



EBU Seminar: “Sifting the Hype”

Television production tools for the next decade

J.J. Peters (Head of Production Technology, EBU)

R.A. Chalmers (Senior Engineer, EBU)

1. Introduction

An EBU Technical Seminar on new television production tools took place at Montreux, Switzerland on 11 – 13 December 1995. It concentrated on those production tools which make use of new recording or transportation methods based on compression.

The concept of compression has been around for some time in the television world but it only emerged recently as an element of design for production tools, essentially in the recording area. After it was accepted in the production area, its use spread quickly and a hype similar to the one which had surrounded its use in the transmission world began to produce a similar confusion in the production area.

In December 1995, the EBU held a Technical Seminar on new television production tools for the next decade. In this article, the authors give their personal views on the main elements covered by the seminar – compression, recording, archiving and routing.

Various video compression systems have been developed for different applications. As a result, new recorders, servers, non-linear editors and networking systems have proliferated without apparent coherence. The Production Management Committee (PMC) of the EBU, which supervises all studies relating to production matters, decided as a matter of urgency to prepare an objective snapshot of the current situation – in the form of a technical seminar – for the benefit of studio engineers and technical decision-makers. All systems would be introduced in pure technical terms and would be described by objective data, in order to



“sift the hype”. Demonstrations would also be given, specifically oriented towards the needs of broadcasters. The seminar was also aimed at providing the basis for any possible standardization activity that might take place in this area.

The seminar programme was coordinated by Mr. H. Schachlbauer (IRT) who, for many years, was Chairman of EBU Specialist Group MAGNUM. Then – following the recent reorganization of the EBU Technical Department – he went on to become Chairman of MAGNUM’s successor: EBU Project Group P/DTR (Digital Television Recording). Mr. Schachlbauer managed to attract key speakers at “Sifting the Hype” who skillfully delivered presentations at the appropriate level for the participants.

The International Academy of Broadcasting (IAB) took care of the logistics of the event – which was held in the Petit Palais, a restored building close to the Convention & Exhibition Centre in Montreux.

The seminar was open both to EBU Members and non-Members, as well as to the specialist press. About one hundred persons attended (not taking into account the speakers, who numbered about 40). Loose-leaf copies of the speakers’ texts were distributed at the seminar and the interest shown in these has subsequently persuaded the organizers to produce a bound version of these documents¹.

2. Compression

The seminar started with a presentation on the general principles of compression. The session chairman was Mr. M. Ardito, head of production systems at the RAI Research Centre in Turin and also Chairman of the EBU Production Management Committee (PMC).

Mr. Ardito’s main message was that the new technology has radically changed the way a given piece of equipment performs a given task. Dedicated equipment no longer operates through a specific hardware design but rather through software control. At first sight this would seem to give each tool a greater universality. However, given the wide range of companies wishing to enter the professional broadcast world, especially from the

computer industry, the result is a frequent lack of interoperability. Software solutions intended as a bridge between different products, do not necessarily give the answer requested in the television chain; for example, they generally do not provide bit-rates that are compatible with television production processing, nor do they provide real-time working.

Compression is intended as a solution to the bit-rate problem. However, broadcasters have been hesitant about bringing compression into studios as these places have always been a domain of the highest quality requirements. Coupling the increasing number of signal generations which modern production techniques imply, with the often limited quality that computer systems currently offer for video, was seen as a risky adventure. Production staff were looking for evidence and for tutorials on the subject; the seminar programme had thus been planned to meet these expectations.

Overviews were first given by research experts both from industry and from broadcasting organizations. They covered the principles of lossless compression and of compression systems using discrete cosine transforms (DCTs) such as JPEG, M-JPEG and MPEG. Wavelet and fractal-based systems were not forgotten. The differences between these algorithms are not always well perceived and their respective applications are not so obvious. Even at a conference, this is somewhat arduous to make clear, so the accompanying papers were very welcome.

