ACHIEVING FIRST GENERATION NTSC QUALITY IN A RECORDABLE LASER DISK COMMERCIAL INSERTION SYSTEM

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Abstract

*Recent introductions of recordable and **track-erasable** (TE) laser disks have improved the versatility, storage capacity, operational flexibility, applications and image and sound reproduction quality of commercial insertion systems by orders of magnitude over the original 3/4-inch videotape cassette systems. Image quality which is subjectively the equivalent of 1-inch Type C recordings results from the FM recording of the chrominance signal as line-sequential C_R and C_B, and FM recording of the luminance signal at a higher center frequency.*

*Incorporation of TE disk drives in these systems will also dramatically reduce their Total Life Cost (TLC). Their applications can be extended to include storage and playback of **program** material in cablecasting and broadcasting, and a variety of image, sound and data material archived in libraries, schools, museums, MIS systems, government data bases, etc.*

*Use of a Component Analog Video (CAV) videotape recording format, such as S-VHS (S-Video), for shooting and postproduction editing of original footage before transfer to either a WORM (Write Once, Read Much (or Many - times) laser disk, enables each playback of a segment from the automation system to be **first-generation NTSC!***

The 1980s evolution of automated commercial insertion systems

When local cable system operators first began to generate income by inserting local commercials into their programming, only 3/4-inch videocassette recording and playback equipment would both fit their budgets and deliver a minimum acceptable level of picture and sound quality. This format had become the de facto standard for broadcast industry ENG (Electronic News Gathering) in the mid 1970s. Because SMPTE (the Society of Motion Picture and Television Engineers) had subsequently documented its specifications[1], it was a "safe" format for the cable industry to adopt as a de facto standard for commercial insertion systems. Both recording and playback equipment and videotape cassettes were available from competing vendors with guaranteed interchangeability .

During the 1980s, signal output quality was regularly improved through upgrading of recording head, tape and processing electronics designs. However, the limit of these improvements is imposed both by the 1969-introduced electro-mechanical design, and the recorded video and audio footprint on the ferrous oxide tape frozen in the above-referenced "ANSI/SMPTE Type E" US NTSC 3/4 U standards.

On-line spot commercial insertions into cable channels began as a process of manually cueing and rolling spots from "day reels" on a single playback deck. By 1989, however, the commercial insertion process was typically accomplished on computer-controlled automation systems containing upwards of four decks per network. Its software can manage the tightly-

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1 SMPTE 21M-1986, Video Recording--3/4-in Type E Helical Scan--Records

SMPTE 22M-1986, Video Recording--3/4-in Type E Helical Scan--Cassette

SMPTE 31M-1989, Television Analog Recording--3/4-in Type E--Small Video Cassette

scheduled playback of hundreds of on-line spots to multiple active channels, initiating each commercial break either against a master control clock command, or by responding to cues embedded in the current on-line program. It can also select playbacks from external sources.

On-line system functioning could be controlled by a separate traffic department computer, issuing cue and play commands against insertion orders stored in its data bank. Optional software in the automation system computer today can also monitor the playback system's state of health, shuffle playback sequences to prevent dead air, switch defective tape decks off line and sound alarms, generate logs, command the printing of invoices in a billing department computer, and schedule and automatically run make goods.

Constant software upgrading driven by competitive pressures insures that current automation systems will keep pace with 1990s-emerging demands for more and more operations sophistication. However, the same cannot be said of cable operators' ***and viewers'*** continually more critical demands for improvements in received signal quality. Further, the 1990s will see a constantly growing need to maintain larger and larger quantities of spots on line, for computer-directed access against clients' rapidly changing scheduling needs.

