SONY

24P

At Age One

THE TRIUMPH AND THE PROMISE

CINEALTA

24P AT AGE ONE : THE TRIUMPH AND THE PROMISE

TRIUMPH OF CREATIVITY AND TECHNOLOGY

INTRODUCTION

Television history has never seen anything quite like it. Only a year ago, 24P was a hot topic—but only for discussion. Now it's one year later, and 24P is a reality—a significant reality, with new productions springing up all over the U.S. and in other regions of the globe. From prime-time television program origination, to television commercial production, to independent theatrical movie production, to special 3D projects, to the first major motion pictures in 24P, this new digital production system is being embraced by an ever-broadening spectrum of producers, directors and cinematographers.

In every sense, the success of 24P represents a triumph for the many visionary production people who encouraged manufacturers to commit the substantial development resources required to create this new digital system.

As recently as NAB 2000, worldwide members of the broadcasting and production community first saw the arrival of an all-digital 24P high definition camcorder. They also saw much more. They saw 24P studio cameras, companion 24P portable cameras, HD Telecines with 24P interfaces, 24P editing VTRs, 24P switchers, on-line editors, off-line editors, projectors, studio monitors, and a wide range of 24P system peripherals. Most important, they saw that these products came from a broad array of professional equipment manufacturers. Something big had happened -and it had happened in a very short space of time.

The last time a new technology descended upon the television production landscape, and changed it forever, was the period of 1976-1980, when electronic newsgathering swept 16mm motion picture film from the hundreds of television stations doing daily news. The immediacy of video swiftly prevailed over a lingering affection for film in a production environment that knew only the relentless daily pressure to keep pace with news events—and communicating news to the home was never to be the same.

Different imperatives are driving the success of 24P. New creative possibilities, increased production flexibility, cost-effective shooting, and comfortable coexistence with 24-frame motion picture film—all these advantages combine to herald an era where 35mm film and digital HD acquisition will finally converge. The two media can be used independently on productions that seek to harness their individual merits; on other productions, they may well be used in combination. Either way, high-end program production will never be the same.

24P – A TRIUMPH IN PROGRAM ORIGINATION

In the first year of the digital 24-frame system, an impressive number of productions have successfully used this new technology. They span both television production and feature films intended for theatrical release.

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Starting in 1999, dozens of prime time television programs formerly originated on 24-frame motion picture film were transferred to 24P HD and then digitally mastered in that format. In mid-2000, George Lucas started shooting *Star Wars*: Episode II on 24P. The first major series for a cable channel was also shooting multi-camera 24P in mid-2000, and prime television sitcoms and drama productions on 24P were underway. A surprising number of independent film projects switched to 24P, and at least a dozen major television commercials were originated on 24P.

24-FRAME ORIGINATION – A TRIUMPH OF COMMITMENT

Marketplace acceptance of something new is always, first and foremost, based upon confidence. The decision to embrace an older, yet tried and true, picture capture rate inspired a high level of confidence in the new 24P digital HD production system. After all, 24-frame (and 25-frame) motion picture film is known and accepted the world over, and film certainly continues to make great television.

It was not unexpected that the world's program production community would place their confidence in this new 24P digital HD program origination system—a system with picture capture rate based on the firmly established film platform.

Coupled with this familiar frame rate was a creative issue: producers, directors and cinematographers had, over four decades, grown passionate about the distinctive "look" of 24-frame capture when transformed to 60Hz and 50Hz television portrayal.

Many in the production community also saw the commitment to a 24-frame system as a positive gesture on the part of the traditional video industry, some of whom had formerly argued against the development of such a system.

Traditional video engineers might still cringe at the thought of technically "stepping back" to a sub-sampled rate from the long-established higher 60Hz picture capture rate. However, the sheer success of 24-frame film as a source for prime time television cannot be denied. It speaks to a practice that is not only working extremely well, but also global in scope. And, most important, that same 24-frame film has, for many decades, facilitated smooth international program exchange—an exemplary model for an HD digital acquisition system.

24P – A TRIUMPH IN STANDARDIZATION

When the topic of 24P was first introduced to the International Telecommunication Union (ITU) in early 1999, it attracted immediate attention. This attention quickly evolved into broad and

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enthusiastic support, reflected in the subsequent production of a draft Recommendation for a worldwide standard for HD Studio Origination and International Program exchange. All this took place within a few short months of intense activity in 1999.

This innovative ITU Recommendation recognized two critical realities: first, that the 60-year television legacy of 50Hz and 60Hz picture capture rate would, for better or for worse, carry far into the digital era; second, that the 24-frame capture rate of motion picture film represented the only possibility for any near-term single worldwide standard.