The most recent of these coding algorithms standards – the 4:2:2 profile at the main level of MPEG-2, which has been designed to suit studio applications better than the basic algorithm – was the subject of a special paper by Mr. C. Ricken (Technical University of Braunschweig, Germany). Mr. J. Wilkinson (Sony) reported on tests made to assess the effect of some parameters in the algorithm, especially in relation to the noise contribution. The standardization procedure is nearing completion; the full set of tests are now being analyzed and, very likely, a formal proposal will be put to the relevant ISO Sub-Committee (SC 29) this Spring.

All the tutorials were well illustrated. Special mention has to be given on this matter to Mr. M. Barbero (RAI Research Centre) for his very clear presentation on transform coding techniques, with the help of some sixteen specially-designed figures!

1. A 400-page book which contains all the Proceedings of “Sifting the Hype” is available at a price of 140 CHF for EBU Members, 160 CHF for non-Members. Orders can be sent to Mr. J.J. Peters at the EBU in Geneva (Fax: + 41 22 717 27 10).



Figure 1
The team behind
“Sifting the Hype”:
(from the left)
Mr. G.T. Waters,
Mr. H. Schachlbauer,
Mr. M. Ardito,
Mr. J.J. Peters and
Mr. R.A. Chalmers.

■ 2.1. Concatenation of digital processes

The production chain of today is characterized by a succession of many processing links. Consequently, a critical matter concerning compression systems is that of their concatenation.

Good picture quality at the output of a given coding system does not imply that the coding can be repeated, particularly in the case of compression techniques which leave out part of the source information. Moreover, what makes the present (MPEG) situation basically different from the situation that resulted from previous standardization is that encoding is not defined. Algorithms should be compliant but they can be different. Therefore, if two encoders are fed with identical video signals and even if they deliver equivalent output rates, there is no guarantee that the decompressed video quality will be the same.

Different compression algorithms show different artefacts. As each coding step in a production chain can use a different coding algorithm, each subsequent step can influence the following coding step in some way. Concatenation of coding steps can therefore result in a very variable picture quality. The variation can be quite unpredictable, as some coding artefacts are dependent on the picture content. If one then adds to the effect of compression, the need – for some time yet – to implement signal format conversion at certain points in the chain, we make it almost impossible to determine the probable performance of a typical television chain equipped with such new tools.

This concatenation problem has been judged to be such an important issue for broadcasters that the EBU has set up a project group to study this subject. It is chaired by Mr. Hans Hoffmann of the IRT. At the commencement of these studies, about 200 combinations of coding links were examined in experiments carried out by the IRT in Munich. Mr. Herbert Hofmann, another IRT expert, presented a report to the conference, explaining the conditions behind the choice of combinations and the way the experiments were conducted. The tests clearly showed that picture sequences which are relatively uncritical for a single link may become critical by the addition of artefacts generated through concatenation. For example, non-linear editing systems are a particularly hostile environment for compressed signals. The tests also showed that the situation appears even more sensitive when one considers the whole television chain. There is a noticeably negative effect when 34-Mbit/s codecs are used in tandem with PAL interfaces.

■ 2.2. Evaluations of picture quality

The last presentation in this tutorial session, by Mr. N. Lodge (ITC), examined “what is wrong” with current methodologies for evaluating picture quality. He proposed criteria for the building of methods which are appropriate to compression systems.

Conventional methods are of limited use in this case, especially when the compression coding is dependent on local picture content. There is no sign of an objective method – i.e. test signals – which could take care of such a treatment; the nature of the artefacts which can arise is extremely varied. Subjective evaluation is therefore the way to go but, even there, existing methods are not totally reliable. The ITC tests dealt with the viewer’s tolerance to distortion and the identification of scenes which would reveal deficiencies in the subjective optimization of compression schemes.

■ 3. Recording

■ 3.1. Digital video tape

“From tomorrow, tape is dead” was a frequently heard refrain before and during the seminar – but is the requiem premature? Certainly many manufacturers are confident in the future prospects of tape, at least in the short- and medium-term, and are backing their confidence with investment.