Five concerns about the current 3/4-inch VCR systems are being voiced by cable operators:

1 - Insufficient on-line storage capacity to accommodate future needs, made worse by software limitations on capacity expansion by adding tape decks;

2 - Limits on picture and sound signal quality improvements to keep pace with the constantly improving signal quality being distributed by the cable networks and syndicated program vendors;

3 - Quality deterioration which results both from multiple generation dubbing of NTSC format recordings and repeated tape shuttling and playbacks;

4 - Tape shuttle time limitations, which often preclude back to back scheduling of selected spots except by manual "podding" (re-recording them at a new tape location);

5 - Tape deck maintenance costs required to meet manufacturer-prescribed schedules for regular replacement of mechanical components, at the risk of on-line failures and resulting revenue loss, advertiser unhappiness and viewer irritation.

1990s commercial insertion systems features

Arvis 7000 series system features

Automated head-end operations software developed by Arvis Video Information Systems during a decade of service to the cable industry eliminates the first two cablecasters' concerns listed above. Arvis also offers two recording system hardware options in new systems or system add-ons, which eliminate the first concern without adding tape decks, and eliminate the quality ceiling, quality deterioration, scheduling flexibility, maintenance cost and system reliability problems which in fact characterize the four remaining concerns.

Features in the current generation of Arvis playback automation software provide access, cueing and and glitch-free playback of spot commercials stored on up to sixteen on-line cassette tape decks and laser disk drives. These can include both the 3/4-inch decks in an existing Arvis system ***plus*** a mixture of added high-density sources, including both S-VHS format playback-only tape decks and laser disk players. The on-line storage capacity and worst-case access times of both of these formats are substantially better than the 3/4-inch format. Therefore, adding either to an existing system results in a reduction of the number of 3/4-inch decks needed on line.

Typically, a single laser disk drive can replace at least three and sometimes four 3/4-inch decks. Two or three S-VHS decks can replace four 3/4-inch decks. These expansions dramatically improve system operating capabilities and reliability, while substantially reducing labor and spare parts costs now required for 3/4-inch system maintenance.

S-VHS format features and benefits[2]

Several 1/2-inch professional video cassette formats introduced in recent years have potential as de facto standard successors to 3/4-inch systems, to eliminate the last four cablecaster concerns. They all offer offer substantial improvements over 3/4-inch in bandwidth (resolution), color fidelity, noise margin, tape deck shuttle speeds, tape handling and tape life. They all have image and sound quality specifications approaching 1-inch Type C recorders. The component analog professional S-VHS format is of particular interest to cablecasters because it offers these quality advantages in economically priced hardware. It further offers substantial increases in on-line capacity without tape deck additions, and reduced access time, which increases scheduling flexibility.

S-VHS cassettes hold 120 minutes of tape in the smaller, simpler and lower-cost consumer VHS cassette. This cassette provides twice the storage capacity of the 60-minute 3/4U cassette, doubling the inventory of spots which can be stored on line in any size of automation system without any increase in worst case access time. Further, the S-VHS tape transport shuttles at twice the 3/4-inch tape deck speed, providing access to over 40 spots in 30 seconds, compared to 12 in a 3/4-inch system. On any tape system, however, the available tape length cannot be filled with recorded spots. Even the fastest-shuttling tape deck requires five to ten seconds of separation between recordings (16 to 33 percent of maximum available tape recording time) for pre-roll, and as a margin of safety against tape cueing errors and running out of tail-end black.

S-VHS signal processing electronics provide improvements over 3/4-inch in both image and sound quality. Video is recorded and reproduced as a two-channel "Y/C 3.58" signal (also referred to as "S-Video"), eliminating cross color and cross luminance artifacts common to 3/4-inch NTSC playbacks. Luminance resolution is maintained at 400 lines, compared to 240 lines in 3/4-inch. Video signal input and output interfaces are both NTSC and S-Video. This makes it possible to shoot, transmit, record, edit and re-record images without ever losing the bandwidth or adding the noise created by signal processing in NTSC.

