A NIGHT AT THE DIGITAL VIDEO ROUNDTABLE:

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One night during the NAB '94 a small group of key players in the Macintosh Digital Video field came together for an informal discussion of the issues that concern them. This is a report on that meeting and some of the issues discussed

Background on the Digital Video Roundtable

The Digital Video Roundtable began as an outgrowth of online activity in the Digital Video Forums. Randy Ubillos, of Adobe, found that participants in the forum wanted a meeting at NAB in which users and developers could share ideas and where grass-roots collaboration could be encouraged. Tim Myers, Adobe Premiere Product Manager, worked with Ubillos to facilitate the meeting by arranging for a meeting room and by notifying a small group of key people involved with digital video on the Mac. The meeting was intended as an informl,open discussion—a collaboration.

The meeting was well attended, with representatives from most of the major companies in the Mac digital video field. Most of the attendees representing companies were engineers or other key people interested in an issue-oriented discussion with other developers and users of the products.

Adobe, Aldus/CoSA, Avid, Data Translation, Digidesign, ImMIX, RasterOps, SuperMac and many other developers participated in the event. A number of well-known users also contributed their views. Apple was represented by Peter Hoddie, who heads the QuickTime team.

By the way, as to the debate raging in some corners about whether QuickTime is in fact digital video, it is accurate to call it digital if it is stored as ones and zeros, period! Don't confuse the issue of digital with other technical issues such as frame rate, compression, and resolution. QuickTime may not be equivalent to CCIR 601 but it certainly can be compatible with it.

Issues in Mac Digital Video I: Problems with Resolution

The FCC details a specification designed to eliminate visible black borders around the active picture area. Historically the problem has been caused by processing devices that can add to the blanking, and through successive generations yield a black border at a picture's edge. This would be a very unusual condition today with modern processing equipment. The FCC doesn't enforce this rule currently, because it isn't causing problems. But one should check the policy of the network or broadcaster to which a particular piece of Mac-generated digital video will be submitted.

Technically, the FCC specifies that the active number of vertical lines of video should be 483.5, rather than the 480 lines typical of computer-based NTSC video. The blanking would therefore be 20.5 and 21 lines on alternate fields, and active video would be 241.5 and 242 lines on alternate fields.

Computer-based systems would require four additional lines to provide the specified active video area. Most frame buffer developers that answer this do so by providing 486 lines vertically. The 486 line-number is consistent with the CCIR 601 specification for vertical resolution. It provides slightly more active picture area than required but still allows blanking to fall within range.

Animators and producers deal with the issue of line count in a few different ways. The problem presented to a producer of computer-generated images is that most computer systems work with a 640 by 480 square-pixel display. Several frame buffers, including the Video Explorer, from Intelligent Resources, and the NuVista, from Truevision, can provide 486 vertical lines if set-up accordingly. To simply add vertical lines to an image, though, would disturb the one-to-one, square-pixel aspect ratio and complicate several software issues.

To keep pixels square, frame buffer developers scale the number of horizontal pixels by the same factor as the vertical pixels, 1.0125. This changes the 640 by 480 square-pixel display to a 648 by 486 square-pixel display. This takes care of the blanking or active video issue, but creates other problems.

Most digital video software for the Mac can handle this break from the standard 640 by 480 resolution without difficulty, but all graphics output through a frame buffer configured for 648 by 486 display must be prepared for that resolution. That means that every image created in the facility must have 648 by 486 pixels, even those created on systems that have only standard displays. With a standard display an artist could not even look at the entire image at full size. This can be easily remedied by assuring that all designers use higher resolution primary monitors. Other related problems are

DIGITAL VIDEO FRAME RATE

Frames	X	Seconds	X	Minutes	=	Frames
30.00	X	60	X	10	=	18,000
29.97	X	60	X	10	=	17,982
				Difference	=	18

more difficult to solve.

Increasingly, clients will bring a facility pre-prepared graphics created at 640 by 480 resolution. Assume that a production facility configures a frame buffer used to output to tape for 648 by 486 display. When standard resolution graphics are brought in, the board will display borders around the image unless it is scaled overall by a factor 1.025. Obviously, a border would be undesirable and scaling an image "up" will reduce image quality. Even if a facility could control the resolution on all still graphics coming through the system, it would face an entirely new set of problems created by the compression-based disk recorders and editing systems. Most of these work in the 640 by 480 standard.

