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ABSTRACT

Stages in developing editing equipment and processes for videotape are described. In 1956, when the first broadcast videotape recorders were installed, a splicing block, consisting of an aluminum block, steel ruler, and sharp razor blade, was used. Gradually, technicians developed more sophisticated methods. At present, two very advanced methods have been developed. The CMX 600 is a light pen editing system. In this technique, picture and sound information along with time code reference are all loaded segment by segment or scene by scene into magnetically coated spinning discs which rotate continuously at 1800 rpm. Scenes are accessed by scanning these discs with special pick-up heads. An offspring of the CMX is the Edipro 300, an on-line editing system in which one builds a master tape as he goes along. (JK)

"Razor Blades to Computers"

by

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The first broadcast videotape recorders were installed in 1956. Almost immediately the question arose, "Can we edit videotape?"

Obviously, the first attempts were very crude. The first splicing block was just that--an aluminum block, a steel ruler and a sharp razor blade. A very fine carbonyl iron powder in solution was brushed on the oxide of the videotape.

This "developed" the electronic pattern on the tape and enabled the editor to "see" the television frame line which is known as the edit pulse. Initially, there were two edit pulses per television frame and there was a 50-50 chance of making an edit that didn't roll or whip. It was similar to splicing film in the middle of the frame.

The standard of using one edit pulse per frame was then established, which at least insured that the edit point was at the end of the TV frame and not in the middle.

Videotape splicing was beginning to fascinate more and more production people so Ampex came out with a more accurate version of the videotape splicer. It consisted of an aluminum bed, doors to hold down the tape, rollers to position the tape and precision glass guides so spaced as to allow a razor blade to be drawn through the guides to accurately cut the tape.

It worked well to a certain degree - depending primarily on the skill of the operator, but more often than not, the splice lurched or whipped, as it went through the video head. The splicer also lacked the ability to easily see the developed pulses on the tape in order to determine the exact edit point. At this point, the famous "Smith" splicer was introduced and is today the standard splicing tool used all over the world. This is the ultimate splicer for mechanically cutting videotape. It not only had the aluminum bed, the doors and the rollers of the Ampex splicer, but it did away with the glass guides and provided a positive means of locating and positioning the edit pulse, firmly holding down the tape and with great precision, cut the tape precisely at the end of a television frame without disturbing the video. Now, instead of a razor blade, a guillotine-type cutter bar was employed which made a smooth cut and seldom needed sharpening. A 40 power microscope was added to relieve the strain on the operator's eyes. All of these refinements allowed an editor to make precision edits with relative ease repeatedly.

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In the year 1958, at NBC in Burbank, I was involved in the development of what is known as the double system method of tape editing.

Basically, a copy of the video tape master was made on 16mm film using a direct positive picture and a single system optical track composite. However, the optical track did not carry the program sound associated with the picture. The sound was used as an electronic edge number to later correlate the videotape original with the edited 16mm kinescope film work print. In addition to the 16mm picture, a 16mm magnetic sound track was made having two tracks. The prime or edge track carried the program sound. A second or "cue" channel adjacent to the sprocket holes was used for the electronic edge number.

This electronic edge number is a voice track--one man's and one woman's--with an audible low frequency "beep" every 24 frames synchronously recorded. The voices alternately gave the minutes and seconds between beeps. The frame count was derived from measuring the number of frames from the beep nearest the splice to the physical splice in the work print. This edge number code is called "ESG" or edit sync guide. The editor did not normally concern himself with this ESG until he completed his editing.

Standard 16mm motion picture film editing equipment and techniques were used to edit literally hundreds of television specials, series, and commercials. The "Bob Hope Comedy Specials" and the "Laugh-In" series were some of the shows edited in this manner.

During the transfer process from tape to kine, this ESG is applied to the videotape cue channel, the optical sound track of the 16mm picture and on the cue channel of the 16mm mag track. The ESG is delayed on the kine and mag track so they are in frame sync with the videotape.

Once the film had been edited, a log or "count" sheet of all the physical edits in the work print was made.

The sound of the ESG cue track was found by using an optical reader. The operator wrote the timecode information on a log as a frame accurate guide for the tape editor.

The original videotape scenes are cut apart and put onto smaller reels for ease of handling. All the videotape editing is done on an editing bench and a custom made audio reader for the videotape allows the editor to read either the program audio for scene identification or the cue channel for ESG code. The time code is then matched by listening for the code, then the beep, developing the beep on the tape and using a special ruler, measuring down the number of frames called for on the log. The scenes are then spliced in conformity with the log.

The 24 frame editing system as initially developed by NBC had a number of inherent technical problems because of the 24 frame per second rate of film as opposed to the 30 frame per second rate of videotape. These problems were overcome by various ingenious techniques and equipment too complex to mention in this paper. Suffice it to say that it worked well for some dozen years. Many award winning shows were edited using this method.