In a brilliant strategic move, the ITU took the digital 1920 x 1080 HD production format —the format that had already gained consensus on the international stage—and made it the core of a new multiple picture capture rate standard. The insertion of the 24-frame picture rate into the protracted international debate on 50Hz and 60Hz seemed to rejuvenate discussions that had grown weary of the conflict between these two traditional television rates. Here was something that all countries could agree upon.

Very quickly, the now-famous ITU Rec 709-3 Digital HD Production Format document was created and approved. This document stipulates worldwide agreement on a singular set of specifications defining all aspects of a single still picture frame. Simultaneously, it also recognizes the need for multiple picture capture rates that encompass internationally formulated positions and needs. As a consequence, the Recommendation defines five progressive scan rates and two interlaced scan rates. For the 60Hz regions of the world, these include 60 and 30 progressive frames per second and 60 interlaced fields/sec. For 50Hz regions, Rec 709 includes 50 and 25 progressive frames/sec and 50 interlaced fields/sec. Most important of all, Rec 709 also specifies the 24 frames/sec progressive scan rate as a single region-independent global picture capture rate.

One year later, 24P (at the digital sampling structure of 1920 x 1080) is now a widely accepted international digital HD production standard. As such, it promotes the creation of digital program masters of the highest quality and assures an extended shelf life for these valuable assets—assets guaranteed to be accepted worldwide. The multiple picture capture rate, in combination with a novel implementation known as 24 PsF segmented frame transport, has allowed manufacturers to endow this first-generation 24P system with the nimble ability to switch operation between 24P, 25P, 30P, and also traditional 50i and 60i formats (see Appendix 1).

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24P – A TRIUMPH IN SYSTEMIZATION

From the outset, 24P represented a sea change in digital video program creation. This was far more than the isolated introduction of a 24P camcorder. From its inception, 24P had to be powerful enough to offer all of the production and postproduction capabilities of highly refined contemporary 50Hz and 60Hz standard definition digital systems. It had to be able to offer all that the 24-frame film origination and television postproduction combination represents in that presently highly refined system. And it had to provide serious and immediate advantages to moviemakers, television producers, and producers of television commercials. Such ambitious goals called for a broad industry alliance.

The industry proved to be more than ready. There had been widespread apprehension at the prospect of building multiple post rooms to handle the plethora of digital format variants associated with burgeoning U.S. DTV services. Especially in the area of postproduction, many companies had been considering the merits of a 24P postproduction system capable of motion picture film mastering for television. One of these companies, Laser Pacific of Los Angeles, boldly stepped forward in 1998 to galvanize a multi-manufacturer commitment to implement a total 24P postproduction system. Creating a digital high-resolution master at 24P, with digital downconversion to all of the global digital distribution formats (both HDTV and SDTV), proved an elegant and timely solution to the problem of multiple digital variants.

Spurred by the work of the SMPTE, and energized by the marvelous accomplishment of the ITU, dozens of manufacturers climbed on to the 24P bandwagon. Another "grand alliance" had been born.

24P – A TRIUMPH IN WORKING ALLIANCES

Two fundamentals are essential to any effective industry alliance. They are a common standard, and a shared enthusiasm. From the beginning, the enthusiasm for 24P was palpable. One contributing factor may have been the solid commitment made by Sony in plunging ahead with 24P on a very broad system front, including production and postproduction. An even bigger factor was the unbridled enthusiasm expressed by major figures in the entertainment production community. Many of them said, in effect, "If you build it, we will come—and we will use it." Indeed, they have.

A mere twelve months after the introduction of 24P, an impressive list of high profile companies have begun to participate in manufacturing key elements of the production and postproduction systems for 24P program creation.

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These companies include (in alphabetical order):

Accom
Apple Computer
Avica
Avid Technology, Inc.
Chyron Corporation
Da Vinci Systems
Digital Origin
Digital Vision
Discreet Logic
Dolby Laboratories
DPS
Evertz Microsystems Ltd
Faroudja Labs
FilmLogic
Leader Denshi
Leitch/ASC
MTI
NothingReal
Nvision
Pandora International Ltd.
Philips
Pinnacle Systems
Pluto Technologies
Post Impressions
Quantel
Shibasoku
Sierra Design Labs
Silicon Graphics Inc.
Snell & Wilcox
Sony Tektronix
SyntheSys research
Tektronix
YEM

In order to expedite the industry's full exploitation of all that HDCAM technology has to offer in combination with other manufacturers' key products (especially computer workstations), Sony has formalized a number of business relationships based upon our hardware and software HDCAM interface Codecs. These greatly enhance the flexibility and openness of HDCAM system infrastructure by supporting real-time interfaces of low data rate (bit rate reduced) HDCAM signals to a variety of computer workstations, which can decode these signals using either a software HDCAM decoder or an installed HDCAM decoder P.C. board.

