

# Component Television — A Panel Discussion

The following is a transcript of a panel discussion that took place at the 19th Annual SMPTE Television Conference in San Francisco on February 15, 1985, following the session on Analog Components. Merrill Weiss, Imagex Corp., moderated the panel, which included Birney Dayton, Grass Valley Group; Stanley Baron, Thomson-CSF; Larry Thorpe, Sony Broadcast Products Co.; Charles Poynton, Poynton Vector Corp.; Dominique Nasse, TDF/CCETT; and Geoffrey Leighton and David Griffin, Rock Solid Productions. The transcript has been edited to conform to *Journal* style.

**Merrill Weiss:** I will open the floor to questions, but to get things started, I will pose one to the panel and let everybody have a crack at it. I hope this will get us off to a good, thorough discussion. Given all of the development in the technology that's taking place in both analog and digital components, will we really see a change in industry practices from the current composite systems to components? Are people going to adopt what we are doing, and if they are, when will that happen? Why don't we go left to right and start with Dominique.

**Dominique Nasse:** I'm probably the only one on this panel who does not belong to the industry. Perhaps it was not clearly stated this morning that I'm on the broadcast side. I think the question should be answered first by the representative of the industry, although I believe that we will actually witness changes in industry practices. I am particularly thinking of something that was dealt with about the checkout procedures and the new features that are already available in video equipment. Whereas the maintenance procedures are already beginning to change.

**Stanley Baron:** I believe that the changes will occur. They will occur when the industry — and I think by industry you meant the users as well as the manufacturers — perceives a

benefit. The changes must be user driven. It is the broadcasters who will institute the change, not the manufacturers. We, the manufacturers, can build all the equipment we want, but if no one purchases it, it's for naught. The change will occur as people perceive that there is an advantage to be gained, and the perception, I think, will come soon because of these demonstrations [referring to SMPTE demonstrations at the conference]. You can see an improvement in quality of the signal within the studio, and you can see an improvement to the signal that is transmitted, but when you see a reduction in cost and the absence of maintenance — that's when the change will occur.

**Larry Thorpe:** Yes, I agree with Stan. I think it will be user driven and that the pace will be determined very much by the perception of how to get there. What the industry is seeing at the moment are isolated movements starting to come together. I think this conference, more than any other, has been showing the ties and pacing between some of the movements — digital components, analog components, both parallel and serial, high definition, enhanced 525, improved NTSC — they are all moving, and there now seems to be some correlation taking place between some of them.

That's, of course, what the SMPTE is trying to put order to. Frankly, at this point, I don't know what the pace will be, when any one of these will truly mature, and whether it will be more than one. My company is involved in isolated pieces of it. The digital VTR is a very big issue with us. High-definition component systems are very big with us. We have a 1/2-in. component system, but it is very difficult to predict precisely how you, the end users, are going to put all of these together, and how rapidly you would change from a composite system to a totally component system. But, we are trying to help you.

**Birney Dayton:** I think we will see the early experimenters rather soon. In fact, our opening film helped to make the point that there are people already using some of the new technology. Before we see the major body of users make a changeover to anything different than the basic system they are using now, we have to look at

the basic price/performance features characteristics of any new system. So far, most of the work has been concentrating on performance, but when the mainstream user sees equivalent or better price and features, and also sees the complete system available to work in a component television system, then we will see some substantial changes in that direction.

**Charles Poynton:** Well, there is no doubt that the move to components is happening. But, I think Merrill invited me up here to be controversial, so let me make some comments about that. One thing that the users need to be aware of in the move toward components — which everyone thinks is a good idea — is that a great deal of effort expended by the manufacturers in developing component analog machines might contaminate what all of us would like to see ultimately — the digital component machine. It might be interesting to explore the views of the audience on how users feel about the possibility that they may have to invest in large capital items like, perhaps, some sort of 1-in. S-MAC machine, which we all understand to be just a stepping stone on the way to a digital component VTR.

Certainly, the move toward components is going to happen. In any case, using technology that's available, I think the users are sort of driving that. I don't think that when Sony introduced Betacam they expected it to be taken as a really serious production tool. I think that it was intended for news, and — I'm guessing here — but maybe it comes as a surprise for Sony to see people like Rock Solid Productions doing really interesting and good things with technology that was supposed to be in the newsroom. It would be good to encourage people in the audience to make comments on their feelings as users.

