/4-in discette medium, the soft-sectored 35-track/16-sector double-density was selected out of the numerous 5 1/4-in formats in use today (see Table 1).

Table 1 — Proposed EDL Flexible Disc Standards

Size	Tracks	Sec/ Track	Bytes/ Sector	Sector; Inter- leave	Skew	Dirac- tory/ Start
200mm 8-in	76	26	128	2	6	Isn 24
130mm 5 1/4-in	35	16	256	6	6	Isn 0

(Isn = logical sector number)

* "CMX" is a division of Orrox Corporation.

Provision is made for the storage of multiple EDLs on a single discette, organized as files referenced by a directory to be stored at a specific location on the disc. In order to avoid burdening a low-level (low-priced) editing system with a requirement to handle a full directory structure, a directory format should allow for a minimal standard disc, with one EDL file and a constant dummy directory which still makes sense to a high-level system; conversely, a high-level system can transmit a single list to a low-level system by writing a single-entry directory and list at fixed assigned locations on a clean disc.

The directory structure used by Digital Equipment Corporation (DEC) on their RT-11* operating system was selected, not only because of its wide use in the industry (DEC equipment is used in many but by no means all editing systems), but because of the simplicity of its sequential contiguous-file organization. It is placed at the DEC-specified location for 8-in discettes, logical sector number 24. It was decided to leave the first three tracks of the 5¼-in discette free for optional user applications (e.g., bootstrap programs and/or other operating system software); logical sector numbering thus begins with the first sector of track four.

Edit Decisions List (EDL)

The EDL is made up of printable ASCII characters, and is organized into lines by the presence of carriage return (CR)-line feed (LF) pairs in the data. The end of an edit list is indicated by either: (a) the end of the storage medium or file, or (b) an ASCII 'control-Z' character (octal 032).

An important distinction must be maintained between the EDL as it exists on the transfer medium and the lists which users commonly see on display screens and printouts. All that is required of the standard EDL is that it be computer-readable. In practice, however, there are often instances when users must examine the contents of EDL transfer media on teleprinters, terminals, or other non-edit-system devices. For this reason, line length has been limited to 72 characters to ensure readability in such situations; if an "edit line" consists of more than 72 characters, a CR-LF pair must be embedded, preceded by a "backslash" character ('\, ASCII code octal 134) — the sequence '\CR LF' is to be interpreted as a simple separator by the edit system, and prevents corruption of data display when lists are dumped to screens or printers.

The EDL may contain two types of lines: "Edit lines," describing the finished audio-video product; and "System Directives," conveying control information to the editing system. Edit lines all begin with an event number field consisting of one to four numeric characters, an optional letter, and the line type identifier signifying one of three types of edit line:

1. '*' Comment lines, containing information to be read by the operator of the system.
2. '/' Basic edit data lines, and expansion of the form in common use in the industry.
3. '\$' Special data lines, information specifying the control scope of the basic edit data line. Although the format has not been firmly established, it is most likely that a destination device identifier will be employed, along with optional timing information, in addition to the data to be transmitted.

The absence of a line type i.d. character signifies a basic edit data line. As explained later on, certain edit lines are not meant to be recorded as such, but rather serve to set up source conditions which can be referred to by later events as complex sources. These are denoted by a '>' character appended to the event number field, and are referred to herein as "virtual events."

Comment line

1234A* This is a comment line. Since it is longer than \72 characters, a line continuation character has been used.

Special Data Line

002/ < device i.d. > (time information) < data >

Basic Edit Data Line

```
023B$ TAPE02.1 B2 WSB123 90.667
(1)      (2)      (3)      (4)      (5)
                                01:02:03:00 01:02:07:12 1:00:00
                                (6)      (7)      (8)
```

Figure 1. Examples of various types of edit lines.

The basic edit data line describes event 23B as a soft-bordered wipe, pattern 123, taking 90 frames to reach a pattern limit of 2/3, to source TAPE02; source audio track 1 is recorded on record track 2; source has non-drop-frame code, with drop-frame on the record master; the '\$' sign indicates that it has already been recorded.

