

EBU Technical Information I26-1994 Guidelines for the development of individual parts of the television programme chain

<i>EBU Committee</i>	<i>First issued</i>	<i>Revised</i>	<i>Re-issued</i>
BMC	1994		

Keywords: Miscellaneous

The use of increasingly sophisticated signal processing operations for the video, sound and data components of television programme services gives rise to the possibility of complex interactions between individual parts of the programme chain, some of which may be detrimental.

EBU Sub-group VI has identified the need for a set of Technical Guidelines to be used by those working on the development of equipment for individual parts of the programme chain. These Guidelines will help to ensure that the individual parts will operate satisfactorily when used as part of a complete programme chain. This means that as far as possible they will not be adversely affected by processes occurring earlier in the programme chain, and they will not adversely affect subsequent processes.

The Technical Guidelines given in the Appendix are appropriate for a television broadcast chain, including contribution links. Guidelines for other applications, such as multi-media/computer integration should be the subject of further study.

Appendix Guidelines for the development of individual parts of the television programme chain

1. Test environment

A piece of video, audio or data handling equipment will generally be used as part of a programme chain. A typical skeleton chain is shown in Fig. 1, as an example of a suggested test environment. It comprises the following elements:

1.1. Contribution link

The contribution chain might include cascaded codecs and/or PAL decoders and coders; this should be reflected in a test chain used for verification of the performance of equipment under development.

The use of low bit-rate codecs for satellite news-gathering (SNG) might, in particular, introduce serious quality degradation further down the chain. These degradations should be taken into account in a test chain.

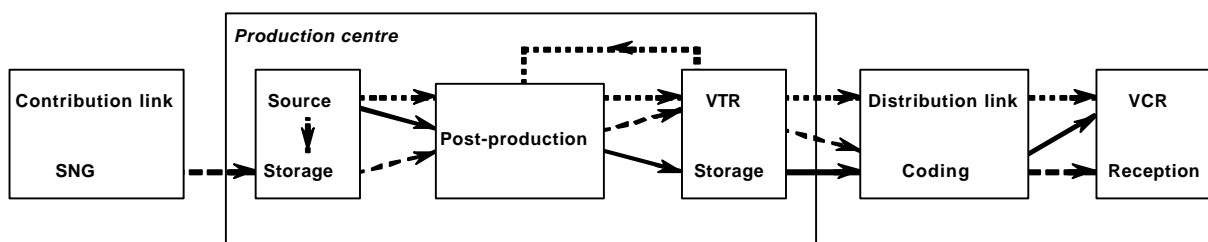


Fig. 1 - Skeleton programme chain for the testing of television equipment that is under development.

More complex chains may include electronic zooming and picture shift as well as chromakey. All of these might introduce artefacts and the test chain should also reflect the fact that the signal will have to pass through such areas a number of times.

1.3. Distribution link

The distribution link has two parts: primary distribution and secondary distribution.

Secondary distribution might be in the PAL or SECAM standards, or might in the future be in digital form.

1.4. Reception

The material transmitted might be recorded on a consumer digital VCR using bit-rate reduction. This should also be taken into consideration in a test chain.

2. Aspects of performance to be verified during system development

The equipment under test must be able to operate satisfactorily when fed with the full range of signal characteristics and impairments likely to be found in a typical programme chain. Extremes of impairment are a special case and are normally dealt with by purpose-built equipment.

The equipment under test should not introduce any artefact or impairment likely to have an adverse effect on subsequent operations. Moreover, whenever testing is carried out on a section of the chain that may introduce processing visible or non-visible distortions, it is desirable to make a transparent recording of the resulting signals; the recording should be made available for subsequent tests made downstream.

Examples of the signal characteristics and impairments likely to be found in practice, and which may require special attention during the development of new equipment, are listed in the following sections.

2.1. Video

- Noise levels, varying as a function of picture content.
- Variable camera integration time (variations of only a few thousandths of a second may be important).
- Compression coding artefacts, depending on picture content (especially when cascaded).
- Sync/video timing instability (if the timing is outside the system specification, purpose-built measuring equipment is required).
- Long-term sync instability (hum).
- Reduction of luminance and/or chrominance band-width.
- Changes of quantization levels and distortions due to multiple analogue/digital conversions.