**David Griffin:** I think the main body of producers are intimidated by technology, and it isn't realistic at this time to expect them to spearhead the drive or to give the equipment manufacturers one clear signal as to what should happen. As a producer, I am concerned about the quality of the programs we produce, and I am interested in having what we put on film or tape be reproduced as purely as possible. Rock Solid is unique in that we

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Participants in the panel discussion held at the 19th Television Conference in San Francisco. From left, Dominique Nasse, Stanley Baron, Larry Thorpe, and Birney Dayton.

are not too intimidated to explore new areas.

At the same time, since we have a component bay, there are a lot of instances where producers, people doing shows, come to us and because of certain technical limitations and their lack of familiarity with the technology, they shy away. I think they have a wait-and-see attitude. They are waiting for companies to come to them and say, this is the way it is going to be, and this will make it work well. Once that is proven, and down, and clear, they will be more inclined to go forward with the technology.

**Geoffrey Leighton:** I also think we are dealing with two phases here. One phase is that most of the post-production houses we are familiar with have introduced Betacam as a source machine in an existing NTSC edit suite, so we are not talking about a full commitment to component. As David said, it's a wait-and-see attitude, and I think that we are not going to see a full commitment until there is clear evidence that component video is the format of the future. As you pointed out, people have been burned too many times on too many different formats. They're taking it really slowly. The component video switchers and completely component edit bays have been possible for a long time now, but nobody's done it yet. It is because they have been burned and they want to

wait and see. Is digital next? Is component next? It's still a question.

**Weiss:** I will welcome questions or comments from the floor at any time from here on. So if there are any, please go to a microphone. The only thing I ask is that when you finish, you write down your name and question so that it can be published, possibly later on.

**John Lowry, *Scientific Atlanta:*** I have another question, based on the response to that one, to throw back to the panel. We've discussed analog component, digital component, and high-definition component television. If one of them is adopted by the industry, what happens to the other two?

**Weiss:** Who wants to try that one? Or should we go down the row again?

**Nasse:** Well, I think this is a case where we should keep a cool mind, because we should consider that we don't have such uniformity of video systems now, and it is not likely that we will be in a position where we are compelled to make such a drastic choice, as John has just suggested. The present state of things suggests that the digital components, for example, that we might have some time from now are not going to be small, low cost, and lightweight for a long time. Whether analog components could take over all of the present applications of composite systems is another question. I do not see it really

possible in the future that one of the three possibilities just mentioned could completely take over all the applications. It is likely that there will still be room for several picture representations.

**Baron:** Basically, I agree with Dominique. Your statement, John, assumed that they were mutually incompatible, and that is not necessarily the case. Or are you asking whether they are mutually incompatible?

**Lowry:** I'm making the assumption that the industry possibly can afford one of them, doubtfully can afford two, and certainly cannot afford all three.

**Poynton:** I'm hoping that tomorrow's session will have something to say about that issue. There are a lot of people who are exploring doing something between what we thought of as HDTV two to three years ago, which is 1100 lines, and 525 lines. I think it may well be that the processing of 525 at the studio and in the production facilities, and such things as frame stores and field stores in receivers will give 525 a longer life than we thought a few years ago. The only really strong reason, it seems to me, to go to a different format for display is aspect ratio.

If you took people on the street into a television studio and showed them what NTSC is capable of in the stu-

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dio, they would really be surprised. I think that an improved receiver, which could do deinterlacing, doubling the frame rate, perhaps combined with some way of getting rid of subcarrier-related artifacts, might be MAC or something else. If we can eliminate subcarrier artifacts, do something about interlace, and double the frame rate, it would satisfy almost all of the requirements that are pushing us towards HDTV.

**Dayton:** I'd like a shot at the question, John. I'm not sure that all three of those notions are mutually exclusive. I would tend to agree that if we go from where we are now and fully invest in the 13.5-MHz digital plant, that we have precluded that same operation from becoming an HDTV operation for at least 15 to 20 years, if we look at the investment cycle. This is one of the reasons I have been such a promoter of parallel analog components as a technology study, because that is clearly the technology of high-definition television, at least for the next ten years or so.