Let's examine each of these fields more closely (numbers in parentheses refer to the numbered fields in the example above):

- (1) *Event number field* — (Event number)(line type i.d.)(“done” indicator):
One to four numeric characters optionally followed by a single alpha. Leading zeroes are insignificant, i.e., 002 and 2 are equivalent. The physical ordering of events on the transfer medium specifies the order in which events are to be recorded; this information is not conveyed by the value of the event number, which is just a tag. There is no line type i.d. on a basic edit data line. The presence of the '\$' sign indicates that the event has been recorded.
- (2) *Source identification field* — (source i.d.) (tracks):
Source i.d. is one to six alphanumeric characters. A subfield consisting of any number of one- or two-digit numbers linked by commas and/or hyphens may be attached by a period, indicating audio playback channels.
The source i.d. may refer not to an actual source, but rather to a compound source specified by some earlier event. In this case, the source i.d. field consists of the event number followed by the left arrow character '<', and is referred to as a "virtual source."
- (3) *Edit mode field*:
The mode field indicates the desired record channels to be activated, and consists of a single alpha optionally followed by any number of one- or two-digit numbers linked by commas and/or hyphens, indicating audio record channels. The following are the forms of this field:

V — video only
A — all available audio channels

* RT-11 is a registered trademark of Digital Equipment Corp.

- B — video and all available audio channels
- An — audio channel number *n* only, where *n* is a number 1–99
- Bn — video and audio channel number *n* only, where *n* is a number 1–99
- Am, n — audio channels *m* and *n*
- Am, n p — audio channels *m*, and *n* through *p*
- Bm, n — video and audio channels *m* and *n*
- Bm, n–p — video and audio channels *m*, and *n* through *p*.

If neither source nor record audio channels are specified, all possible source channels are recorded on the corresponding record channels. If a record channel is specified and no source channel is specified, the source is to be taken from the source channel corresponding to the indicated record channel.

(4) *Transition/effect type field:*

The first character in the type field is one of the following type identifiers:

- C — CUT
- D — DISSOLVE
- W — WIPE; this must be immediately followed by a pattern number of up to three digits.
- K — KEY; the associated source indicates the key source (cutter). If no foreground source is specified in the following edit line, the foreground is the same as the key source. A pattern number immediately following the “K” or any modifiers indicates a wipe key.
- M — MATTE; the associated source indicates the key source (cutter). The foreground source is a matte generator. A pattern number immediately following the “M” indicates a wipe matte.
- F — FOREGROUND filler; the associated source indicates the filler for the immediately preceding foreground effect (e.g. fill hole cut by key signal, or fill border of a wipe).
- N — Non-Additive mix.
- R — SYNC ROLL; no switcher transition is indicated by this type mnemonic; the field is used to indicate a synchronization line.

Type Modifiers

Certain transition/effect types may be modified by one or more of the following characters, referring to commonly-used functions on most video switchers. While analog information required to completely specify these functions would be included in special data lines, it is felt that the presence of the modifier characters serves as flags to the operator and will be sufficient in many cases where analog parameters are to be set manually. Modifiers appear between the TYPE character and any pattern number.

Wipe or wipe key:

- R — Reverse direction
- S — Soft edge
- B — Border
- P — Position
- M — Pattern modulator
- A — Shadow

- V — Spin or revolve pattern
- G — Spot light; the presence of this modifier indicates a single-source effect — a wipe between the indicated source at full luminance level and reduced level.

Key or Matte:

‘-’ Preceding the type with a “minus” sign indicates a transition away from the indicated effect (used to fade or wipe out a key).

- H — Shadow
- O — Outline
- E — Edge (border)
- I — Invert (exchange foreground and background, usually by inverting the key signal)
- T — Soft edge between foreground and background
- C — Chromakey.

Different modifiers are needed to indicate soft edge and border information for keys and wipes because both the effects may be active at one time — for example:

- KS020 — soft-edged wipe 20 to key
- KT020 — wipe 20 to soft-edge key
- KBS020 — soft-edged bordered wipe 20 to key
- KFS020 — soft-edged wipe 20 to bordered key.

Wipe Pattern Codes

Because there is no practical limit on the number and scope of possible wipe patterns, only the most commonly used patterns have been assigned codes, and provision has been made for uniquely distinguishable but undefined numerical assignments.

Numbers 1 through 199 designate specific patterns, 50 of which are described in Appendix 1. Note that the 23 assignments in common use in the industry have been left unchanged, but that reverse-direction wipes are denoted by the modifier “R.”

