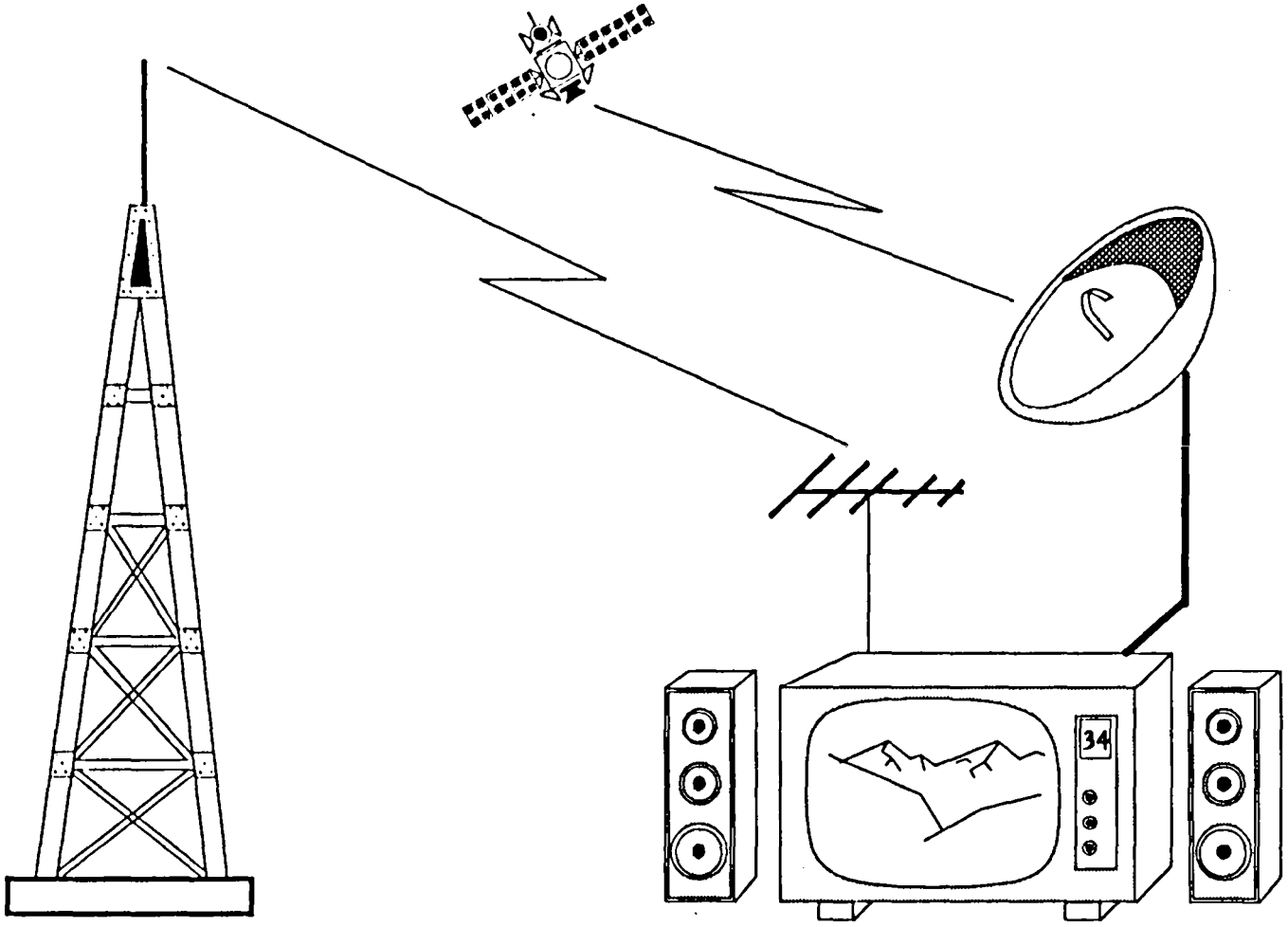
INTERNATIONAL TELECOMMUNICATION UNION

1992 - CCIR RECOMMENDATIONS

(New and revised as of 15 September 1992)