Let's look at a hypothetical situation. A digital video producer acquires a video segment on a Radius VideoVision Studio equipped with an FWB -array hard disk. VideoVision recordings at data rates of 6 +MB per second are amazing. The producer creates an elaborate segment with CoSA After Effects and decides that it looks so good that he or she would like to output to Betacam SP using an Abekas digital disk recorder (DDR) or an ADI Digital Magic. (this combines with a Video Explorer board to provide what might be the hottest Digital disk recorder that can be connected to a Mac.)

To prepare his segment for output at CCIR 601 resolution the producer must scale the video up to 720 by 486 pixels. This procedure can take a lot of time and a huge amount of disk space, and may not produce a clear gain. Due to the quality loss resulting from scaling, this approach might yield a recording with lower overall image quality than if output directly from the VideoVision. On the other hand, material created entirely at CCIR 601 resolution, such as 3-D renderings, would benefit substantially from output using the Abekas DDR or ADI systems.

So how does our digital producer deal with these problems? If he or she decides to capture, output, and produce with the VideoVision at 640 by 480 resolution, his or her work can still look very good on a video monitor. It would be interesting to see how many broadcast engineers could tell the difference between the various resolutions mentioned above without the use of test equipment, and how effectively they could discriminate with test equipment. Several of the users at the Digital Video Roundtable reported submitting material to local broadcasters and networks without incident.

According to VIDEOGRAPHY Technical Editor Mark Shubin, the use of 640 by 480 resolution,"if done properly, should not cause a problem." Yet, a network for whom Schubin frequently provides technical services will not accept material submitted with excessive blanking. It is still an FCC rule, after all.

So how do producers who wish to avoid compromise proceed? If a video segment is to be input into the computer for processing, it should be captured frame by frame with a video board configured for 486 lines of vertical resolution or imported from a Digital Magic or an Abekas DDR. Although it does yield slightly better quality, it is not essential that a producer use 720 pixels horizontally. The 648-pixel horizontal resolution maintains square pixels and therefore is much easier to deal with.

Most users at the Digital Video Roundtable agreed that if a designer must create images or animations for the 720 by 486 resolution, the best approach is to work at excessive vertical resolution and scale "down". With 720 pixels horizontally, the appropriate vertical resolution to maintain square pixels is 540. Once a producer completes design, painting, rendering, and compositing a project, the final step is to scale the entire segment by a factor of .9 vertically using CoSA After Effects or Equilibrium's Debabelizer. This will reduce the 540 vertical lines to 486. On a square pixel-display, the images will look as though they've been squeezed vertically but will look correct on a 720 by 486 NTSC display. One should weigh the situation carefully to determine when the extra effort is warranted.

Issues in Mac Digital Video II: The 29.97 Frame Rate

As we all know, NTSC video does not run at the 30 frame per second (fps) rate nominally assigned to it, but at the rate of 29.97 fps. This odd number creates problems at several phases of production. Drop-frame time code, in order to keep the frame count in sync with clock time, drops two frames every minute except for every tenth minute. Over a ten-minute span of time the 29.97 fps actual rate will produce 18 frames fewer than the nominal 30 fps rate. See chart, above.

Over an hour, using on-drop-frame time code, the code will indicate that the program is 3.6 seconds shorter than it really is. It is not surprising that the 29.97 frame rate can cause problems with QuickTime-based software since it causes problems nearly everywhere else in the production process. The problem actually has not been with QuickTime, but with software developers ignoring the issue. QuickTime is a time-based, not a frame-based system. If the duration of the frame is identified correctly then it will be handled properly.

Applications should count frames and not simply capture and display 30 frames in every second. If a system captures 30 frames in every second, then in the course of 10 minutes it will have captured 18 frames

more than the source provided. Therefore, it would have to capture 18 frames twice. If the segment was simply played back, it might well drop exactly the same frames as it captured twice. But if the segment is brought into a processing program such as After Effects, numerous problems can arise.