If we learn to work with that technology well, we may even be able to implement plants that are, in effect, HDTV-compatible. The change would not be a wholesale change, a change of the backbone, it would be an evolutionary one, wherein you could have some HDTV production going on concurrently with component production through the same distribution system in the plant. Those are some of the areas, I think, that need serious investigation.

In contrast to Charles' comment that we all want digital in the end, I question whether that is necessarily a valid conclusion. I think there are those things that are done well only in digital. And there are those things that are done now, and maybe for a long time to come, more economically and better in analog. So, the real exercise of HDTV versus the other two is whether or not we can develop a plant that can accommodate both in the short term.

**Griffin:** Speaking personally, I'd like to see HDTV as a system. HDTV is not likely to be available in the consumer household at any point in the near future. But, for such things as HDTV clubs, monitors in lounges and bars, special sporting events, concerts, and music events — those are some exciting applications. I would hope that it would start there, and then, perhaps, become accepted. Eventually, HDTV will be a reality for the consumer household. I hope that Betacam technology at least stays in the vanguard for five years, until we pay it off.

**Leighton:** Along the same lines, I think that to some extent we have already made our commitment in terms of your three different choices, because we have sort of done what we did with color TV. We have component that is now compatible to NTSC. It's usable in an NTSC system, and as soon as that is out, which we have done a lot to promote, it's going to be very hard to make another transition. I agree with you — we seem to confound ourselves a lot. We have set up a situation where we have gotten people really excited about component, and they are going to be reluctant to spend money to shift the system over to either digital or high-definition television, especially when you are talking about a complete change. Component has the advantage of being compatible with existing systems, so I think we have, to some extent, supported it ourselves.

**Weiss:** Larry, do you want to comment on it?

**Thorpe:** I'll give you a dose of Irish optimism. I think we engineers have a dangerous tendency to always take anything new and mount a major search for the confrontations involved. That is something that has been very visible in the last year. There are high passions at this point, as evidenced by some of the wonderful conversations today, and I expect the next few days, that will certainly bring this to the forefront. We are

hearing raging debates between digital and analog and high definition. My optimism is that out of all this, when we engineers talk ourselves dry, or drink ourselves silly, from this a few pennies will begin to drop. The synergism and energy released are going to do some awfully good things for television in the future.

One year ago, you could hardly mention the word component analog without seeing a lot of spines stiffen among the digital people. I think a year later, there are the glimmerings of an understanding that there isn't necessarily a confrontation here, that one actually might be doing the other a lot of good. There is a perception that it is now easier to understand that HDTV, as we know it today, is a component analog system.

It is easy to relate that to some of the examinations we are making now in 525 and 625 component analog systems. There still is difficulty in understanding high definition, as we know it today, and how it relates to digital 13.5, CCIR 601. For example, I will read a paper tomorrow that will speak about a system that marries component analog, digital technology, high-definition technology, and at the end of that system, we spit out 525 NTSC as we know it today, with a marvelous improvement in it.

It is that sort of thing that makes me feel optimistic to think we engineers are going to make these things work. That other confrontation we perceived two, three, or four years ago when high definition first started to be talked about, a confrontation with film — we are now realizing that there isn't necessarily a confrontation there, that high definition may do wonderful things, hand and glove with film. I think we will be seeing some aspects of that at the demonstrations on Sunday.

**Weiss:** I want to make one comment, just to take a little bit of issue with Charles. One element that you left out in your analysis is that the digital videotape recorder may, in fact, be far more expensive than existing machines, at least in the beginning. We may also see lower-cost machines that match or exceed the quality of existing machines, that happen to be analog, and that may cause the marketplace to go in a different direction than digital.

Even though digital is perceived as the ultimate, the question is whether or not, at least in the short term, the



Panelists Charles Poynton, David Griffin, Geoffrey Leighton, and Merrill Weiss.

marketplace can afford the digital videotape recorder. Until we see those machines on the market and see what they cost, it is very difficult to know the answer to that question. But other possibilities are likely to be seen before we see the DVTR, at least in some form. They may raise more questions and more problems before we have any real answers.

Are you waiting to ask a question? Please identify yourself.