Mr. S. Owen (Panasonic) gave his personal views. He recalled that digital video tape got off to a slow



start; it is only now gathering momentum as the third generation formats begin to become the work-horses of the broadcasting industry. Tape itself has shown steady if unspectacular improvement. This, combined with the acceptance of mild compression and more sophisticated error correction and channel codes, has led to not one but three new proposals for lightweight fourth-generation tape formats. These are aimed at acquisition, low-end production and what is now referred to as *streaming*, i.e. taking off finished programmes or material for later use. Although similar in some respects, these new formats are aimed at different market sectors and are intended to fill different gaps in the respective product lines of their manufacturers, according to the descriptions of the SX format by Mr. P. Sykes of Sony, the DVCpro format by Mr. S. Owen of Panasonic and the D-VHS format by Mr. N. Neubert of JVC.

■ 3.2. Disk storage

Whatever the future for tape, even the tape manufacturers agree that it will never again have the field to itself. Disk storage was thus the main subject of the seminar and Mr. Schachlbauer had assembled an impressive number of authoritative speakers to cover it.

Everybody knows that disk storage will come and, in fact, it is already in use for a number of applications. The questions are not *if* or *when*, but *where* and *how*? Two approaches emerged during the seminar, based on the different backgrounds of the manufacturers. Traditional broadcast manufacturers such as BTS, Panasonic or Sony, saw disks as a new medium to be integrated into the traditional production structure. Their approach was to use disks in situations where they are most suited, and to use other technologies in situations where they offer a better alternative. The user may not necessarily know, or care, how the signals are stored. Other manufacturers, particularly with a background in computing, such as IBM, Tektronix and Hewlett Packard, started with disk recorders and proposed using other technologies only when their basic disk technology is not suitable. Alternatively, they limited their products to areas which can be solved by disks, rather than offering across-the-board solutions.

There was strong agreement during the seminar that no single technology is suitable for the whole range of broadcasting activities. For instance, everyone agreed that hard disks offered the most user-friendly approach to editing. The requirements of editing – random access, non-destructive editing, ease of handling the audio and video – are

best met by disks. The only questions were ones of cost and quality. Disk technology is advancing, and a number of very interesting seminar contributions on the basic technology of disk drives predicted that it will continue to advance in the foreseeable future. However, the vital parameters – capacity, cost-per-unit of storage, bit-rate and, to a lesser extent, access time – still pose problems for simple disk systems. Disk systems are rarely aimed at full studio quality, which means “4:2:2 Rec. 601” signals. Therefore, in almost all solutions aimed at general broadcasting as opposed to high-end production, compression is used to achieve a more attractive balance of quality, capacity and cost.

Much of the attraction of the many non-linear editors which are on the market is that they are based on widely-available and cost-effective workstations used for many other applications and thus they take advantage of the economics of large-scale production. It must, however, be remembered that the cost is relative. These are not the sort of PCs that can be bought over the counter in a computer store. An approach common to many manufacturers and customers is to ask “can we accept the quality that we can get from this equipment?” rather than asking the question “what equipment do we need to get good quality?”. However, it was very clear that the advances in processing power and disk technology mentioned above will take place, whether or not it is used in broadcasting, because the primary driving forces from other computer users are so strong. Things can only get better.

■ 3.3. Video servers

Another popular application of hard disks which was strongly canvassed during the seminar is what is now being called the *video server*. This was proposed for two uses, either on final playout or as a multi-access store for topical programmes such as news or sport. In the case of final playout, the attractive features are instant (or very fast) random access and multiple playout. Programmes, particularly short items such as advertisements, station IDs, trailers etc., can be played out under software control to one or more networks. These features may be possible today with automatic cassette loaders but the video server seems a more natural choice for this application – provided, that is, that the quality is acceptable.

Here again, there is a difference between the “best possible” and the “good enough” approaches. At the moment there seem to be problems with achieving the necessary quality, speed and capacity, all at the same time. A playout server may

need to store days rather than hours of programme material. What the accompanying demonstrations at the seminar appeared to show, was that present-day proposals did not put a limit on the quality which could be delivered to the home by conventional methods of terrestrial, cable or satellite transmission. In other words PAL and SECAM, coupled with the defects of transmission paths, seem to be more of a quality bottleneck than the compression used on servers. Furthermore, if the confident predictions on improvements in disk technology are achieved, then practical, affordable servers may be here soon. An open approach to compression is already apparent and several disk systems allowed the user to choose the compression to suit his/her needs or even to use different compression on different programme material. Disks can exploit variable-length signals in a way that is impossible with tape.