Adobe'sTim Myers says that the soon-to-be-released version 4.0 of Premiere will have a sort of "software timebase corrector" that will avoid most problems related to this issue. It seems safe to assume that other major developers will also deal with the problem.

It should be noted that animations that are laid to tape through a QuickTime-based playback system are much less likely to suffer from the problem than captured video segments.

Issues in Mac Digital Video III: Standard Interface for Animating PhotoShop Filters

Adobe opened a discussion on a standard interface for the animation of filters. The interface standard will be implemented in Premier 4.0 and has been passed on to filter developers. It is basically a method of bringing up the parameters dialogue box twice to set beginning and ending settings. According to Myers, filter developers that have either begun development or embraced the approach include the developers of Gallery Effects, HSC Software, Andrometer, Xaos, Equilibrium, and Gryphon Software.

An interesting point was made by one of the developers present that not all filters can deliver smooth animation. The math for these filters simply may not provide the even number of

increments required for a smooth transition effect.

Issues in Mac Digital Video IV: Acceleration

The group also discussed the possibility of a standard for interfacing with image-processing acceleration hardware. With QuickTime-level support, each developer that produces acceleration hardware would not be required to rewrite the same basic interface components. The software developer would likewise not be required to directly support every hardware acceleration product available. QuickTime interfaces editing software with the video and compression hardware installed in a system and could provide a similar link between effects software and image-processing hardware.

Peter Hoddie acknowledged that it is Apple's (QuickTime's) responsibility to provide this interface, but did not indicate that a solution should be expected anytime soon.

One of the issues that complicates the problem is that current bus speeds are not adequate to shuttle this much data between devices. The video that the system has to pass across the bus must be uncompressed video. Uncompressed video without an alpha channel represents a data stream of about 27MB per second, well beyond current Mac bus capabilities. Also, figure that most processing jobs require at least two images, combine that with their alpha channels, and you have quite a bit of data. Therefore, even if speedy accelerators were available today and were interfaced to software through QuickTime, it is possible that bus speeds would significantly limit the potential speed gains.

Of course faster buses are coming. Apple is expected to support the PCI bus standard with its second-generation Power PCs. Several other vendors are also using the PCI bus. PCI is capable of transferring data at rates as high as from 10 to 100 times the rate of current Macintosh buses. It will certainly be a milestone when a user can purchase a board than runs in either a Mac or Windows-compatible computer.

Issues in Mac Digital Video V: Software Codecs

A problem faced by several users is the lack of software-based codecs for reading and writing images compressed with hardware-based codecs such as the VideoVision. Users clearly stated that they need the ability to compress and decompress images created with these systems when the hardware codec is not present. For instance if a user had three Quadras rendering an After Effects file to be output through the VideoVision, only the machine that had the VideoVision installed would be able to compress the frames. An extra step, therefore, would be added and more disk space required to first build an uncompressed file and then to compress it.

Hardware vendors would not lose sales if they distributed a software codec. Generally, users interested in using that form of compression are also owners of the hardware-based systems.

Issues in Mac Digital Video VI; QuickTime 2.0

The group briefly discussed QuickTime 2.0,which is expected to ship this Summer. For most users, the most important breakthrough of version 2.0 will be performance. Basic improvements to the software should allow it to double the data rates it handles. This gain will impact all Quicktime codecs. Anyone who has compared the overall performance of the higher-end nonlinear editors with QuickTime solutions will appreciate how much snappier Premier or Videoshop could be.

Other improvements to QuickTime include support for MPEG boards and the addition of a time code track supporting various types of time code, including SMPTE. A new "music track" will offer robust support for MIDI (musical instrument digital interface) software and devices. QuickTime version 2.0 will also open the Mac to some game titles created for other systems such as CD-I, and enhance support for interactive devices, such as Apple's upcoming set-top box.

Conclusion

The Digital Video Roundtable brought together people that are shaping digital video for the Mac computer. These pioneers are working to create insanely great products that are changing the face of our industry. Who would have guessed two years ago when we first saw those curious little "movies" on computer monitors just how quickly the technology would mature? □