The S-VHS format provides space on the video track for recording two FM-quality signals synchronous with video, leaving the two standard linear audio tracks available for time code, audio cues and housekeeping data. A digital bit-serial tape transport control signal port provides straight-forward interfacing to standard automation system computers and programmable controllers in either EIA-232C or EIA-422 standards. S-VHS automation systems can therefore be programmed to maintain larger on-line spot inventories for playback on larger numbers of channels.

Laser disk format features and benefits

If laser video disks are used for on-line spot storage and playback, the tape's unusable storage space required for pre-roll is eliminated, because the readout device is a non-contact laser laser subsystem which "flies" above the disk surface. Each spot plays back instantly on demand without a pre-roll cue. Each disk holds 50 30-second spots on each side. Hundreds of spots or the entire active library can be stored on line in a multi-drive system.

Worst-case access time to a spot on the other side of a disk currently being played is less than twenty seconds. Access to another spot on the same side is under one second. The Arvis laser disk system can therefore handle commercial break schedules calling for any reasonable combination of five and ten second promos and IDs intermixed with fifteen and thirty second spots.

If the spots are recorded direct from 1-inch tape or film, image and sound quality are qualitatively identical to the quality of cable network programs which are typically shot and edited on film or one-inch tape.

Further, there is no quality deterioration caused by shuttling and cueing and unlimited playbacks, because there is no physical contact between the laser reading head and the recording surface. Image and sound quality do not de-

[2] SMPTE standards-drafting committees are now working on the upgrading of the existing VHS standards documents, including the addition of the S-VHS (S-Video) format, at the request of one of the S-VHS equipment manufacturers.

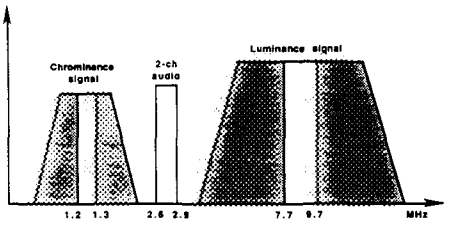
disk and its cassette package, reduce both the physical size of the automation system and the lineal shelf space required for off-line storage.

Recordable laser disk features and benefits

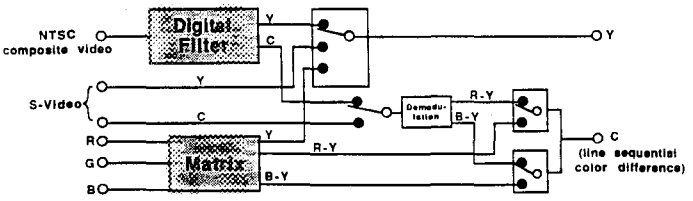
Using laser disk drives in a cable head end commercial insertion system would be operationally and economically unjustifiable, had not the capability to record intermittently on a new-design 12-inch (30 cm) laser disk become a reality. This first level of improvement over the capabilities of the original playback-only Video Disk systems introduced in the mid 1970s is popularly described as "WORM," -- Write Once, Read Much (or Many -- times). Arvis's first generation of **OptiCaster**™ 7000 Series Laser Disk Commercial Insertion Systems uses a WORM laser disk recorder available from Panasonic and Teac to record program materials and spot commercials off line. Playback-only drives in the automation system reproduce the signal in NTSC with more than 450 TV lines of luminance resolution and more than 45 dB chroma Signal to Noise Ratio (SNR). Two discrete channels of audio have better than 70 dB dynamic range at a bandwidth of 20 Hz to 20 kHz.

This substantial performance quality benefit over the 3/4-inch format's color-under NTSC is achieved by recording the input video signal in "Components." Separate frequency bands in the nominal 15 MHz recording bandwidth spectrum are allocated to the chrominance signal, each of two program audio signals and the luminance signal. The two color difference signal chrominance components are time-processed for line-sequential C_R and C_B recording as an FM signal. The video input signal to the recorder may be either NTSC, S-Video (Y/C 3.58 analog components), analog RGB, or a direct dub of an S-Video signal from the playback pre-amp of another drive.