The other popular application for a video server – the multi-access working store for topical programmes – fits more into the concepts of the traditional manufacturers who are thinking of integrated solutions. They have targeted newsrooms as areas where such technology can benefit the users and can make possible attractive new concepts of working. In news, quality has always ultimately taken second place to immediacy. Any pictures are better than no pictures at all. However much this principle goes against the grain of many broadcast engineers, the operational pressures to play out directly from the edit workstation will be irresistible, given today's competitive climate. This is very much a "top-down" approach where the whole operation from acquisition to archiving is covered in a seamless operation. Tape is used for acquisition, individual disks are used for editing, and servers are used for holding material for daily

and weekly access. Eventually, when the material is no longer "hot", it is streamed onto tape, data or video to be stored for future historical use.

It is important to realize that this sort of disk system is much more than a collection of disks. It contains sophisticated backup facilities and much redundancy, to ensure that it can survive damage or malfunctions of its individual components.

All solutions take the integrity of the data stored on disks very seriously. This is a well-understood aspect of data processing and there are many techniques to avoid the immediate effects of total or, as is much more likely, partial failure of the disks. Integrity is significantly more important for compressed television signals because the opportunities for concealment are so much less.

Like so many terms in the new world of information technology, "random access" has many different meanings. Does it mean that any user, or all users, can access any frame in the server? Or does it just mean that a user can ask for a sequence and get it downloaded onto his/her workstation in a reasonably short time? The two concepts put very different demands on the hardware, the software and the cost. The central architecture of servers can have important differences which may influence their usefulness. Amongst other things, as Mr. P. Owen (Quantel) pointed out, the architecture of the server influences whether a final edited sequence can be played out in real time or it has to be rendered into a separate output recording.

The choice of a suitable compression system for storage, or of not using any compression at all, will be a very important consideration, as was reflected in the earlier sessions of the seminar and re-emphasized by Mr. D. Chawner of Sony. He put more emphasis on the compression system than the hardware, particularly for large integrated solutions where the whole complex shares a common compressed backbone, linking many different types of equipment.

There are many possible variations on the server theme. For instance, AVID has developed a camcorder which records on hard magnetic disks; the disk is removable and can be plugged into the studio production system. A number of variations on optical disk technologies have been proposed for permanent records, e.g. by Pioneer. Other archival options use data streaming tapes instead of video tapes.

This illustrates the dilemma for users. Is it better to opt for a package solution which may tie you into a single supplier but which can be seen to

Figure 2
General view of the delegates at "Sifting the Hype".





work, or to opt for an open solution which will allow you to choose the most effective solutions to individual needs but which may contain unknown problems when integrated into a whole system? Certainly many potential users may be frightened by the cost of an integrated approach and may prefer a gradualist one, for no other reason than the lower initial impact on their budgets.

4. Archives

It is a truth universally acknowledged that a television station in possession of a good fortune must be in want of programmes. This has led broadcasters to take a much closer interest in their archives. No longer is the archive a convenient place in which to empty the shelves of the production office, but a gold mine of material which can be recycled ad infinitum. In the seminar session on archives, it became clear that there are as many views on what an archive is, as there are solutions for the requirement. Even within a single broadcaster, it seems that the term can have many interpretations. To a news department, an archive holds last week's news; to a film library, it contains material nothing less than tens of years old. The material held in a television archive, not including films, cannot date from before the dawn of the age of magnetic recording (in the late 1950s). Since then, however, the growth in television archives has been exponential.

Putting across the viewpoint of major broadcasters, Mr. P. Calvert-Smith (BBC) and Mr. D. Frambourn (INA) reported on the problems of ancient programmes. The original 2-inch quad tapes are now obsolete and deteriorating. The replay equipment is old and difficult to keep running. The same is increasingly true of 1-inch tapes in B or C formats. Many broadcasters – realizing the historic and commercial value of old recordings – are starting to dub old tapes onto newer formats. Other broadcasters are still calculating the cost and do not like the answers!