2.2. Cascading of motion compensation

It is anticipated that the recent availability of motion-compensated standards converters, slow-motion machines and motion-compensated video compression codecs and noise reduction equipment may cause problems. Motion compensation can never be perfect and is likely to introduce artefacts. These artefacts, although subjectively acceptable, may influence the accuracy of motion estimation or the effectiveness of compression coding at later points in the programme chain. Developers of such equipment should consider the use of test sequences embodying impairments and artefacts from earlier motion-compensated processes. They should also bear in mind the possible effects of their equipment on subsequent operations.

2.3. Cascading of video/audio compression

Where video or audio compression operations are likely to be cascaded, (for example, in post-production operations or when receiving a previously-coded programme contribution), there is a strong possibility of interaction.

Developers of video and audio coding systems should include test sequences that have been subjected to previous compression coding and decoding operations among the source material used for system

development/optimisation. They should also consider cascading their own system with itself, particularly if it is intended for use in multi-generation post-production operations. A typical range of processing operations should be applied between generations, to explore the operational conditions likely to be found in practice.

Particular areas of concern are changes of sample rate, and changes in quantization levels between generations.

2.4. Standards conversion

Standards converters are required to operate on signals over which the user has little control; often, the user will not know of the processes that the signal has undergone. The output signal from the convertor will inevitably contain a measure of motion judder, or related artefacts, which could have a detrimental effect on subsequent operations.

Standards converter developers should consider the full range of input impairments likely to be found in the current and future broadcasting environments, and choose test sequences accordingly. They should also bear in mind, and attempt to minimise, the potential effects of their output signal characteristics on subsequent processes.

2.5. Colorimetry / gamma / luminance equations

The subject of colorimetry, gamma and luminance is currently under study in EBU Specialist Group G/COL. The principal problems for the future are concerned with:

- interchangeability of signals originated in the proposed new systems and conventional television;
- the imminent availability of displays which do not use cathode-ray tubes and which have different transfer characteristics and (possibly) different phosphor chromaticities;
- the instrumental complexity of performing accurate colour matrixing, requiring inverse gamma correction, in consumer flat-panel displays;
- the loss of luminance detail in saturated coloured areas caused by bandwidth limitation of colour-difference signals.

2.6. Synchronization of sound and vision

Recommended limits for the relative timing of the sound and vision components of a television signal are given in EBU Technical Recommendation R37 [1], although further studies on this subject are in progress in EBU Sub-group G1.

3. Verification in a skeleton test chain

It is recommended that individual parts of the programme chain are verified for satisfactory operation by incorporation, where feasible, into a skeleton test programme chain. An example of a minimal skeleton test chain is given in Fig. 1.

The skeleton test chain for standard definition television systems should generally include a 34 Mbit/s contribution codec, more than one generation of videotape recording or other form of storage, typical post-production operations such as picture manipulation and slow motion, MPEG-2 and composite transmission codecs (in parallel, not cascaded), domestic VCR recording and domestic display.

Additional test conditions may be relevant under certain circumstances; examples are MPEG contribution coding for SNG, cascading of compression coding for primary and secondary distribution, transcoding or domestic VCR recording, and archive retrieval from current and past formats.

4. Test sequences for simulation / development purposes

The development and optimisation of new systems should be conducted using test sequences with as wide a range of image/sound content as possible. The test sequences should also include sequences embodying the impairments commonly found in a typical programme chain and include examples of other processing operations likely to prove troublesome. In order to avoid the optimisation of a system for a particular sub-set of test sequences, the sequences should be changed for a new set periodically throughout the development/optimisation process.

Following optimisation by computer simulation it is essential to implement the system in real-time, for verification of satisfactory operation with a wide selection of test material.

The EBU Library of video sequences [2] contains still and moving picture sequences which will be appropriate in many cases, although the range of material should be extended to include a certain number of natural and computer-generated sequences.

Bibliography

- [1] EBU Technical Recommendation R37-1997: **The relative timing of the sound and vision components of a television signal**
 - [2] **EBU Library of video sequences** (D-1 format videotape) EBU, Geneva, 1994.
 - [3] ITU-R Question 225/11: **Overall co-ordination of the technical characteristics and associated test methods for the separate parts of the television signal chain**
-