HDCAM-ready workstations will facilitate the interface of HDCAM digital program material with a variety of computer systems for additional processing in the form of image manipulation, graphics, blue/green screen compositing, etc. In pursuit of this objective, Sony has already concluded licensing agreements with a number of major manufacturers.

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24P – SONY AND CINEALTA™

At NAB 2000, Sony unveiled its CineAlta concept: a line of 24P acquisition systems comprising the world's first 24P camcorder, 24P studio camera and portable camera. Optical manufacturers quickly and unanimously rallied behind the 24P concept and have since rolled out an increasingly broad array of lenses, filters, and electronic accessories. In retrospect, an astonishing amount of support appeared within a year of Sony's first introduction of an embryonic 24P postproduction system at the '99 NAB. It was as if pent-up energy was released at that first appearance of a genuine 24P reality.

CINEALTA — A PROMISE OF LIBERATION IN PROGRAM PRODUCTION

The name "CineAlta" was Sony's way of symbolizing the bond between cinematography and digital high definition imaging on the 24-frame platform. The CineAlta logo identifies a Sony family of products and systems that offer new creativity in the production, postproduction and exchange of motion pictures. CineAlta technology also brings together the quality and universality of 24-frame cinematography with the real-time capability, efficiency and flexibility of digital high definition technology. In so doing, CineAlta equipment stimulates the creative convergence of motion picture film and digital high definition production on a global basis.

Sony CineAlta products deliver cinema-quality pictures at selectable frame-rates, simplifying International Program Exchange by minimizing the need for complex standards conversion. CineAlta products are equally adept at opening up new possibilities for international co-production.

With CineAlta equipment, moviemaking has been liberated through the creative empowerment of the cinematographer. Creativity on the set is facilitated by real-time HD image evaluation, instant replay of a full-color high-resolution digital "take," real-time image optimization while shooting, a 50-minute shooting load, and, most importantly, the significant cost-benefits associated with this digital tape medium.

CineAlta products also ensure a seamless bridge between 24-frame film originals and a final 24P digital master. A frame of film now has a one-to-one correspondence with a progressive HD frame. The CineAlta environment readily interfaces with the computer graphics world, offering liberating benefits in postproduction. The direct color conversion of progressive 24P masters to film, and to a multiplicity of international digital HDTV and SDTV distribution formats, represent the final promise of liberation.

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24P – THE PROMISE OF COST-CONTROLLED PROGRAM PRODUCTION

Much has been said and written about the potential of 24P to reduce the soaring costs of production. It is always tempting for manufacturers to promote the cost benefits of using their new technologies. It must be recognized, however, that the production costs associated with prime time television production, moviemaking, and television commercial production encompass a multiplicity of line items—in both above-the-line and below-the-line costs. Creative practices will vary widely. Film shooting has established norms and imperatives that cannot be brushed aside. Union practices can also play a significant role in determining costs.

Perhaps the most that can be claimed in these early days is that 24P digital program origination offers opportunities for re-examining many cost items in a total production project. But only the creative community can determine the ultimate cost-benefits of 24P. Projects to date have displayed a wide range of 24P system implementations, each with its own cost model.

Certainly, the most visible cost savings relate to media. It is a fact that 24P tape is considerably lower in cost than motion picture film – certainly far lower than 35mm film. There are no film processing costs. There are no Telecine transfer and associated color correction costs. 24P can, and usually does, involve a modest degree of tape to tape color correction, but the process is not nearly as complex as correcting for the three emulsions of film. Yet the immediate cost-savings of tape versus film need to be considered in the context of a particular genre of show and its overall production costs, which for major shows can collectively dwarf the cost of media.

Another potential cost saving of some significance arises from the 50-minute recording time of the 24P camcorder. In underwater shooting, for example, this longer recording time could yield impressive cost savings compared to the time and logistics associated with changing 35mm film magazines every 11 minutes, which can be both fiscally and logistically onerous. Wildlife and natural history shooting has its own economics. The long digital record time of 24P can make the difference between capturing that elusive wildlife occurrence (entailing hours of patient waiting and costly rolling of film media) and the possibility of missing the shot during a film magazine change. The need to extract minutes of dramatic, irreplaceable images from countless hours of necessary capture, often in the most hostile of physical environments, creates economics that can be unsustainable for an independent natural history producer. The advantages of 24P shooting have been further enhanced by a novel and recently evolved acquisition system encompassing a miniature camera head which can be mounted in challenging physical locations and cabled back to a portable long-form battery-

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operated VTR supporting up to two hours of 24P recording.