Technically, the choice of a new format is difficult. Most, but not all, accept that it should be digital. But is it better to leave the signal in a coded form or to decode now? Should data compression be used or will the future demand a better quality? Should we wait and see the next generation of tape and disk? Do we need a specialist format for archives or are there too many formats already? All these questions were put without any definitive answers. It is important to take into account the large time spans involved. We may wish to transfer a 30-year-old tape to a new format now, and still

expect to be able to play it in yet another 30 year's time.

The technical problems may turn out to be relatively easy to solve compared to the organizational ones. In many cases no one knows what is actually on some old tapes. Better ways are needed to log the material that is stored in an archive so that it can be accessed via database "search and browse" techniques. This should be started now to avoid problems recurring in the future, but few broadcasters seem to have the resources. This is an issue overlooked in many would-be solutions which concentrate on the hardware.

Archives should be about "store and retrieve" not "store and forget". Even those who appreciate this may have difficulty with the scale of the problem. It has been difficult enough to protect vintage material from the 1960s, stored as early video tapes, let alone the vastly larger number of programmes that have been stored in later years on a bewildering variety of formats. And that does not take into account the data, scripts, stills, unedited takes, browse-quality extracts, etc. which a fully-automated archive would entail.

Nevertheless, many manufacturers are suggesting interesting solutions which can be applied to limited areas of television production. Generally these use a hierarchy of storage media, based on computer experience in large data banks. Material is relegated to cheaper but less accessible media as time passes. The final storage media may well be a data medium, tape or optical disk, which may be quite unfamiliar to broadcasters, e.g. the *Media-vault* system described by Mr. S. Atkinson of StorageTek, the *Exabyte* system described by Mr. G. Boath of Tektronix and the data tape format described by Mr. I. Wordsworth of Sony.

The major difference between these systems and other archive applications seems to be one of timescale and volume of television production. The timescale is not measured in days, weeks and months but rather in weeks, months, years or tens of years. The number of separate video tapes already runs into millions: each one needs tens of gigabytes of raw data². One problem which the data processing industry has effectively solved is the integrity of the data. This is far more important with financial data than it ever can be for television. There are also well-developed methods of logging the error rates when replaying material from a known defective media. Using these techniques, any endangered data can then be dubbed

2. Data which accords with ITU-R Recommendation 601 requires 27 x 60 x 60 Mbytes/hour.

automatically onto a new support or even a different media. These are all important steps towards the "eternal archive" where the user asks for and receives a programme in the form of data – not, as now, where he/she receives a tape which contains the data.

Another interesting approach to a broadcast archive is to use a more stable medium such as optical disks. These tend to be WORM disks (which were described by Mr. P. Kelly of Pioneer), so are most suitable for completed programmes, recorded in one pass. Other types, however, are also available.

A further aspect to add to the already confusing scene is the question of non-real-time access. Do users really want instant replay in real-time from material which has been undisturbed for many years? Would they want a browse copy for office viewing before they made a final decision? Would they be happy with delivery within a day or so, by means of an inexpensive data circuit? Perhaps this last question somewhat anticipated the next session at Montreux . . .

■ 5. Routing

A basic reason for the development of compression systems was the need to be able to convey video signals in the limited bit-rate channels that previously were available in the telecommunication and computer worlds. With high-quality video compression schemes working at ever-decreasing bit-rates, and data networks being designed for ever-increasing bit-rates, some convergence of the technologies can be observed. Can television production benefit from this situation? Instead of a conventional bus-type chain, would not the television studio cabling be better structured into a network? The session proposed an overview of the most commonly-cited candidates for networks in the production area.

Protocols specifically designed for video networks include Fibre Channel, operating at a clock rate of 270 Mbit/s, and adopted by DVB for interconnecting compressed digital video and SDI data. The SDDI protocol has been devised by Sony to convey multiple compressed video signals on an SDI link. It has been proposed to the SMPTE as a standard. SDDI is currently being discussed with broadcasters, especially as it looks like a natural extension of SDI, and can provide expanded routing possibilities.

