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 submasters 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.

AFFORDABLE ONE-INCH

Introducing the Ampex VPR-80.
Type "C" broadcast quality on a budget.

Excellent picture quality and low cost. That's what you get with the VPR-80, the new professional video recorder from Ampex. Whether you're adding to your present facility, or moving into the professional video market, you'll find the VPR-80 to be a totally new concept. Yet, it incorporates the most demanded features of the world's most popular one-inch Type "C" VTR, the VPR-2, plus several new and advanced capabilities.

The VPR-80 provides the latest in recording technology. You get a transport designed for superior tape handling of all reel sizes from 6½ inch "spots" to 2-hour, 11¾ inch reels. It has dual microprocessors to control all VTR functions and servo systems, a universal power supply, built-in audio monitoring and a power-down feature that remembers the control panel setup even when the power's off. Plus built-in diagnostics to keep operation and maintenance costs to a minimum. But there's more.

You also get as standard the Ampex exclusive AST™ automatic scan tracking for perfect slow motion and still frame pictures, plus frame-accurate editing with simple, operator-oriented controls. Not to mention table-top or rack-mount versatility and compatibility with the entire family of Ampex VPR accessories. With the VPR-80, everything from setup to servicing can be accomplished with a minimum of effort and time.

The VPR-80 was truly designed for the operator. And it's backed by the unique worldwide service and support that Ampex is known for. To find out how the VPR-80 fits into your application, contact your Ampex representative or write Ampex Corporation, Audio-Video Systems Division, 401 Broadway, Redwood City, CA 94063 (415) 367-2011.

AMPEX

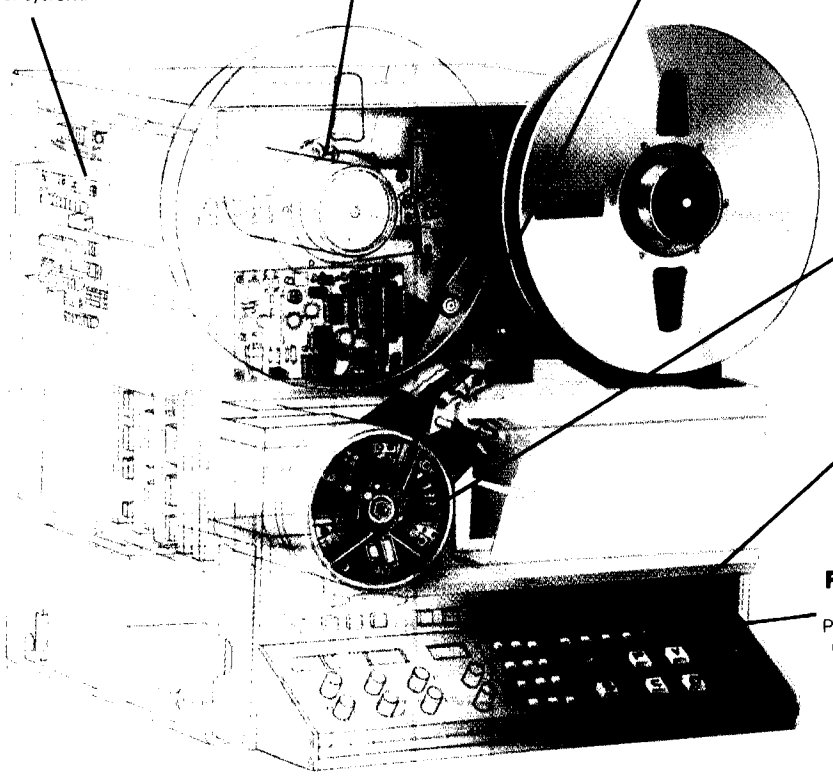
TOOLS FOR TOMORROW

Ampex Corporation • One of The Signal Companies

Serviceability
From the top, front and back with hinged door assemblies providing easy access to the audio system, major plug-in printed wiring assemblies and power system.

Advanced Transport Design
For fast and gentle tape handling of all reel sizes from 6½ inch "spots" to 2-hour, 11¾ inch reels.

AST™ Automatic Scan Tracking
Delivers disturbance-free slow motion from play to still-frame mode.



Individual Head Replacement
Quickly with only a screwdriver. No mechanical adjustment or drum change required.

Frame-Accurate Editing
Results from the VPR-80's precise tape timer and search system, AST™ and simple edit controls.

Fault And Non-Standard Operation Detection
Performed as part of the power-up sequence. If detected, the specific condition appears as a unique code in the timer display.

auxiliary signals. The interface should permit separation of the units by distances of typically 1–300 meters (3–1,000 ft). The environment is generally relatively free of noise and bandwidth/noise/attenuation. Considerations tend to favor a simple wide-band/low-attenuation solution with a minimum of error-processing.