Early reported cost advantages of 24P production have responded more to the enhanced management of cash flow than to absolute bottom-line savings. For example, for the reasons earlier stated, the front-end costs of digital HD are much lower than for film production -primarily because tape is significantly lower in cost. This relieves a burdensome "front-end" investment that can be substantial obstacle for the low to mid-budget productions. Also, at the "back-end" of a movie production project, the contents can be displayed to prospective distributors in full HD resolution -and only after it has been sold will the need arise to incur the cost of transferring from 24P digital to motion picture film for theatrical release.

24P – THE PROMISE OF EMPOWERMENT OF THE CINEMATOGRAPHER

There have been some confusing writings and statements regarding the role of 24P in high-end program production, especially from the viewpoint of how film DPs are adapting to this new medium. The good news is that all 24P projects to date have reaffirmed that the craftsmanship of the DP is every bit as important to digital acquisition as it has been to film acquisition. In the mastery of the DP that creates superb imagery, nothing is lost. All of the honed skills in lighting, filtration, framing, camera movement control, and exposure control apply just as much in 24P image capture as they do in film shooting.

A considerable number of DPs have already become involved in 24P shooting and have demonstrated that making the transition is easy. A single day of training, even for those unfamiliar with video cameras, will generally suffice to ensure a confident capability. A few days into a major shoot, and DPs will be not only be utilizing the full range of their craftsmanship, but also discovering new creative empowerments related to the additional capabilities of the 24P camera. Unlike relatively passive film cameras, the digital 24P camera is endowed with a multiplicity of controls that can alter tonal and/or color reproduction, picture sharpness, or selective picture sharpness in real-time during the shoot. Softening the human face while enhancing the hair is one example of these alternations.

Such control is by no means a necessity in 24P image capture—but it is a powerful new option that can be used at the discretion of the director and DP. Given that the image can be seen in real-time during the shooting, there is always an opportunity to creatively intervene. While initially anathema to some film DPs, who have long depended on their film recording skills to ensure a superb result that could only be later verified, these real-time camera controls are quickly being mastered by many

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DPs. In so doing, the DPs are being further empowered.

The 24P camera is very sensitive. The Sony HDW-F900 can range from an Exposure Index of about 150 to 1200, with a remarkable low level of "grain" (electronic noise). Thus, one camera is the equivalent of a combination of high and low speed 35mm film stock—and DPs can take advantage of this flexibility when shooting.

PROMISE OF CONVERGENCE – DIGITAL 24P AND 24-FRAME FILM

On the surface, it would appear that these two entertainment program origination media are in direct confrontation—both vying for the hearts and minds of the production community. If the program production world had to make a simple either/or choice between these two disparate media, it would be so. And to a postproduction facility with an established Telecine transfer business, the encroachment of 24P acquisition surely perturbs an established order and upsets a predictable business model based upon motion picture film.

But today's program origination world is nowhere near as orderly as it was only a decade ago. A "wind of change" is blowing across the television and the cinema landscape—a wind that at times appears to rise to the velocity of a hurricane. Acquisition, editing, postproduction, distribution, and repurposing of assets—all are being relentlessly buffeted by these advancing technological windshifts:

- The flight of high-end program origination from the U.S. has grown to a level where certainly the question must be asked: why? What is broken that was working so well only a few short years ago?
- The diversity of program genres is escalating, calling for ever-expanding diversity in the tools of program origination.
- On the program distribution front, more and more distribution media continue to establish firm footholds in the market place. Increasingly, these media carry multiple channels. The appetite for program material to feed all of these largely digital pipelines is insatiable.
- New packaged media—the DVD—continue their vigorous penetration and have dramatically raised the standard of quality in home video and audio. It is only a question of time before the high-definition DVD raises standards even higher.
- Traditional broadcast networks are no longer simple networks. They have become media giants—with global reach, producing and distributing their content on a world stage.
- Broadcasters have also become cablecasters. Microsoft has allied with NBC on a cable channel—and Time Warner, CNN, and AOL have all become one media giant.

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- Leaders in telecommunications are buying major cable operations—as demonstrated by AT&T's purchase of TCI.