Judicious allocation of spot commercials, IDs, PSAs and promos to WORM disks minimizes the number of disks that must be changed out as the inventory grows and changes over time. Separate disks can be allocated to storage of seasonal items. Individual clients whose spots would never be played back to back, such as competing automobile dealers, can be grouped on two or more disks which are kept on-line for long periods. Experienced Arvis operations analysts are available to provide each automation system operator with a customized recording allocations policy and procedure.



A. Recorded signal frequency spectrum



B. Video input signal block diagram

Video Resolution	More than 450 TV lines
Chroma S/N ratio	More than 45 dB
Audio response	20 Hz to 20 KHz
Audio dynamic range	More than 70 dB
Video inputs/outputs	NTSC, S-Video, RGB, Y/C dub
Operational control	EIA 232 C, EIA 422 optional

C. Performance and control specifications

Panasonic recordable laser disk functioning and specifications

Track-erasable/re-recordable laser disk features and benefits

At the 1990 NAB Conference and Exhibit held also in Atlanta, several laser disk drive manufacturers debuted production models of ***track-erasable*** laser disk recorders and companion players. Their appearance is too recent to have resulted in a single popular acronym to describe them, but for brevity they can be referred to as "TE" laser drives and disks.

These units provide a commercial insertion system with the storage flexibility and spot replacement benefit of an all-tape configuration, plus all the above-listed capacity and quality advantages of laser disk drives.

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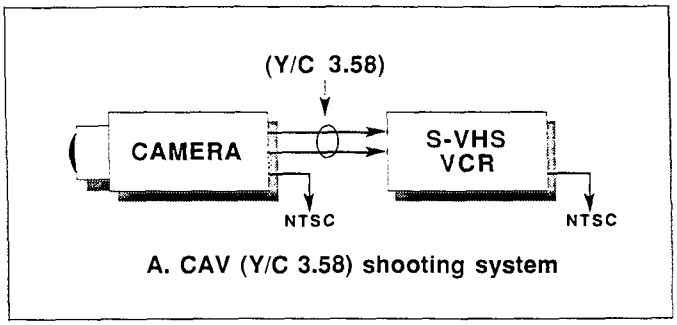
Arvis is debuting this newest commercial insertion system option at this NCTA conference. As quickly as production models of these TE drives are priced and available, the OptiCaster 7000 Series family will include them. Agreements are being worked out with several drive suppliers to provide trade-in options to near-term purchasers of WORM systems whose long-term needs can better be satisfied by a mixture of tape, WORM and TE systems.

Achieving first generation NTSC quality in spot production and playback (See block diagram)

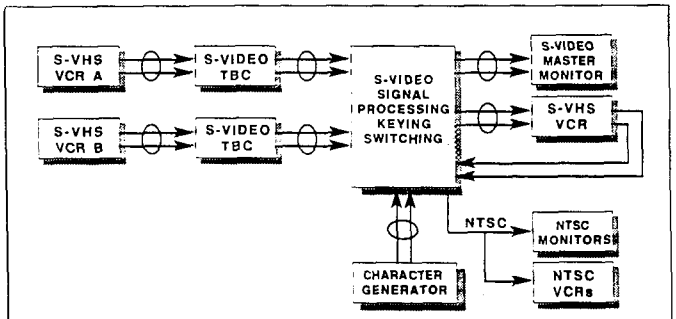
Editing and dubbing in the Y/C 3.58 format common to the laser disk drives or S-VHS tape decks eliminates the video signal degradation so objectionable in editing and dubbing in the 3/4-inch NTSC color-under format. Quality-minded cable operators can completely eliminate this degradation by standardizing on S-VHS equipment in both production shooting and postproduction editing systems.

Many portable and studio camera manufacturers now provide both NTSC and S-Video outputs. All S-VHS tape recorders have input connectors to accept an S-Video feed from these cameras. Their S-Video outputs can be fed to a wide selection of video switchers and special effects units now also equipped with S-Video Input/Outputs. Many monitor manufacturers also market high-resolution master monitors equipped with S-Video inputs. Therefore, an edited master tape can now be produced without ever recording or transporting or viewing the video signal in its composite analog NTSC form.