The numbers 200–999 may be used to signify other patterns. These user-definable numbers indicate manual pattern selection. System designers have the option of providing a means of associating the numbers 200–999 with specific patterns. These assignments may be changed or cancelled as needed. Any number system should make no pattern selection.

(5) *Duration and limit field:*

This consists of up to three digits indicating the duration of the transition in frames. Following the duration, and linked by means of a period (‘.’), there may be an effect limit of one to three digits (0–999), indicating a decimal fraction of effect execution. In this case, the duration field represents the time in frames required to reach this limit.

Time Code — General

Time code is expressed in terms of four two-digit groups representing Hours, Minutes, Seconds, and Frames, separated by punctuation marks, in the form HHpMMpSSpFF. The separator between the seconds and frames groups is significant in that it is used to denote drop-frame/non-drop-frame time code and to indicate field 1 or field 2, as follows:

- : (colon) — Non-drop-frame code, field 2
- ; (semicolon) — Drop-frame code, field 2
- . (period) — Non-drop-frame code, field 1
- , (comma) — Drop-frame code, field 1.

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Allowance is made for the expression of time code in compact form by the suppression of leading zeroes and associated punctuators, up to but not including the seconds-frames punctuator, as shown in field (8) in Fig. 1.

- (6) *Source-in:*
The source-in time designates the first field taken from the indicated source, field 1 or 2 being differentiated by the seconds-frames separator.
- (7) *Source-out:*
The source-out time designates the first field of source material not recorded. If a foreground source-out time implies a record-out time less than the implied record-out time of all other edit lines within the event, the source is popped out at that time.
- (8) *Record-in:*
The record-in time designates the field at which the recording of source material from the current edit data line is to begin. The record-in time, the source-in time, and the initiation of any transition indicated are synchronous. Every edit data line within an event must have a record-in time greater than or equal to the record-in time of the first edit data line in the event.

System Directives

A system directive appears between events, on a line without an event number, for the purpose of providing information to the editing system and/or operator. System directives defined thus far are as follows:

- WAIT — stop auto-assembly when the following event is encountered
- SKIP do not perform the following event
- BELL — sound an audible indicator before performing the following event
- REEL <separator> <source ID> --- indicates that all subsequent events until another REEL directive are to be recorded on a reel (or other medium having the indicated identifier)
- TITLE <separator> <ASCII string>—indicates the title to be associated with the following event list.

Relationships Between Events

The physical order of events on the transfer medium determines the order in which they are to be interpreted. Later events supersede prior ones, and the resulting audio/video program should be equivalent to that which would be produced if the events were performed in this order.

If the first line of an event is other than a CUT, it calls for an inter-event transition. Transitions such as dissolves and wipes involve two sources, referred to as the “from” source and the “to” source. The “from” source for an inter-event transition is the source condition which the immediately preceding event (ignoring any “virtual events”) specifies for the record-time corresponding to the start of the transition. The use of an inter-event transition requires that:

- (1) the record out-time of the preceding event is equal to or greater than the record in-time of the current event, and

- (2) the record in-time of the preceding event is less than the record in-time of the current event, and
- (3) the mode of the preceding event includes the mode of the current event. That is, the previous event must specify the required conditions for all video and/or audio involved in the transition.
- (4) any transitions in the (compound) “from” source have completed, i.e., reached a static state.

Event 01 calls for 20 seconds of source RL1 to be recorded, with a key effect from source CG coming in 5 seconds after the record-in, and remaining up until the record out. Event 02 specifies a fade to BLK at 01:18:00 — the “from” source consists of the compound source RL1 with CG keyed over it according to the above guidelines.

If the complete “from” source for the current event cannot be determined from the preceding event, then one or more zero-duration from-source edit lines, referred to as “tracking edit” lines, must be included in order to completely specify the from-source. Such a tracking edit line or group of lines is interpreted as a compound background edit line for the duration of the event in question.

The inter-event transition in Fig. 2 requires no tracking edit line. If events 01 and 02 are separated by other events, however, tracking edit lines are required to specify the “from” source of the dissolved, as follows:

01	RL1	B	C	10:00	30:00	01:00:00
01	CG	V	K 20	00:00	15:00	01:05:00
02	BLK	B	D 20	00:00	01:00	01:18:00

Figure 2. Inter-event transition example.