The large question emerging from all these trends is: "can the old center hold?" Can analog motion picture film continue to be the dominant medium of program origination in such an incredibly complex digital world? With conditions so uneasy in program production, it is defensible at the least to consider 24P and 24-frame film as reluctant partners. It would be better still to assume that both motion picture film and digital 24P (along with other digital variants) will be called into play as business realities continue to evolve. On this assumption, Sony has planned our Vialta™ Telecine to be an integral part of our total 24P system.

CINEALTA AND VIALTA – PROMISE OF COEXISTENCE

In recognition of the continuing coexistence of film and digital 24P, Sony has elected to fully service both media. Our Vialta Telecine has raised the bar of image quality in film transfer and built a high-performance bridge into the 24P digital world. Our 24P CineAlta system has carried the rapidly evolving HD digital imaging to a new high level. The common 24-frame platform has greatly expedited the transfer of program content in both directions -from film to digital, and from digital to film. 24P postproduction has brought important innovations to the management of the mastering process for diverse digital distribution formats.

Collectively, this is a win-win environment for a creative community that can elect to use either medium for a specific production -or to deploy both media on the same project, extracting the advantages of each on separate scenes within a single production.

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THE TRIUMPH OF SEGEMENTED FRAMES

APPENDIX 1

Sony gave a special priority to developing a hybrid HD postproduction system that could be switchable between 1080 / 24P / 60i / 50i.

To do this cost-effectively, we re-structured the 24 frame progressive HD video format to approximate the structure of the 50/60 Hz interlaced format. This is accomplished by separating each progressive 1080-line frame into two 540-line segments that are separated in time by 1/48th of a second. We identify this transport video format as 1080P/ 24 PsF. It still perfectly retains all of the frame-based progressive attributes of its original 24P capture.

The 24 PsF video format is structurally very close to the 50i format, and is not so far removed from the 60i format. Switching video circuits between the 24 PsF video and either the 60i or 50i video is now primarily an issue of switching clock frequencies, rather than switching field and frame memories (which would be a requirement in switching between a 24P signal and the 50/60i signals). Now the operation of recorders, switchers, digital effects, etc., can more cost-effectively switch between recording, processing, monitoring of 1080/24P or 1080/60i or 50i video.

It is very important to note that the segmented frame structure is not an interlaced signal. The two separate segments always come from the same original progressive picture frame. captured in the 24P HD camera or transferred in the HD Telecine. At any point in the total system, they can be reassembled into a perfect 1080-line progressive frame devoid of any new scanning artifacts. Most importantly, the segmented frames do not carry any interlace "footprint" in terms of associated filtered vertical resolution or 30Hz "flickering" alias.

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SYSTEM NOMENCLATURE

APPENDIX 2

The importance of using the proper nomenclature to identify different digital production formats has increased, primarily because a new terminology has been born within the context of the 24 Frame system—namely, that of segmented Frames. It is to be hoped that the following explanation will help all understand the true meaning of the nomenclature presently being separately examined by recognized standardization bodies (like SMPTE and ATSC, domestically, and the ITU, internationally) for Progressive, Interlaced, and Segmented Frame video formats. The basic characteristics of each format will also be described.

Within the context of electronic production formats (be they HDTV or SDTV), there are three key parameters to be considered when using "shorthand" acronyms for describing original electronic acquisition and the subsequent video system. They are:

- The actual Picture Capture Rate—that is, how many true "exposures" the camera makes per second.
- The structure of a Picture Frame—that is, the number of full-frame pictures per second, and whether that frame structure is progressively scanned or interlaced.
- The Transport mechanism of the video signal format—that is, whether it is via a progressive, segmented Frame, or interlaced signal structure.

It is difficult to find a shorthand nomenclature that sensibly describes all three parameters. However, an emphasis on correctly identifying the number of exposures per second used to originate the video has always been a top priority. This is the primary numeral assigned to a given production format.

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Within a new world of mixed interlaced, progressive, and segmented Frame formats, it is essential to carefully preserve a clear distinction in precisely how the picture was originated—that is, via progressive or interlaced scanning. The identification of the transport mechanism is the second priority—the lettering used to describe a given format. The scanning structure of the Picture Frame will then be intuitively deduced from the first two elements.

Table 1 below shows some of the more common examples of contemporary digital video formats in our new world of DTV.

Camera Picture Capture Rate (Exposures/Sec)	Picture Frame Structure (Full-Frame Pictures/Sec)	Transport	System Nomenclature
60 Hz	60 Hz Progressive	Progressive	60P
60 Hz	30 Hz Interlace	Interlace	60i
50 Hz	25 Hz Interlace	Interlace	50i
24 Hz	24 Hz Progressive	Segmented Frame	24PsF
24 Hz	24 Hz Progressive	Progressive	24P

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