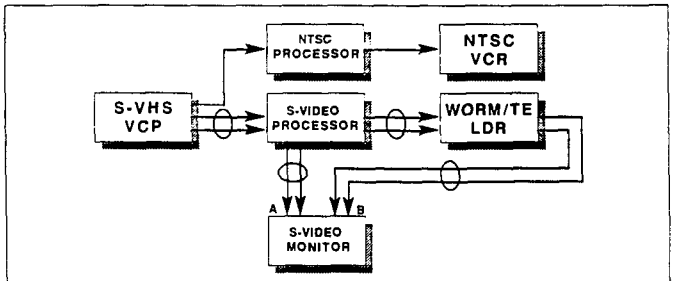
The S-VHS tape decks and laser disk recorders marketed by Arvis in their 7000 Series Commercial Insertion systems are similarly equipped with both NTSC and S-Video inputs. If the edited master tape has been created in an all-Component Analog Video (CAV) environment, then any spot resident on an S-VHS tape or laser disk on-line in the Arvis system is truly "zeroth" NTSC generation. Thus its playback through an analog component NTSC Time Base Corrector (TBC) or NTSC encoder creates a ***first generation NTSC*** signal each time it is played. To the home viewer, the quality of this signal will be indistinguishable from any cable network feed into which it is inserted!



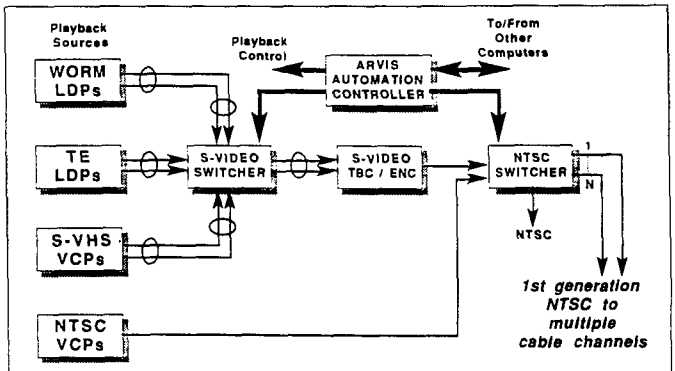
A. CAV (Y/C 3.58) shooting system



B. CAV postprodution editing system



C. S-VHS master dubbing system



D. ARVIS 7000 series commercial insertion system

INTERCONNECTION LEGEND

- S-VIDEO (Y/C 3.58) cable
- NTSC cable
- Automation control cable

ABBREVIATIONS

CAV	Component Analog Video
ENC	S-VHS to NTSC encoder
LDP	Laser Disk Player
LDR	Laser Disk Recorder
TBC	Time Base Corrector
TE	Track Erasable
VCP	Video Cassette Player
VCR	Video Cassette Recorder
WORM	Write Once, Read Many

Economics of S-VHS tape and WORM and TE laser disk formats

Pricing of both 3/4-inch and S-VHS recording and playback decks and blank cassettes is currently in a state of turmoil. Pricing of WORM laser disk drives and disks has been relatively stable for some time. The recent announcements of TE drive and disk availability, features and specifications have been accompanied only by "Preliminary" pricing. These numbers are in general twice or more times higher than those currently quoted for WORM drives and disks.

It is rumored that TE pricing will fall quickly if the product generates early buying enthusiasm. This will trigger significant decreases in WORM pricing. Further, S-VHS pricing may be forced downward as marketing of the HI-8 8 mm component analog format steps up.

Arvis is developing "total life cost" comparison information on the alternative integration of S-VHS, WORM and TE playback sources into existing and new 7000 Series Commercial Insertion systems. These will be available from Arvis as soon as possible in one or a series of economic considerations bulletins.