The system was in general use at NBC Burbank until sometime in 1971, at which time they switched from the 24 frame per second kinescope film system to a 30 frame per second system which made the film editing process more compatible with videotape since they are now on a one-for-one basis.

In early 1963, Ampex developed an electronic method of tape editing. One of the first systems was installed at NBC in Burbank, and I frankly admit I wasn't too thrilled with the idea. I told the Ampex engineers that I wasn't about to store my faithful splicer in cosmoline.

The first Ampex electronic editor had no precision control of the edit point. At the point at which the editor decided to make an edit, he pushed the record button "on the fly" in other words, as the tape played through the machine. There was no preview mode. Since there was an 18 frame delay built into the system between the video erase turn on and the record head, he had to anticipate each edit by 18 frames or a little more than half a second in order for the cut not to be late. This is what is known as "punch and crunch" editing. If you were late on the edit, you could re-do it and push record a fraction of a second earlier or--if he did as many of us did--pushed record too early, guess what? Yes, re-record the scene you just wiped out or start over again.

The next step was for Ampex to install a programmer for their editor which gave the operator quite a bit more control. This was known as "editec."

By playing the tape you could mark your edit point precisely, shift its position forward or backwards, and the suicide factor in electronic editing was neatly eliminated. Now you could preview each edit, make a video only or audio and video edits, and yes, even animate frame by frame. This was all accomplished by an audio "beep" applied manually by the operator to the cue track of the videotape. Even today, there are many editec electronic editing systems in use, including network TV stations.

I now thought to myself, "Well, now maybe I will put my splicer aside-- but not yet in cosmoline."

Several years after the introduction of editec by Ampex, a firm called Electronics Engineering Company or as it is affectionately known in the industry as EECO, developed a revolutionary new editing system that used a binary computer time code which was recorded in the cue channel of the video tape. This code would cause the videotape to start or stop on cue, edit audio-video, video only or audio only. This approach to editing eliminated a good percentage of mechanical hangups that slowed down the electronic editing process in the past.

During the editing process, the tape operator pushed a time hold button on the VTR panel at the instant he wished to designate an edit point, which stops the numbers in the window. The time code numbers are seen as numerical readout in hours, minutes, seconds and frames. The operator then dials in these numbers to either start or stop an edit or it will start the playback VTR when the number dialed into the playback VTR corresponds to the same number on the record VTR as it is in the play mode. This function, of course, allows an edit to be previewed many times and then recorded. An external source such as an audio playback machine may be connected in the circuit and it may be synchronized precisely to the frame with the videotape for audio sweetening.

The EECO system I would estimate speeded up the editing process by about 30%. It was the first of what I call the semi-automatic editing systems.

There also are a number of very good electronic editing systems in use today such as CDL, Datatron, RA-4000--each designed to control videotape machines, search, cue, preview and edit--each designed for certain types of budgets.

But the main reason for the limited discussion of the history of videotape editing is to concentrate on the new innovations in electronic editing recently introduced.

Now ladies and gentlemen, by way of explanation, it is not my intention that the following discussion sound like a sales pitch. In tape editing, I have been one of the first to physically splice videotape with the aluminum block and razor blade, through editec, EECO and others. I have been the broadcast television industry for more than 21 years, as well as having an extensive background in motion picture film editing. But I feel that what I am about to discuss is the most significant trend in tape editing.

I have been fortunate as supervising videotape editor of Consolidated Film Industries, to come in contact with two of the most sophisticated electronic editing tools ever devised by the mind of man to date.

The first is known as the CMX 600, or as many of you have heard, the light pen editing system. Basically, picture and sound information along with time code reference are all loaded segment by segment or scene by scene onto magnetically coated spinning discs which rotate continuously at 1800 rpm. Scenes are accessed by scanning these discs with special pick-up heads. These disc drive units incidentally are almost identical to those used in banks and other institutions where information is stored and must be retrieved instantly. Instead of digital information, however, the CMX discs store black and white pictures and sound information. Each drive holds up to $4\frac{1}{2}$ minutes of material and the system is designed to operate with 6 such drive units or "6 packs" giving a total working capacity of about 27 minutes.

My first impression was that 27 minutes of working material would never fulfill my needs. However, the one hour "Julie Andrews Documentary TV Special" that I recently edited on the CMX 600, allowed me to work with 5 hours of raw material, ending up with a one hour show-time accurate to the frame. It was done by breaking up the raw material into various 27 minute packs. In other words, 27 minutes of various material would give me about 5 or 6 minutes of edited material. This could be called a "reel." There were twelve 27-minute packs loaded with raw material and twelve 5-minute edited segments or reels that were electronically spliced together to form the one hour show.