**C. R. Caillouet:** I'm a consultant — I've done some work with Charles. I would like to address some things to him, but also to all of you. My background is in broadcasting, but I'm also a consultant to some nonbroadcast areas. I hear you saying that there is an industry out there, and I have to disagree with that. I think that there are several industries out there. What you need to keep in mind is that you are not going to zero in on the ultimate solution. What you are going to find is a number of solutions that various people are going to grab.

Some people may want Charles's digital machine and may be able to afford it. We've seen that all along the way in different types of machines with different costs that reach different markets. We see a lot of  $\frac{3}{4}$ -in. work being done out there still by people who can't afford 1-in. machines.

We see  $\frac{1}{2}$ -in. fitting in the middle somewhere. We didn't see that when it first came out, at least I didn't. And then there is 1-in.

I think you need to address the fact that you are not talking to just a broadcast market. You keep talking about broadcasters. You are talking about industrial people and film producers, about different grades of film producers, those who want 1125 line or whatever to go to 35mm. Some of you are doing surprising things with 525-line transfers to 35mm. Going to 16mm would look pretty impressive, too. So, I'd like some people to address not only the broadcast users, but all the users in the "industry" out there.

**Weiss:** Very well taken points. Gentlemen...

**Thorpe:** I'll make a short response. I think you put your finger right on it. Take that controversial one, high-definition television. I've been on and off airplanes almost nonstop for the last year, talking to all sorts of people about HDTV. You would be amazed at the ideas churning out there in the nonbroadcast marketplace, non-broadcasters, that is, as we might consider them. It's fascinating, and it leaves no doubt in my mind that high definition has an enormous future, regardless of the agonizing that we

might be doing inside our broadcast world. It's a very good example.

**Weiss:** Anybody else?

**Griffin:** I think your observation is valid. As a production company, we have a lot of people coming to us to produce shows on different levels — an industrial base, a commercial base, syndicated or broadcast television base, documentaries, and behind-the-scenes type programs. The thing that seems to filter across all of them is that even if you are doing an industrial, all clients are aware of the buzzwords and the techniques and the technologies that exist in broadcast. Their budget may not be there, but they know they want all those effects and things. So there is a kind of cross-collateralization. We attempt to define what is possible within our clients' budgets, but it's hard. Expectations are high, and with the cost of the new technologies, a lot of production budgets are low. I do think, however, there are strong applications for what we are trying to do.

Occidental Petroleum is a client. In my mind, an oil company is the perfect client for a Betacam-to-film production. Producing training tapes for the oil rigs is something that should be shot and edited in Betacam. To facilitate distribution to their international outlets, the Betacam edit master

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could be transferred directly to 16mm film. Most of their rigs and outlets have projectors, and it works very well in that application. So on an industrial level, you can take great advantage of the blend of new technologies.

Who is going to get on the bandwagon first? If most production houses are waiting for producers to come and say, now I want to produce in high-definition television, and then the production or facilities house says, okay, now we'll go buy our high-definition recorder — I don't think that is going to happen. Further, studios are not going to encourage producers to spend more money on productions. We still see the final product, in the case of households, in NTSC with generally poor monaural audio. Somebody has to break the chain. In the meantime, there are current, economically reasonable applications in each of the areas.

**Weiss:** Please identify yourself.

**Ralph Dodds, Consultant.** The previous gentlemen said half of what I was going to say, and I totally agree with him. I would like to project a couple of scenarios I see as valid. One, the user marketplace is being equipped very rapidly with high-definition, color display devices, because of their computers. Some projection units will meet the same 80-column resolution requirements in full color that are being met now with the 13 and 17-in. type displays that go with your home computer. Some of the broadcast makers are actually making sets now that will match up to the *RGB* computer capabilities. That says that the high quality will soon be in demand at home, if there is some other mechanism to get it there. So there will soon be a marketplace in the home if it has the rest of the equipment to drive it.

Going back to the other end, cameras are really best as analog devices. Camera communication is really best, in my opinion, analog. Studio cameras have good analog communications that can be recorded on a good

analog tape machine. The ENG equipment can address itself through very short lines now to its own recorder. That recorder is quite good and getting better. Those recordings then can be digitized and handled in non-real time for most of the editing at a master level, and most of the interim editing can be done at the quality levels that we have now. Once the master tape is put together, you go back to your one-pass master (digital) and piece your whole system together. Then keep it in digital form for posterity.