Among the various sorts of computer network systems which could have specialized applications in the studios, ATM is being pushed very hard by its proponents, both for local-area networks and wide-area networks. Although originally designed for low bit-rate communication applications, it is now available at many speeds up to digital television rates and even higher. If used, ATM would change considerably the architecture of the production centre; for example, no physical routing switcher would be needed. That function would be carried out through interactions between the ATM packet header addressing information and the "cloud" of ATM connection points.

ATM will almost certainly be implemented in future telecommunications networks but its use in a studio environment is questioned. The quality level is not yet good enough for use in the television production chain. Furthermore, ATM switches which can handle the full television bit-rates are too expensive. It is therefore expected that broadcasters will consider that SDI should remain the standard within the studio, and ATM could be used outside it. For example, ATM is known to be the technical basis for an exchange network for audiovisual archives being planned by INA and the BBC.

The seminar also heard presentations on file formats which are more at home in the desktop video field, e.g. OMF, open DMF etc. The EBU has established contacts with the manufacturers concerned, in order to gather as much information on the subject as is possible.

The last session made it even more obvious that a certain level of standardization is required if the various links of the television production chain are to work in a complementary and harmonious way. Standards should also be established to allow equipment or system to be used flexibly within any given link, in order to allow interchange and interoperability. This viewpoint was expressed by Mr. K. Davies (then Vice-President of Engineering at the SMPTE) who has many years of experience in standardization activities. Talking about MPEG-2, he mentioned that this set of standards gives *almost unlimited flexibility but (also) unlimited opportunities for disaster in the production environment, where editing, switching, mixing, effects, geometrical manipulations and the like are essential. Thus there is a need (. . .) to define applications-oriented sub-sets.*



The broadcasting community therefore has a large amount of work ahead of it, in order to complement the universal agreement on the use of MPEG-2 for digital television.

6. Conclusions

We do not know whether the Montreux seminar has effectively sifted the hype. Many technical proposals still need to be examined in more detail before the potential users commit themselves in a

clear and unambiguous way. However, a general survey of the situation has been presented, which clarifies the relationship between the various proposals.

The contacts that have been established, and the frank exchanges of views and of information that the occasion gave rise to, have elicited many positive comments. Consequently, a similar event – “Sifting the Hype 2” – is being planned for early 1998 with, nevertheless, a somewhat modified focus and target audience.

Third International Symposium on Digital Audio Broadcasting Montreux, 4 and 5 June 1996

The EBU – in cooperation with *EuroDab Forum* and *Eureka 147* – is organizing the Third International Symposium on Digital Audio Broadcasting.

This symposium is held every two years and attracts manufacturers, service providers, network operators, broadcasters and other parties involved in DAB from all over the world. It is a great opportunity to meet and discuss technological innovations for the production, distribution and emission of sound, data and multimedia programmes.

This year, the symposium is being organized at a critical time when DAB technology is being brought to the marketplace in many countries. It will thus provide an opportunity to harmonize the introduction strategies of DAB around the world.

Papers will be presented by leading DAB experts from the many sides of this exciting new technology – representing the equipment manufacturers, broadcasters, network providers and regulatory organizations.

The main sessions will cover:

- essential highlights of pioneering DAB projects
- markets and consumers
- DAB services
- DAB equipment
- DAB technology
- satellite DAB
- planning and using the frequencies

Early on the second day, there will be a Technology Market Place which will provide an opportunity for the front runners to describe their experiences when setting up major pilot projects, on-air DAB services, SFNs, etc.

Further information on the Third International Symposium on Digital Audio Broadcasting can be obtained from:

Mr. George T. Waters, EBU
Ancienne Route 17A
CH-1218 Grand-Saconnex (GE)
Switzerland

or

Radio Montreux
P.O. Box 1451
CH-1820 Montreux
Switzerland

Tel: +41 22 717 2111
Fax: +41 22 717 2749

Tel: +41 21 963 5207
Fax: +41 21 963 8851

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