4 cameras in motion

The story of a four-camcorder shoot... with live switching on location and a roving Steadicam JR...followed by post-production synchronization of four isolated videotapes for on-the-fly editing...using a low-cost switcher with digital video effects and a synchronized multitrack sound recorder.

Bob Doyle observes his work with the four input and two output monitors attached to the Panasonic WJ-MX50 video mixer. The Tascam 688 Midistudio provides up to seven audio tracks running in sync with the video SMPTE.

"How accurate are the quartz crystal clocks in consumer camcorders?" someone asked at an informal meeting of a Hi8 user's group in Cambridge, Massachusetts.

"Probably better than the crystals we used in the 1970s to synchronize Super8 movie cameras and Super8 sound recorders," came the answer.

"Then how long do you think two cameras could stay in sync if they were started at the same time?" went question two. "Fifteen minutes? Twenty minutes?"

"Long enough to complete a multi-camera shootwith no connecting cables, I'll wager."

And so our group decided to test the ability of consumer camcorders to run in sync. With modern cameras speed-controlled by highly accurate crystal-oscillator clocks and the recent availability of Sony rewriteable consumer (RC) time code, it seemed possible to take tapes shot in separate camcorders and re-sync them in the studio. We wished to switch between multiple source decks to achieve on-the-flyA/B roll editing. We also hoped the different tapes would play in sync with a master audio recording on a multitrack tape recorder.

Did we succeed?

Did we ever.

Multi-camera shows are the rule in conventional video production, particularly in live television. Studio cameras are genlocked together with an external sync signal guaranteeing each camera scans the scene in perfect sync. The video switcher can cut or wipe between cameras without a glitch.

Consumer cameras possess no such genlock ability. So we looked to the pro practice of resyncing isolated camcorder tapes back in the studio using time code.

Though two camcorders may output the same frame using time code, they still scan through that frame at different points in the video signal. One might finish a scan of line 35 while the other is somewhere in the middle of line 212. A normal switcher would cause the video to break up in a transition between the two signals. Fortunately, new digital audio-video mixers can synchronize the signals from **two** cameras. We used the WJ-MX50 mixer, with two frame synchronizers and four video inputs.

Assuming we could successfully position the four tapes to the same frame, we'd have to sync-start the recorders to make sure they'd all come up to speed on about the same frame. Then we could feed the video into the MX-50, which would sync the sources down to the pixel. We'd then be able to make transitions between all four tapes.

We also needed to be sure the camcorders wouldn't quickly drift apart. For long scenes of lip-sync audio, the video should stay within one frame. Early tests

by Stuart Cody and Bob Doyle

were encouraging. We recorded window burns of SMPTE time code from a Horita [illegible] at the top of the screen on one two-hour Hi8 tape, on the bottom on a second tape.

We then placed the tapes in two Sony V801 camcorders, starting them together with infrared remote control. We passed the video signals through the MX-50 switcher, performing a vertical wipe so both time codes were visible. The results we recorded on a third tape. We played this tape back to gauge the amount of movement of the two source camcorders over a period of two hours. Though they drifted apart by a frame on several occasions, they always came back into sync. At two hours and four minutes they'd strayed but one frame apart.

We repeated this experiment with different camcorders—with poorer results. For example, the EV-S900 Hi8 recorder and the V801 differed by one frame in eleven minutes. This was still acceptable for edits lasting five to six minutes.

Our results suggested we could duplicate a process that requires many tens of thousands of dollars in the professional realm. Working only with low-cost consumer camcorders and the new digital A/V mixer, we could simulate multiple genlocked VCRs and TBCs. We aspired not merely to A/B roll, but simultaneous A/B/C/D roll, using only about $10,000 in equipment.

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Our opportunity came in the form of a theatrical production that posed some serious videomaking challenges. It was the Omega Theater production of *Sejecho: Voice of the Earth*, staged at the Cambridge Multicultural Arts Center in July 1992. An audience of about 200 people would participate in the piece. It would feature a large musical finale, with everyone dancing around a central altar topped with a radiant earth globe.

Theater videos are often dull and lifeless. Audience seating and the theatrical window of the stage's proscenium arch severely limit camera angles, distances and movements. The only visual variety is zooming and panning. Audio suffers from the hollow sound of a lone microphone in a giant theater.

With a multiple camera approach, we hoped to pace the video to match the drama and action. For the principal audio, we strung two-directional mikes from the balconies overhead; they hung just above the actors. The artistic director gave us permission to circulate a member of the crew out among the audience, bearing a tiny Sony CCD-TR101 on a Steadicam JR. In this way we could cover the opening audience participation workshops and move around the stage to obtain shots of actions impossible to capture with tripod-mounted cameras.

We placed two Sony CCD-V801s and a Sony V5000 on the main floor along the west wall to provide left, center and right views of the main stage. A second V5000 we mounted in the center on the balcony, looking almost directly down onto the stage. Also in the balcony was the MX-50 switcher, with video cables feeding in from the four tripod-mounted camcorders and an audio feed coming from the overhead mikes. The switcher we connected to a Sony EV-S900 so we could get one tape of the whole event switched live.

The video crew included four camera operators plus the Steadicam operator, two people at the switcher, a technical director and an assistant. All but the Steadicam operator were connected by intercom headphones with the director in the balcony, who tracked all the camera images on a motley collection of monitors.

