HP1/85/60
COST211bis/HW2/85/3
CCITT SGXV/WPXV 1/Doc.#57
Date: January 1986

Title: Chrominance Sampling Parameters for n x 384Kbit/s Video Codec.

Source: Federal Republic of Germany, Netherlands, United Kingdom

1. Introduction

The third meeting in Turin of the Specialists Group on Coding for Visual Telephony adopted a format of 288 lines, 360 pels per line, 1:1 interlace and 29.97 pictures per second for the luminance component. Further study and contributions were requested for colour-difference signal parameters.

2. Chrominance Resolution

2.1 Table 1 of CCITT SGXV/WPXV 1/Doc.#54 lists candidates for colour-difference sampling densities ranging from 60 to 180 pels per line and 72 or 144 lines per picture. Section 3.3 of that document also states "Tape demonstrations related to Document #42 and #50 showed that all of the pictures in this range have no significant difference".

2.2 Document #50 concluded that at 384Kbit/s the use of 144 lines with either 180 samples per line orthogonal or 90 samples per line quincunx is appropriate for natural pictures. However, 90 samples per line with quincunx is less satisfactory for graphics-type pictures. Also the use of quincunx may have an adverse effect on the efficiency of transforms under consideration for the source coder.

2.3 Since it is likely that many users will be obliged to send any documents, diagrams etc through the moving picture coder, then it is desirable that the colour-difference sampling parameters are sufficient for that purpose rather than the less demanding "people pictures". Informal subjective tests by the UK indicate that for orthogonal sampling less than 144 lines and 180 pels per line for each colour-difference component is unsatisfactory in this respect.

2.4 It is therefore proposed that the following parameters apply to each of the colour-difference components of the Common Intermediate Format:

Active pels per line	180
Active lines per picture	144
Sampling structure	Orthogonal
Pictures per second	29.97
Interlace	1:1
Signal levels	as defined in CCIR Rec. 601

These values result in the total number of chrominance pels being 50% of the luminance ones. This resolution should be regarded as

the highest attainable by the moving picture coder when spatial resolution reduction is not invoked elsewhere in the coder, for example, as part of the bit-rate control strategy.

3. Positioning of Chrominance Samples

3.1 There are two questions to answer here:

(1) The phasing of the two colour-difference sampling grids with respect to each other.
(2) The phasing of colour-difference samples with respect to the luminance samples.

3.2 There are two approaches to consider:

(1) To align the chrominance pels with alternate luminance ones in an analogous manner, though extended to the vertical direction also, to the 4:2:2 structure of CCIR Rec. 601. This is illustrated in figure 1.

(2) To align block boundaries. One reason for doing so is to avoid the possible appearance of coloured fringes at block boundaries. Additionally, there is a higher probability of being able to utilise common block parameters (such as transmitted or not transmitted and motion vectors), at least for the two colour-difference signals, if the relevant blocks are exactly coincident. Because the chrominance sampling grids are coarser than the luminance one and a block edge falls midway between samples, the chrominance samples should not be situated at luminance sampling points. Note that this is independent of block sizes. This configuration is depicted in figure 2.

3.3 Both of these approaches lead to the answer to the first question above being that the two sets of colour-difference sampling points should be co-sited with respect to each other.

3.4 The only advantage of the pel-alignment approach is that it is closer to CCIR Rec 601. However, such an argument is weakened by the fact that the non-interlaced format is not a recognised member of the family of coding standards in that recommendation.

3.5 The block-alignment approach does not necessarily require additional hardware complexity. For analogue inputs, the horizontal positions can all be derived from a 13.5MHz clock. For digital inputs conforming to the 4:2:2 member of CCIR Rec. 601 the horizontal filter and downsampling process can introduce the required offsets between luminance and chrominance. In the vertical direction the low-pass filters in the chrominance channels can incorporate the necessary shift to place the chrominance lines mid-way between luminance lines.

3.6 The block-alignment approach offers the possibilities of less artefacts and some coding gain over the pel-alignment alternative. Therefore it is proposed that the phasing of the colour-difference samples be such as to give alignment of chrominance block edges with luminance ones, that is, the scheme of figure 2.

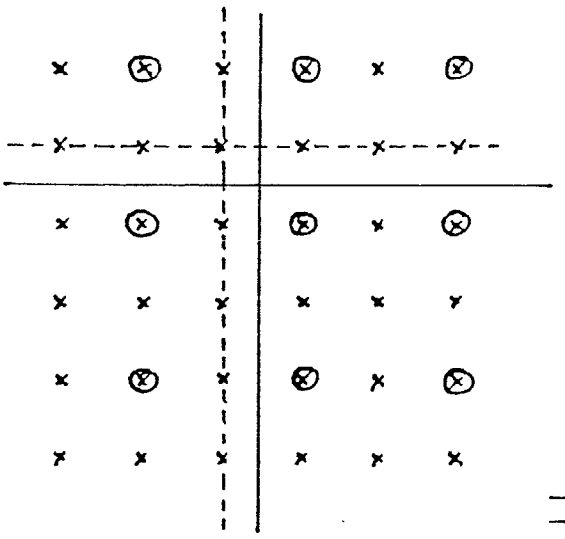

FIG. 1

× LUMINANCE SAMPLE

o CHROMINANCE SAMPLE

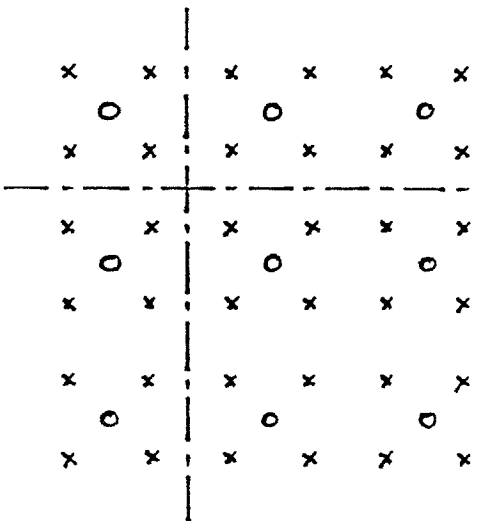

FIG. 2