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Recommendation 797 (1992)

Parameters for wide aspect and 4:3 enhanced television systems that are NTSC compatible

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RECOMMENDATION 797

PARAMETERS FOR WIDE ASPECT AND 4:3 ENHANCED TELEVISION SYSTEMS THAT ARE NTSC-COMPATIBLE

(Question 42/11)

(1992)

The CCIR,

considering

a) that new digital technology offers storage, filtering and processing capabilities that will permit separate scanning standards for the picture source, emission and in the display;

b) that in Japan a 4:3 NTSC-compatible enhanced television system, CLEARVISION, has been operational since the end of August 1989 (see Annex 2, § 3);

c) that in Canada and the United States of America studies are underway on advanced television systems (see Annex 2);

d) that the development of high-definition television with an aspect ratio of 16:9 has increased the availability of wide aspect ratio source material;

e) that there is considerable interest in the ways of using wide aspect ratio formats for 4:3 enhanced and conventional television systems,

recommends

that the parameters for an enhanced 4:3 NTSC system in Japan should be those defined in Annex 1.

ANNEX 1

In principle, the parameters of an enhanced 4:3 NTSC system should be fully compatible with the existing television system. For enhancement of picture quality, the following methods could be used.

At the studio side:

- an enhancement of the resolution: higher resolution signal sources;
- an enhancement of the chrominance signal: pre-compensation of detail in highly saturated colour pictures which are specified in Appendix 1 to Annex 1;
- an enhancement of the luminance signal: adaptive emphasis of high-frequency components which are specified in Appendix 1 to Annex 1;

At the emission side:

- a reduction of the ghost interference: insertion of ghost-cancelling reference signals.

At the receiver side, it could be applicable to enhance the picture quality:

- progressive scanning display and/or three dimensional *Y/C* separation filter and the ghost-cancellation circuit.

APPENDIX 1
TO ANNEX 1

Pre-compensation of chrominance
(Quasi-constant luminance processing)

The chrominance signal is enhanced as follows:

- the red signal before pre-gamma compensation with an amplitude of 50% plus 20% sub-carrier level is used as a reference;
- a pre-compensation of 2 dB for 50% saturated red signal and of 10 dB for 100% saturated red signal is used.

The saturation level for red signal is specified as follows:

$$(C - K/C) \times 100\%$$

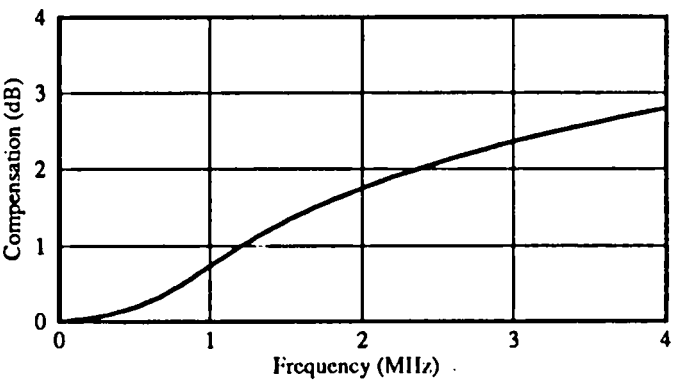
where:

C: red signal voltage amplitude

K: green and blue signal amplitude.

Adaptive emphasis

The following emphasis curve is applied to enhance the luminance signal. "0" frequency means under 0.5 MHz.