The interface may find some use in inter-area or inter-vehicle connections in remote pickups, and a preference exists for interfaces having good common-mode rejection. Care is also required to ensure that signals transmitted through the interface do not cause harmful crosstalk or interference into other digital video circuits or other services.

Signals To Be Transmitted

The interface must pass transparently and in real-time the component digital video signals described in CCIR Recommendation AA-11 with the necessary housekeeping data associated. In addition, the interface may also pass auxiliary signals during times that video data is blanked. Signals may include time-code, teletext, test signals, user production data, and other control or data signals.

It is also desirable that the interface be capable of passing other forms of digital video, as long as this imposes no significant penalty on the minimum system, and respects the essential needs of component digital video signals described in AA11.

Such forms might be:

- Nonreal-time video in variable length blocks with addressing data (H&V position and lengths).
- Bit-rate reduced video from higher levels of the hierarchy.
- Multiple channels of video from lower hierarchy levels.
- Digitized composite video.

Interface Forms

A single interface is conceptually appealing, but may not be feasible in the near term unless logic capable of operation at rates near 500 Mbit/sec becomes rapidly economical. At the present time logic cost/performance considerations favor an 8-bit plus clock bit-parallel form operating near 30 MW/sec. This arrangement allows transmission on multiple twisted pairs up to about 50 meters or on simple optical fibers beyond that. The bit-parallel system is attractive for unit interconnections but poses problems for switching, patching, and multiple destination distribution.

An economical all-serial approach is limited by LSI logic speeds to about 130 Mbit/sec and the extension to 230 Mbit/sec adds considerable complexity and cost. A system separately transmitting on two channels luminance and multiplexed color difference signals might offer a workable compromise pending improvements in silicon-bipolar or gallium arsenide LSI designs at 300–500 Mbit/sec.

The all-serial approach can employ either coaxial cable or optical fiber transmission. Available low-cost driver transistors, cables, and connectors favor a system using coaxial cable (similar to CATV technology), and work is in hand to quantify performance and potential problems such as RFI requirements and connector reliability. The optical fiber approach requires laser transmitting sources and high quality diode receivers, both fairly costly. Technology for connecting, splicing, patching, etc. in the glass medium is also costly compared to that in coaxial cable. Maximum cable losses and equalizer needs are sensitive to channel-code but appear manageable for simple codes that can be readily implemented.

It is generally agreed that an interface based on a single coaxial cable is the most attractive current approach, and that a bit-parallel approach should be available as an alternative. The transmission medium for the latter approach is not yet agreed upon.

Data Forms

It is highly desirable that the data and control transmissions in the interface be designed with as much generality as possible and that proper separation of data, data control, link control, and link synchronization be observed. Only at the specific link level should there be differences between the serial and parallel forms of the interface. The Open Systems Interconnection model described by ISO illustrates and quantifies such an integrated and structured approach.

While discussions are continuing on many of the specific details, the Working Group has achieved some measure of agreement on the following points:

- The interface should operate on a packet basis modified to afford priority for real-time transmission of video data in a continuous block of one line. Luminance and color difference signals would be multiplexed into a single stream.
- Packets of video data might include line number data as part of the address. Further studies of this are required.
- Other data would be in packets of variable length (declared in header) and would be given priority in the transmitter.
- Data error protection is to be arranged on a "packet type" basis. For example, different techniques may be used for video, audio, user data, etc.
- In the studio, error control and protection must be relatively simple and a proper interface link of low intrinsic error rate must be specified.
- Link synchronization is separated from data packet synchronization, to allow similar structures in both serial and parallel transmission formats.
- All data are transmitted on the same link.
- Care must be taken to specify link control procedures that allow full freedom for 8-bit data transmission. While some code patterns in video are forbidden due to bandwidth considerations, they may occur naturally in some data streams. A secure procedure using both pattern detection and time correlation must be designed. A system using clock violations to achieve link synchronization might also be considered, but it is less desirable.
- Channel codes are not yet investigated. A preference exists for codes that are simple and inexpensive to implement, even at the price of a modest increase in bandwidth requirements.

Conclusion

The Working Group is continuing to study the interface needs and possibilities. The notes above indicate the current position. Individuals, groups, or other committees are encouraged to contribute to this work, particularly as it might affect their own work. The Working Group is attempting to establish interface standards having a maximum of flexibility and application and which will enhance the worldwide compatibility achieved in Recommendation AA-11.