Prior to loading the disc packs, all the raw material is transferred to an inexpensive half inch slant track color videotape "work print" with the time code information visually impressed over the picture in the bottom of the frame. The client is provided with a viewing room, a color monitor and a half inch tape player. He then makes a log of the scenes.

The start and stop times of each scene or segment is logged and from this a load list is built. The two inch master is played back and the selected scenes are loaded into the discs, as mentioned earlier.

Now the editing begins. With light pen in hand, the editor starts building an edited work print. He selects the raw material from the right hand monitor by touching the scene asked for. Instantly, the first frame of the scene appears on the right hand monitor. He touches play. The picture moves forward until he stops it. He has complete control over the speed of the picture from up to ten times faster than normal forward or reverse, to normal forward and reverse, through slow speed which gives you as slow as 1 frame per second. A final mode gives jog or single frame advance in either direction. In stop frame mode, the audio associated with the picture is still framed and the amazing thing about this is when you listen to the audio from still frame, though ten times faster than normal, the audio retains the correct pitch. This is great for music editing because it allows you to move frame by frame until you select the correct musical note on which to make an edit. An "A" note is "A" at any speed--even at still frame for example.

You pick a start edit point on the right monitor, splice to the left monitor which becomes your edited takeup reel. Then play down the left monitor until you find an out point. Again, you go to the right monitor, select a new scene and repeat the process. The CMX also allows you to make dissolves, fades and 23 programmed wipes in any increment from 1 to 255 frames, which is equivalent to $8\frac{1}{2}$ seconds maximum length.

Another feature is that video only, audio only or audio-video dissolves or fades may be indicated.

An edit, once it has been made, may be respliced at any time, as many times as necessary. It takes only a matter of ten seconds or so to resplice. This same procedure on film would take anywhere from 5 to 10 minutes.

The output edit list is a computer punch tape that corresponds to all the edits in the splice list. This tape is then programmed into a companion computer which controls three VTR 2000 broadcast tape recorders. The uncut scenes are then placed on the VTRs and the program tape calls for the edits to be made in conformity automatically with the edit decisions as done earlier on the console. This automatic assembly can make an average of 30 edits an hour depending, however, on the number of reel changes and the search time of the VTRs to find the correct scenes.

The description of the CMX is of necessity brief, but I assure you that the flexibility in editing that the CMX off-line light pen system offers is unparalleled. The system in essence becomes an extension of you because no longer are you concerned with the mechanics of editing. You are free to concentrate only on the esthetics and the continuity of your show.

We now come to the offshoot of the CMX system, which is known as the Edipro 300---another marvel of this electronic age. This is an on-line editing system, in other words, you build your master as you go. This system is designed to control up to 6 VTRs as well as auxilliary inputs. On-line editing essentially began with the first splicing block.

But the on-line editor, the Edipro 300, not only gives you sophistication, but flexibility. For example, a typewriter key board and a visual monitor perform the VTR operations and keep the operator informed as to the status of the edits. Either the "A" playback, the "B" playback, the auxilliary input or the record VTR may be selected by putting them in play, marking an edit point in and out, or, if the exact time code of the edit is known, it may be preset by typing the code into the computer.

Cuts, fades, dissolves or wipes may be indicated in any length from 1 to 255 frames, previewed, modified, trimmed plus or minus in any number of frames. The system has a built-in effects generator as well as an audio and video dissolve bus.

To preview a dissolve, the system will search the 2 playbacks and the record VTR simultaneously , park on a minus, 10 second roll cue, go into play, preview the dissolve, stop all machines and wait for its next command. If the operator is satisfied, he then calls for the record. The process is repeated except that the actual recording is made on the master tape.

When the recording has been completed, the teletype types out on paper:

1. Which VTR was in play, what type of cut, dissolve or wipe
2. The exact start and stop time of the playback VTR
3. The exact start and stop time of the record VTR.
4. The last out record time is the total length of the recorded material to that point.

For additional convenience, a punch tape is made of all of this information. This tape may be read and another duplicate paper copy printed out for your files. This means that you could conceivably come back at some future date re-edit easily by just typing in the printed-out start and stop times of a particular edit and possibly substitute another scene in the same spot with no error--in a matter of minutes.

The only time you need leave the keyboard is to load or unload tapes on the VTRs. It is possible to do an entire edit session without leaving your chair--except of course, for lunch!!

I think at this time, I would like to summarize by saying that in the past 15 years, the television industry has made monumental strides in all areas especially in editing. No longer will the tape editor get calloused hands from splicing nor will he get flat feet from standing in front of VTRs all day. Computerized editing is here today. It is fast, extremely accurate and economical.

And, oh yes---one last thought. I still won't put my splicer away in cosmoline. It'll make a great paper weight for my desk!!!