Time constant: 100 ns

ANNEX 2

Factors affecting the choice of parameter values for enhanced NTSC-compatible television for terrestrial broadcasting

1. Introduction

Since the development of electronic television, the art has experienced a continuous evolutionary development which has produced a stream of improvements in the quality of pictures displayed to the viewer. A quantum step in quality occurred with the introduction of colour. New digital technology now offers storage, filtering and processing capabilities that will permit separate scanning standards for the picture source, emission and in the display, thereby providing increased quality through conventional television systems. New distribution media having wider bandwidth, such as broadcasting satellites, will permit new services with increased definition and wider aspect ratios.

Television pictures wider than the conventional 4:3 aspect ratio have been available for many years through the medium of cinematographic film. However, the development of high-definition television with an aspect ratio of 16:9 has increased the availability of wide aspect ratio source material and has led to the development of wide aspect ratio television displays. There is therefore considerable current interest in ways of using wide aspect ratio formats for 4:3 enhanced and conventional television systems.

2. Definition of terms

The term enhanced NTSC television designates a number of different improvements applicable to 525/60 television systems, providing an aspect ratio of 4:3 or wider, either with unchanged or with new emission standards.

The term enhanced television is used here to include all television systems (from source to display) not covered by Recommendation 470 (Conventional television systems). It is noted that the signal format may change at different parts of the signal chain.

Enhanced NTSC television systems may be classified according to the following parameters:

- aspect ratio: either normal aspect ratio (4:3) or wider aspect ratio (for example, 16:9),
- signal format: composite based on NTSC.

It should be noted that there exists no clear definition of some of the terms widely used in the description of enhanced television systems. For example:

- *Compatibility:* various degrees of compatibility are possible. These range from full compatibility with existing systems, through systems that share the same scanning formats, to systems that have no direct compatibility with existing systems. The compatibility can also apply only to parts of the system, for example, receiver compatibility.
- *Resolution:* enhanced television systems do not necessarily imply the provision of increased resolution; in some circumstances the resolution may be reduced as a result of other enhancements, such as provision of a wider aspect ratio.

3. Enhancements for 4:3 NTSC

Enhancements to conventional television systems are expected to be introduced in the areas listed below, all of which will contribute, in a varying degree, to improving the overall quality of the received television picture:

- alias effects generated by the scanning process;
- luminance/colour difference cross-effects;
- signal processing capability;
- generation of moiré and non-linear signal distortion in video tape recorders;
- immunity to transmission impairments;
- receiver decoding and display techniques.

The composite signal format NTSC suffers from noticeable signal impairment due to cross colour and cross luminance. Significant quality improvements can be achieved by the use of multi-dimension separation filters based on line stores or frame stores. Complementary pre-filtering of the video before colour encoding can further improve picture quality.

When appropriate filtering is applied ahead of the display, further improvements in the effective vertical resolution can be achieved by filtering at the source. The so-called Kell effect, that results from the excess Nyquist margin in the vertical sampling (scanning) of the image that must be allowed at the camera to avoid aliasing, reduces the effective vertical resolution of a television system.

Work has been reported in numerous publications in the United States of America, Japan and in other countries on investigations to devise enhancements to the composite NTSC system.

In Japan an NTSC-compatible enhanced television system, known as CLEARVISION has been operational since the end of August 1989. The new system includes hardware for five key techniques: higher resolution signal sources, pre-compensation of detail in highly saturated colour pictures, adaptive emphasis of high frequency components in the luminance signal, insertion of a ghost-cancelling reference (GCR) signal for ghost reduction in television receivers and receivers with 525-line progressive display and three dimensional *Y/C* separation filters. Subjective tests using 18 still pictures showed an improvement of about 1.5 grades on the CCIR 7-point comparison scale. Ghost interference, evaluated as grade 2.5 on a 5-point impairment scale, was improved to better than grade 4 at most of the locations tested.

4. Enhancements for wide aspect NTSC

In Japan, the study of a second generation NTSC-compatible enhanced television system began in August 1989. The target features of this system are wider aspect ratio, increased horizontal and vertical picture resolution and higher fidelity PCM sound.