Most broadcast-quality cameras in the field today, at least those made during the last 10 or 12 years, can rather easily be adapted to high-definition quality standards of scan rate and line resolution or spot size. So you don't have a big retooling expense. If you go to some master quality level, analog process, then degenerate to broadcast as we know it today, you preserve yourself for broadcast in the future, and film release today and in the future.

**Weiss:** Anyone care to offer additional comments?

**Griffin:** Did I understand you correctly when you said that you felt that computer monitors were basically synonymous with people now starting to have HDTV monitors for television viewing?

**Dodds:** I said the monitor that is now being sold to give the high resolution of the 80-column capabilities of the present home or general-purpose computer systems has that high-definition resolution, and all it needs is the right tuner or feeding device, high-quality videodiscs generating an *RGB* signal for it.

**Griffin:** I don't know technically if that is the case, so I can't understand it. It's just from a practical point of view, I don't think that people going out to buy computer monitors are doing it as a back door to getting into HDTV viewing. So these could be a spearhead for new standards acceptance on the consumer level.

**Weiss:** Can you get closer to the microphone?

**Dodds:** I don't know the figures for sure, but my guess is that about a half-million of these quality monitors were marketed last year, and that will probably double again. I know that most serious people making projection units now are getting ready to be able to present the high-quality wide bandwidth requirements for next year's computer output.

**Weiss:** Can I interrupt for a minute? I'd like to comment. You have to be careful to draw the distinction between what is commonly called a "high-resolution monitor" sold for use with personal computers, and a high-definition display, which is capable of essentially four times the bandwidth, double the horizontal bandwidth, and double the scan rate.

**Dodds:** Right. The scan rate is the difference.

**Weiss:** The ones that are being sold as high-resolution displays in the home are still at the standard scan rates, they just have a better dot structure.

**Dodds:** That's right. But given a wide-bandwidth picture off of some device — a videodisc machine or whatever — you can have a remarkably better picture that might produce a start at the consumer end. What I am trying to outline is that there are a few tools out there for these nonbroadcast markets, in agreement with the prior speaker. You also have some tools in the studio that don't have to be junked — modernized, but not scrapped.

**Weiss:** Can you identify yourself, please?

**Jim Mendrala, Component Video Inc.:** It seems like the whole industry is thinking in terms of television as only camera output through the transmitter out to the home. But in reality, just like the film we saw at the beginning of this session, there is a big dividing line between distribution of product and the making of product.

Referring to John Lowry when he mentioned what's going to happen to the other systems, I think really what we are seeing here is a breakaway from the NTSC syndrome and the benefits of working with component colors. We are going to have to go much further by making component color equal bandwidth — either *RGB*, or *YIQ*, or *R-Y, B-Y* — so that the producer can do in a post situation what he can now do only in a live

camera situation. Until that comes about, we will still be floundering around.

So what does the producer need to produce shows and interesting documentaries? He needs the full capability to manipulate pictures in any way, shape, or form, not only in a real-time situation, but also in the post situation. So I think the industry is going to divide between ENG, where you don't really care to manipulate things, you just want to record it for posterity and transmit it, and the producer who wants to put together a show and wants to try all different kinds of things with the basic raw data gathered in the production stage.

**Leighton:** I agree 100% with what you are saying. One of things we've run up against is that, unfortunately, there is a great void between the ENG production of component and legitimate producers who use component. I mean, by the very fact that what you're talking about is a mastering medium that only has 20-minute load, it limits you as a producer who produces a syndicated program that is a half-hour or an hour long.

It is really difficult to overcome, the fact that Betacam is set up as an ENG medium. The BVW-40 recorder was patterned much more after a BVU-800 than it was a BVH-2000. I think it was planned very much the way U-Matic was planned when it came out, to be a news-gathering format. All of a sudden, everybody is interested in it, and a lot of changes have to be made, and people are not willing to make the changes or the expenditure until there is a demonstrated market for it.

In Los Angeles there is a demonstrated market. Most of the post-production houses handle Betacam and will do Betacam to 1-in. There are a lot of syndicators who are using it as a source to do programming, but I think there is a big step that has to be made between using it as an ENG format and a legitimate producer's format. One of those things is expanding the length of its record time, and also dealing with the record machine as much more professional, on a par with a BVH-2000.