The first three lines of event 02 comprise the tracking edit; since they are of zero duration, the BLK line is used as inter-event transition, and not simply a background transition within event 02. The tracking edit lines are required because the “from” source for the video fade to BLK cannot be determined from the immediately preceding event 01A, an audio-only event.

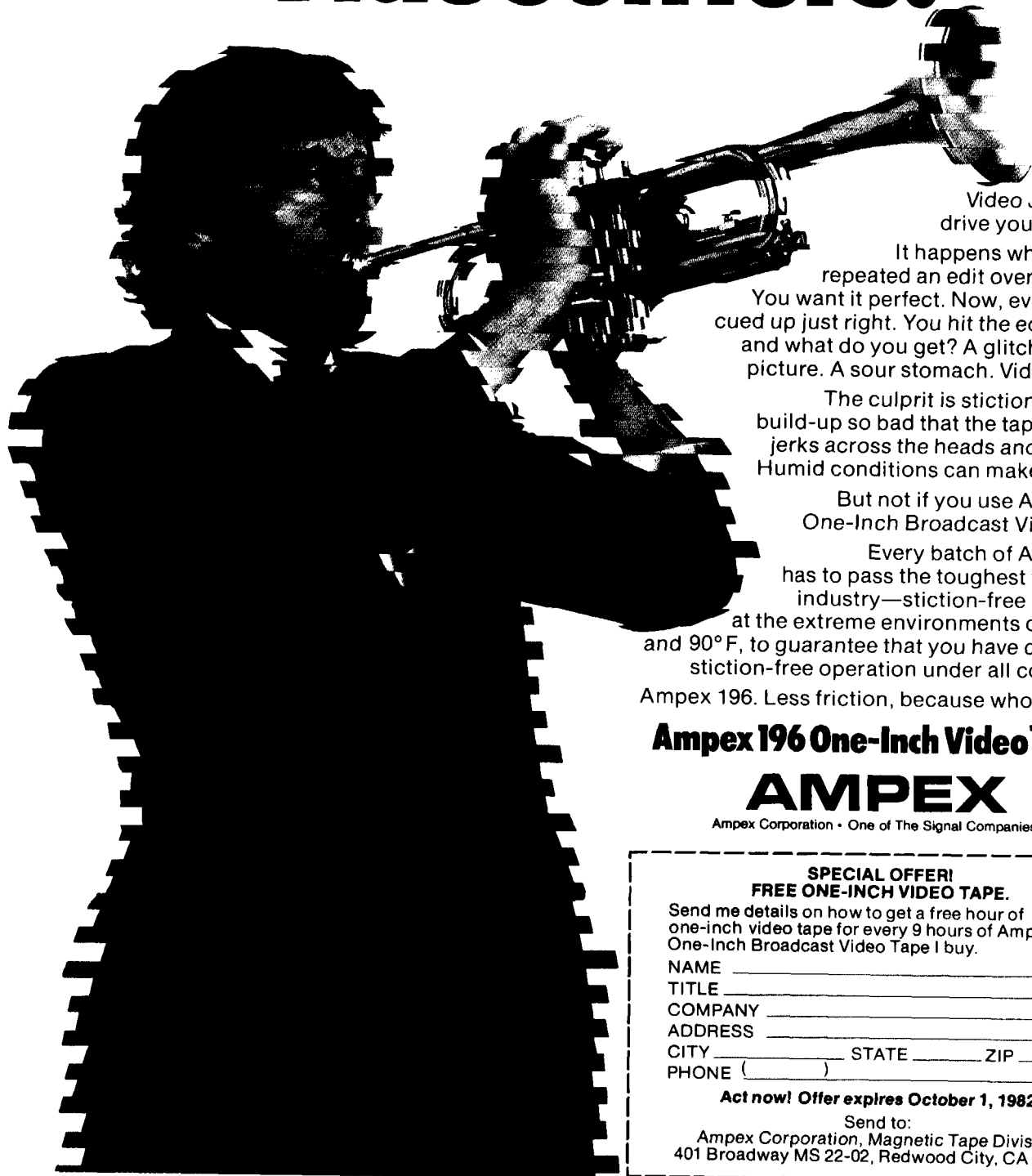
The repetition of both lines of event 01 is not necessary above if use is made of the “virtual source” indicator. We can construct an edit line wherein the source field refers not to an actual source, but rather to an earlier event which specifies a compound source — hence the term “virtual source.” The event referred to may be an actual event, or a “virtual event” included for the purpose of specifying the compound source. The example of Fig. 3 can be expressed more compactly as:

01	RL1	B	C	10:00	30:00	01:00:00
01	CG	V	K 20	00:00	15:00	01:05:00
01A	AUD	A	C	05:00	15:00	01:10:00
02	RL1	V	C	28:00	28:00	01:18:00
02	CG	V	K 0	13:00	13:00	01:18:00
02	AUD	A	C	13:00	13:00	01:18:00
02	BLK	B	D 20	00:00	01:00	01:18:00

Figure 3. Tracking edit example.

The ‘0-1<’ source implies the use of event 01 as a play source, as though it had been recorded on a separate sub-master which was then used as a playback reel (Fig. 4).

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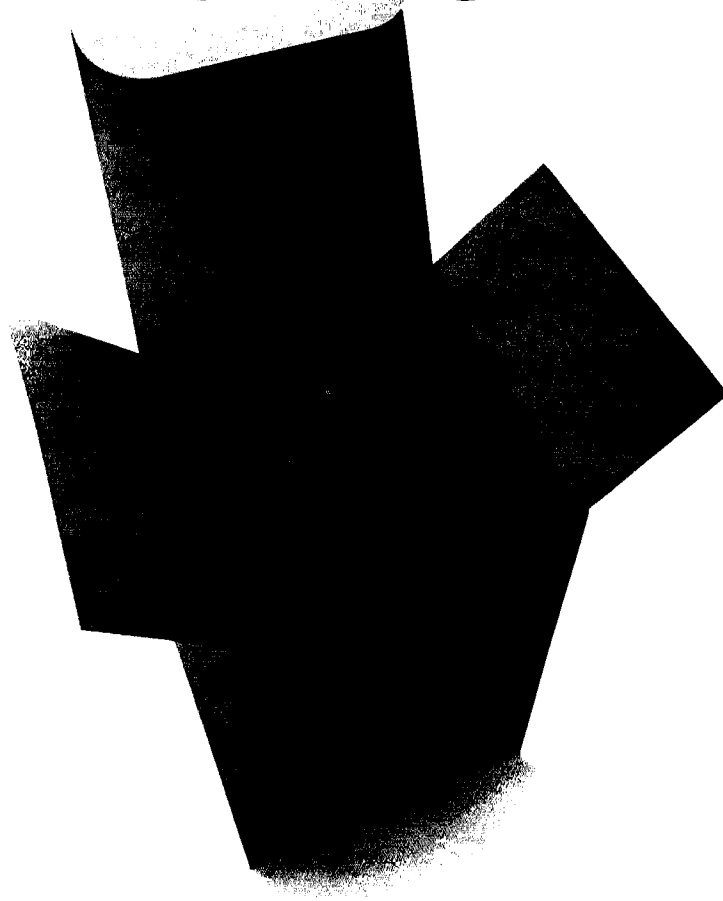
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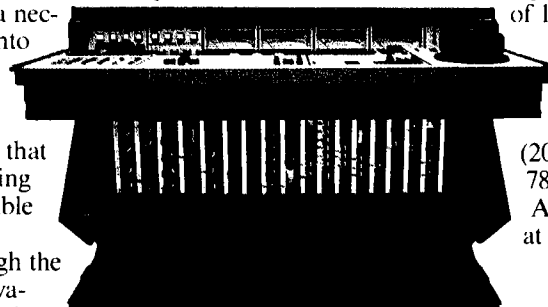
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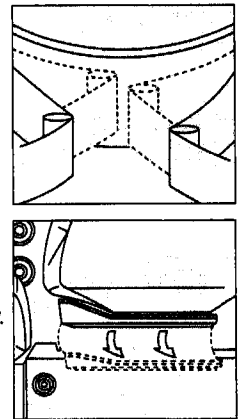
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01	RL1	B	C	10:00	30:00	01:00:00
01	CG	V	K 20	00:00	15:00	01:05:00
01A	AUD	A	C	05:00	15:00	01:10:00
02	01<	V	C	01:18:00	01:18:00	01:18:00
02	AUD	A	C	13:00	13:00	01:18:00
02	BLK	B	D 20	00:00	01:00	01:18:00

Figure 4. Virtual source example.