In spring, 1991, the EDTV Committee of the Telecommunications Technology Council in principle agreed on an aspect ratio of approximately 16:9 for a second generation system. A development schedule target was also set down, giving impetus to investigations within the Broadcasting Technology Association. When considering the compatibility of the system, a point of high interest is how to display a wide aspect picture on existing 4:3 aspect ratio receivers. Surveys and evaluation experiments whereby wide aspect pictures were actually shown on such receivers have been conducted with the results to be announced in the near future.

In the United States of America, the Federal Communications Commission (FCC) Advisory Committee on Advanced Television Service (ACATS) is considering the Advanced Compatible Television (ACTV) as part of its evaluation of advanced television formats. ACTV is a single-channel (6 MHz) NTSC-compatible system developed for advanced television broadcasting.

ACTV is an enhancement of NTSC providing a 16:9 aspect ratio, a 30% improvement in horizontal resolution, progressive scanning, and digital sound.

ACTV provides digital stereo sound channel in addition to the standard NTSC compatible sound channel.

A complete description of the proposal on ACTV by the Advanced Television Research Consortium (ATRC) was submitted to the ACATS on 2 January 1991, and entitled "System Description – Advanced Compatible Television".

There are three methods which can be used to display wide aspect picture on 4:3 display, i.e., the side panel format, the letter-box format and the middle of these two.

The EDTV Committee of the Telecommunications Technology Council in Japan provisionally decided on the letter-box format to develop the enhanced wide aspect NTSC system. Possible reconsideration might happen according to world trends, etc.

In the United States of America, the side panel format is the general practice. ACTV applies with the side panel format with pan and scan.

5. Display enhancement

The availability of low-cost field stores in domestic receivers permits separation of the display scanning parameters from those of the emission standard. Cross-colour and cross-luminance in composite systems can be significantly reduced by luminance/chrominance separation filters using frame stores. An increase in the field frequency can eliminate large area flicker. An increase in the number of lines and the use of sequential scanning can significantly reduce the interline flicker and the line crawl that occur in conventional television systems.

In Japan, a scan-conversion system using a motion-adaptive spatio-temporal interpolation filter with receiver frame memory has been developed to reduce interlaced line-scanning impairments. It improves picture quality for both still and moving pictures.

In Japan, a multi-scan high definition 16:9 projection display has been developed to display HDTV, conventional television and other signals, such as the output of personal computers. A range of vertical scanning frequencies from 40 to 120 Hz is provided. Horizontal scanning frequencies from 15 to 70 kHz are possible. NTSC signals are displayed using a high-resolution scan converter, which doubles the number of NTSC scanning lines through motion-adaptive frame combing. A personal computer output can be superimposed onto the double-scanned NTSC signal, thus widening the applications of the display.

Production of television receivers with functions adapted to the CLEARVISION system such as "motion-adaptive three-dimensional *Y/C* separation" and "progressive scan display" has taken place since 1988, and several models of display sizes of 29 in (74 cm) to 37 in (94 cm) for CRT and 43 in (109 cm) to 120 in (305 cm) for projection type are being produced. Decoders for professional use adapted to CLEARVISION for large displays are also being placed on the market by manufacturers.

As for the ghost rejecting equipment for GCR signals, each of the receiver manufacturers is presently producing and selling their own tuner adapter containing the ghost cancelling function.

6. Ghost cancellation

It has long been recognized that multipath interference is a serious problem and that ghost cancellation could offer significant quality improvements to the existing television services.

A reference signal is inserted in the field blanking interval.

7. Future developments

In Japan, BTA established the methods required to provide the improvements for enhanced wide aspect NTSC at the beginning of 1992. Approximately one year later at the beginning of 1993, provisional specifications will be decided on, and indoor and outdoor experiments conducted. At the beginning of 1994, final specifications will be submitted to the EDTV Committee of the Telecommunications Technology Council. Actual applications of a second generation system will be expected to start in 1995.