**Griffin:** If I could just piggyback one thing on that, I think that another part of the process is the educative process. A good example that comes to mind is the ability to do chroma keying in post, in component. In the past, when we did chroma keying, we had to do it on-stage, live, we had to

get it right, and that was it. We have a lot more flexibility now, in being able to do it as a post process. It allows us, as producers, to experiment and to try other things instead of having to go back in the studio — which is costly and really not practical — and do it differently.

**Leighton:** That's what I mean about equal bandwidth, *RGB*, or *YIQ*, or what have you. Then you can do what you do in the studio live, off a videotape, which you can't do now. Although component is much better than the standard NTSC.

**Poynton:** I can address the last point on equal bandwidth. I'm actually promoting field-sequential video for the very reason that in a field-sequential signal, the only degradation you suffer is temporal subsampling. But all the colors come at full bandwidth. Our motto is component video for the 80s, field-sequential for the 90s.

One serious comment — would you be suggesting we use the jargon term 4:4:4, in other words each of *RGB* or *YUV* at the same ratio? 4:2:2 implies *U* and *V* subsample, half the bandwidth. CCIR-601 itself talks about that as being a possibility, so that is likely to happen.

In the meantime, though, experiments in 4:2:2 digital, and S-MAC, which is 4:2:2 analog, and in Betacam, which is probably 3:1.5:1.5, have indicated that color separation — Ultimatte, chroma key, or whatever you want to call it — results are very good. In practice, it is sufficient to do those operations at half the chroma bandwidth. I think Rock Solid Productions would probably say that they don't find any really severe chroma bandwidth limitations when they do operations like you are suggesting in post.

**Mendrala:** It has been my experience that even with the wider bandwidths, that are not equal, in terms of the Ultimatte or the other matte units, you can end up with a picture that on a 19-in. TV screen doesn't look too bad, but if you are going to blow it up, you start seeing the negative factors of what's happening with reduced bandwidth between the three color channels. The black outline that surrounds the matted foreground image is a graphic example.

**Weiss:** What you are commenting on is the reason, I think, that the industry in general has been going to equal-band *R-Y, B-Y* type systems as opposed to *IQ*. That is why you'll

find that the component systems are going in that direction.

**Mendrala:** There is one other comment I want to make. We keep talking about high definition, and I just want to throw this in for whatever it's worth. Everybody should think and talk about what they would like to see as high definition. The first thing that has to be determined, which has not been set in concrete, is the aspect ratio. Because without the aspect ratio, we are going to end up with all kinds of different numbers to deal with.

**Caillouet:** There may be two issues here, and I'm back to where John was earlier. That was, we talk about high definition and standard line rates, and we also talk about component, and analog, and component digital. We are really talking about two different sets of problems here. We are talking about enhanced 525-line and other systems, and that's where I see the distinction. What I've heard over the last year, maybe starting in Montreal, really hit me, is that people are starting to move back to concentrating on enhanced 525 line.

The last question about aspect ratio, I think, is only applicable if you are willing to take the hit on changing from 525 line, because we're talking about compatibility again. We started off with NTSC based on the psychophysics that I guess somebody's talking about in a room somewhere at this conference. We designed the system and accepted the hits on the system, based on what we thought the viewing distance was going to be, and the viewing conditions, and all the various parameters about the source conditions. Those are the kinds of things we must not forget when we talk about using computer displays for television and how much bandwidth we need for chroma key — those kinds of things.

The computer issue is really serious, because people are trying to force synthesized images into a system that wasn't designed to handle synthesized images. We have out-of-band components in two or three directions now. We need to keep track of what we're trying to do with the system, and that doesn't preclude generating specialized systems for specialized problems. But, if we are going to try to maintain compatibility, we need to keep in mind what the parameters of that compatibility are.

I would like to see people like Charles and John work on the things

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that the digital systems really are good at, and that's getting back and forth between some of the areas that maybe some of the designers are going to come up with in the high-definition area. Some of you are working with film because it is the most practical way to distribute, and for the most part, the quality is better than with scan conversion. I think that is where you are with some of the things you are doing anyway.