Compound "To" Sources

The virtual source and virtual event concepts become essential when describing transitions to effects made up of more than one source. Three-source effects are shown in Fig. 5.

Ignoring timing information for now, we can write effect (A) in EDI form as:

101	P1	V	C	...
101	P2	V	W1	...
102	P3	V	W2	...

Since EDL events are interpreted in sequential order, the parentheses under effect (A) are implied. We can't distinguish this from effect (B) without some sort of effective parentheses to specify the compound to-source, for which

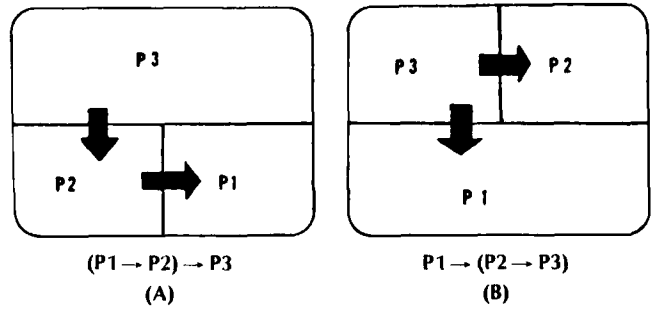


Figure 5. Compound "from" and "to" sources.

we call upon the virtual event. A virtual event is included which describes the relationship between P2 and P3, and this is called as a virtual source to perform the wipe to this compound source:

100>	P2	V	C	...
100>	P3	V	W1	...
101	P1	V	C	...
101	100<	V	W2	...

This method of combining sources parallels the procedure used in setting up the effects buses of a video switcher, al-

WIPE PATTERN NUMBERS

00	None	12		24		38	
01		13		25		39	
02		14		26		40	
03		15		27		41	
04		16		28		42	
05		17		29		43	
06		18		30		44	
07		19		31		45	
08		20		32		46	
09		21		33		47	
10		22		34		48	
11		23		35		49	
				36		50	
				37			

Appendix 1. Sketch shows effect. Normal direction of change is toward increasing white area.