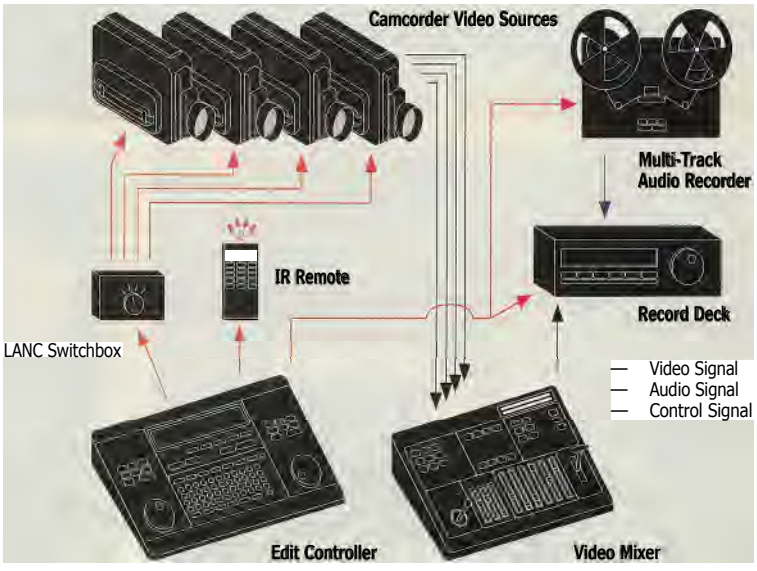
In a little over two hours we had seven Hi8 tapes in the can. We headed back to rewire our production gear as a sophisticated post-production studio. Perhaps the biggest single savings for those working on a low budget, or no budget, is using the camcorder as a source deck when editing. In our case, we had four source decks.

In our first rough cut we performed only A/B roll editing, inserting additional footage into the live-switched video. We used the Sony RM-E700 as our edit controller; we chose as the edit recorder the new EV-S3000, the first Hi8 recorder with linear time counter (but no time code).

We spent several hours logging all the footage with exact time code. Late in the project we obtained Abbate Video's Video Toolkit for Macintosh to help with the logging and editing.

We striped RC time code onto the two V5000 tapes using a V801. The V5000 is a very professional Hi8 camcorder, with

Four video inputs, synchronized multi-track audio and professional transitions with consumer-level gear? You bet.



TBC and digital video effects that are wonderful in post-production. But it doesn't have time code, and is surprisingly limited as an editing source deck. This is because it does not respond to the edit controller's jog/shuttle commands to step backwards one frame, a vital feature of any deck when trying to position tape for an edit. The TR101 recorded its own RC time code. This capability is not widely known; since the TR101 doesn't play back time code, Sony doesn't advertise it as a time code camera.

For the final edit we worked from a paper edit decision list based on the Omega Theater people's reaction to the rough cut. Many scenes offered great shots from several cameras; we wanted to use them all. In a normal editing setup, every time a new source tape is needed the whole editing process stops while tapes are exchanged. With A/B effects, everything must restart in sync. Our goal was four source tapes rolling in sync, so the MX-50 could select anyone at any time without stopping.

Technical Challenges

We faced three big technical challenges in running multiple source tapes in sync for on-the-fly editing.

The first was controlling multiple camcorders with the single jog/shuttle wheel on the source side of the RM-E700. The second involved getting all the cameras to start in sync at the beginning of each edit. Third came maintaining sync with the Tascam MidiStudio 688 multitrack recorder, where we'd recorded multiple audio tracks with continuous music over some scenes.

We solved the first problem by building a simple switch box with one input jack, for the control-L or LANC cable from the edit controller; and multiple output jacks for similar cables to the camcorders. We could enable this switch and the controller would suddenly communicate with another camcorder; this would allow us to move it to an exact frame. We displayed the RC time code on our monitors using the camcorder data screen function.

These stills from the finished ninety-minute video illustrate a visual versatility often lacking in theater video.

We solved the second problem by modifying a low-cost infrared remote to work with the RM-E700, which closes a switch at the start of an edit. Many controllers offer this feature. The problem is how to start the camcorders, which don't respond to a simple switch closure.

So we opened the remote control and soldered a cable connection to the crosspoint of two wires under the play button. We plugged this cable into the editor's trigger output. At the beginning of the edit every camcorder in view of the remote started up. Moreover they started up repeatedly and reliably, though different machines offered different starting offsets. The V801, for example, required positioning six frames ahead of the other units to come up to speed in sync.

The final problem was more difficult. One of us has pursued "double-system" sync sound since the 1970s, when Super8 sound recorders made it possible for low-budget filmmakers to edit sound and picture separately. The availability of relatively low-cost multitrack sound recorders promises videomakers powerful multitrack capability for original soundtracks.

Tascam recently introduced an $800 version of its ATS-500 multitrack recorder synchronizer. This machine syncs audio to video by comparing a SMPTE time code signal from the sound recorder to SMPTE coming from a video recorder. The problem for those using consumer camcorders is that RC time code cannot be directly read by SMPTE gear like the Tascam ATS-500. Even pro video equipment like the Sony EVO-9850 doesn't produce SMPTE code without a $1000 option board.

We solved this third problem by building an experimental converter that takes RC time code in and puts SMPTE time code out.

With this device we could "mix to pix," running the multitrack sound in perfect sync with the camcorders. Since the Tascam MidiStudio 688 recorder is also a 20-input mixing board, we could fade up at any time one of the eight stereo audio channels from the camera master original tapes.

Our test was a resounding success. Using equipment that is extremely cheap by professional standards we achieved the same sort of post-production results turned out in expensive studios.

The finished ninety-minute video aired on Cambridge Community Television. The Omega Theater uses it for fundraising.

Another result of the experiment is this article for Videomaker. We hope to encourage readers to pool their resources as we did; to accomplish more sophisticated productions, shooting with multiple cameras and editing A/B roll.

Stuart Cody is a professional soundman who has worked in numerous film and television productions. **Bob Doyle** is an inventor and organizer of university film, sound and television studios.

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193 (least value) **194** (some value) **195** (most value)