It is going to be very important, as we develop these new technologies, to be able to get back and forth. We have seen that as a problem ever since 405, and 625, and 525, and 819, or whatever it was. I've got it with 945 in Houston. There are all kinds of problems — we've got vector displays, we've got IBM PC displays and Mac-Intosh displays. Everybody has a different line rate. There are some times when you want to get back and forth between those things, and sometimes maybe you shouldn't. At least you should understand whether or not you should, and that involves taking a hard look at what the limitations are.

**Weiss:** Can you identify yourself, please?

**Howard Butler:** I'm with Questel Inc. I have a little more down-to-earth question to address to those of you involved in the committees. Perhaps the answer was the field-sequential comment, but most of the committees' work now seems to be based on either a three-line parallel component system or a MAC system that seems to be going in the direction of 4:2:2. What discussion has there been and what possibilities are there for a single-line, equal band system, either *YUV* or *RGB*?

**Weiss:** Stan, do you want to comment on that?

**Baron:** As I said in this morning's paper, what we've tried to do is take the problems that have been thrown at us and tackle them in a reasonable way. If you find yourself in the middle of a swamp and start thrashing

around in all directions at once, you go nowhere. The equal-bandwidth system, which has been described as the 4:4:4 system, is next on the agenda. As people begin looking for better performing systems, that's probably where we're going to go next.

I just have one other comment that tacks onto John's question. If a 4:4:4 system in the analog or digital domain comes forth, will it replace everything else? The question becomes, How does it fit in? The answer is that all of these things are tools, and they are not really totally incompatible. Half of the work that is being done by these committees is being done in the ad hoc study committees which are joint groups, because in truth, the problems are the same for both the analog and digital domains.

The tools that each domain develops that solve the problem best are going to be fitted into an integrated system. That is really what is going to happen. It is going to be an integrated system. It is not going to be one or the other to the extent that the alternatives are removed from the scene in total. Just as you have film and television production, you can have analog digital systems production.

**Butler:** Has there been any serious discussion on equal-band 4:4:4 systems in any of the committees?

**Baron:** Not in depth. They have just concentrated on 4:2:2.

**Weiss:** Howard, let me point out one thing, as far as the considerations relative to analog components. While 4:4:4 type systems, specifically on a single line, have not been discussed in great depth, one consideration that has been, to a substantial extent, is that these systems in the analog domain are not tied to a particular clock frequency. So they are quite extensible. Once you have the techniques down, there is nothing to preclude using, for instance, even with the 525-line structure, an 18 or 20.25-MHz input sample clock, to make the whole filtering problem much easier. And,

of course, 36 or 40.5 MHz on the S-MAC side. Once you have done that, you can, keeping the same line structure, use any multiple of 4.5 MHz, 13.5 MHz or greater. The bandwidth can then be increased, as long as you've got the distribution bandwidth beyond the 11 MHz we are using now. There is nothing to preclude going to wider bandwidth systems.

There is also nothing to preclude, if you have that capability, going to a different split-up of the line, so that instead of being half/a quarter/a quarter, it could be a third/a third/a third — using the same techniques to go with whatever system you want. What we are doing is forging a method. The constants used in the actual documents can be changed to suit the application. That is one of the reasons we have given so much thought to how you make a transition.

If the direction you want to go is high definition, what is the route you take to get there in terms of what you do today? If the route you want to follow is many more generations, you may be looking at digital. If the route is higher bandwidths, and you want to get there sooner, then maybe the way you want to go is analog. These are the kinds of things people have to look at and decide in order to come to some conclusions about what they will do with their systems, as they build them today.

It really requires a combination of a good understanding of what the technologies are and where they are headed, with a little application of a crystal ball. But I think that if you look at what's going on in the committees, you will see that there is a substantial effort on the part of SMPTE to develop standards that work hand in glove with one another. The user can choose what is best for a particular application, and what is best may very well be a combination.

To formally close this discussion, I'd like to read to you the end of the last paragraph of the paper that I didn't get to read earlier because I ran out of time: "Now the Master of All Images said, 'Let there be components in all forms to meet man's needs for better pictures. Let there be standards, so that man may use the components together in whatever way he requires.' And the master saw that man was learning to use the components and that they were good. So he rested."

Thank you all.