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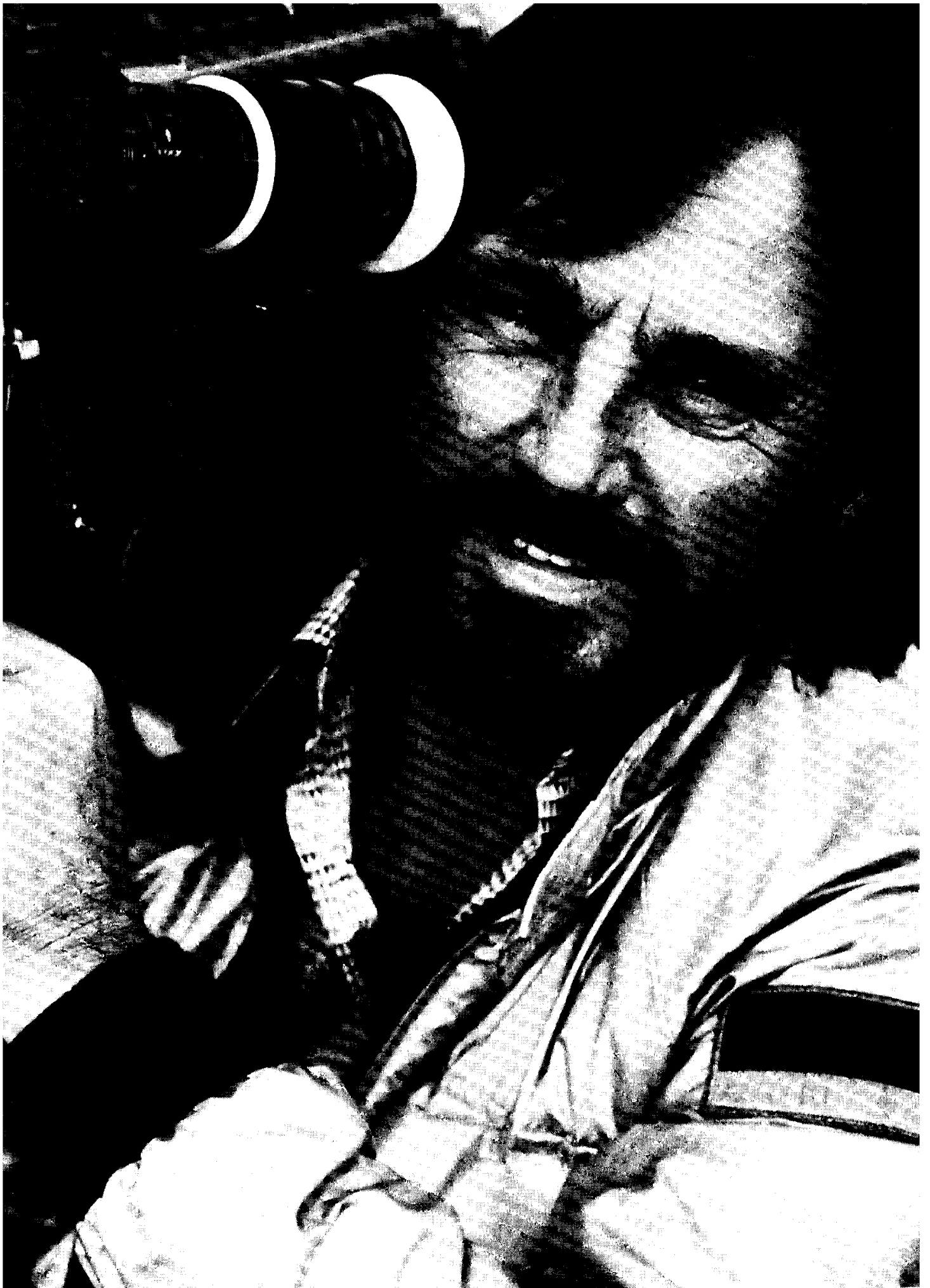
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Worked Perfectly!

David Breashears



ZSIGMOND



"The most memorable moments of any film are created by light."

Born in Hungary, Vilmos Zsigmond has become in the past decade one of America's premier cinematographers. He won the Academy Award for Close Encounters of the Third Kind, and an Academy Award nomination as well as the British Academy Award for The Deer Hunter. His work on The Long Good-bye earned the National Society of Film Critics Award for Best Cinematography of the Year. His latest film, Table for Five, is being shot on location on the Mediterranean.

"My style has changed through the years because technology has changed. We now have faster and better films, and lighting equipment is getting smaller and better. Today you can shoot a film that looks as if the cinematographer didn't use any supplemental light at all. It's a very natural look. And audiences today are much more educated, to the point that, when they see bad lighting, they notice it right away. So we're really forced to make a film look and feel as natural as possible.

"I try to light so that it feels as if it comes from natural sources. That's why I like to have windows in my shots—windows or candles or lamps. Those are my true light sources. Studying the Old Masters, Rembrandt, Vermeer, De la Tour. I found that they painted their best works relying on light effects coming from realistic sources. They even selected their subjects because they loved the light and the people. They were very selective and improved upon nature. They simplified and eliminated

multiple shadows to concentrate on the dramatic. That is what a cinematographer does; improves on nature.

"It was easier to shoot in black-and-white. All you had to worry about was light and shadow, contrast and abstract forms. I can do anything in color that I can do in black and white—and more. And if you want a black-and-white effect, well, you can do that, too. Thinking of paintings: Can you honestly remember any great painting that is black and white?

"As a cinematographer, I often get too much credit for the look of a film—like the red, white and blue scheme of DePalma's *Blow Out*, a film I worked on. A lot of these things are worked out in advance, by the art director, the director, the writer. After all, they spend up to a year preparing a picture before I come on board.

"I like a soft look, and there are many ways to get it. On *Close Encounters of the Third Kind*, all the effects you remember were created by light. In fact, the most memorable moments of any film are created by light. On *McCabe and Mrs. Miller*, I used lots of diffusion filters, and forced the film, and lots of flashing of the negative, which desaturated the colors and made the black sort of dark gray. The whole film had an interesting period look. On *Heaven's Gate*, we didn't filter the camera at all—simply used the natural softness of dust outside and smoke inside. And we flashed the print itself, print by print.

"I like the look of the new Eastman color high speed negative film 5293. It will bring a new look to the industry. It's softer and looks good. Its terrific sensitivity will

enable us to shoot under difficult conditions we only dreamed of. Actually, I go after texture and light primarily. I plan to use 5293 for all of my next feature, and not just the low light segments. There's no problem with overexposure with it. It has a wider latitude.

"I've shot commercials, too—both film and tape. The film look is a lot better. You can't push videotape, either. Videotape can be complicated: In studio it is fine, but on location things break down in a way that doesn't happen with a camera. A film camera is actually very simple. Videotape is just not good enough yet. There's not sufficient definition to project on a big screen. It will probably be decades before they come up with a tape that matches today's image quality of film."

If you would like to receive our monthly publication about filmmakers, KODAK Professional Forum, write Eastman Kodak Company, Dept. 640, 343 State Street, Rochester, New York 14650.

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though the syntax is not dependent on this particular hardware implementation. The breaking down of complex effects into component parts also facilitates the assembly of EDLs by systems without multiple re-entry switcher capabilities, in that it spells out the order in which sub-masters may be made for later combining.

Split Audio-Video Edits

One of the more common editing functions involves separate in and/or out times for audio and video. This can be described in a number of ways, as shown here for a cut where audio starts one second after video and ends one second earlier:

02	RL1	V	C	00:00	10:00	00:00
02	RL1	A	C	01:00	09:00	01:00

Alternatively:

02	RL1	V	C	00:00	01:00	00:00
02	RL1	B	C	01:00	09:00	01:00
02	RL1	V	C	09:00	10:00	09:00

These two events have the same meaning, and it is intended that the method of execution of the event be left to the discretion of the interpreting editing system.

Summary

The work of the working group on Editing Procedures is by no means complete, but significant progress has been made towards a common language for specifying the post-production process.

The EDL format described herein will be proposed as a

Recommended Practice in its present form, and updated as required. Further work remains to be done in the following areas:

- Non-play-speed VTR velocity control — for fixed speeds, a record out-time establishing different play and record durations is one way of describing this; variable speed (“motion memory”) will probably be best handled with special data.
- Digital special effects — manipulation and generation of pictures
- Color correction
- Complete switcher function specifications
- Audio — finer time resolution; mixer and equalization automation (probably appropriate for another group to be formed to handle this)
- Film-tape edit list translation — edge numbers to SMPTE time code, accounting for various means of 24/30 frame rate compensation.

The group welcomes input from the motion picture and television engineering community. Any comments or suggestions pertaining either to the proposed standards, or the pending subjects listed above, should be sent to:

Robert Lund, Chairman
9 East 10th Street
New York, NY 10003

or

Jim Conlon, Secretary
Trans-American Video (TAV)
1541 Vine Street
Hollywood, CA 90028.

Working Group on Digital Video Standards: The Current Position on the Studio Digital Video Interface

Prepared by **KEN P. DAVIES, Chairman**

Approved in Committee April 7, 1982.

Purpose of Document

Recent CCIR action has finalized recommendation AA-11 concerning Component Coded digital video at the studio level (4:2:2), and the Working Group is now engaged in studies leading to a recommendation for a practical implementation of a studio-level interface based on the principles of AA-11 for 525-line applications. In this activity the Working Group is desirous of maintaining close liaison with other Working Groups and Study Groups in the SMPTE and with other committees internationally to ensure that these recommendations fully meet the needs of the

television community. This report outlines the results of some recent studies and discussions and indicates the directions and priorities that the Working Group is following. The Working Group would welcome contributions or comments concerning this work.*

Application

The interface must serve to interconnect units of the digital studio for the transmission of digital video signals, associated housekeeping signals, and optionally some

* The Working Group is anxious to receive as many comments as possible from the television community. Please address comments to Ken P. Davies, Chairman, Working Group on Digital Video Standards, c/o CBC Engineering Headquarters, Studio Systems Department, 7925 Côte St. Luc Road, Montreal, Quebec H4W 1R5, Canada.