FINAL DRAFT

EUROPEAN TELECOMMUNICATION STANDARD

pr **ETS 300 142**

April 1998

Source: NA

Reference: DE/NA-051108

ICS: 33.020

Key words: Multichannel, codec, teleservice, ISDN, video

Integrated Services Digital Network (ISDN) and other digital telecommunications networks; Line transmission of non-telephone signals; Video codec for audiovisual services at p x 64 kbit/s

[ITU-T Recommendation H.261 (1993), modified]

ETSI

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Foreword

This final draft European Telecommunication Standard (ETS) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Voting phase of the ETSI standards approval procedure.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

Endorsement notice

The text of ITU-T Recommendation H.261 (1993) was approved by ETSI as an ETS with agreed modifications as given below.

Page 1

Replace the scope clause with the following two clauses (scope and normative references):

1 Scope

This ETS describes the video coding and decoding methods for the moving picture component of audiovisual services at the rates of p x 64 kbit/s, where p is in the range 1 to 30.

The standard includes conformance test specifications.

Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendments or revision. For undated references the latest edition of the publication referred to applies.

[1] ITU-T Recommendation H.120: "Codecs for videoconferencing using primary digital group transmission".

[2] ITU-T Recommendation H.200: "Framework for Recommendations for audiovisual services".

[3] ITU-T Recommendation H.221: "Frame structure for a 64 to 1 920 kbit/s channel in audiovisual teleservices".

[4] ITU-T Recommendation H.230: "Frame-synchronous control and indication signals for audiovisual systems".

[5] ITU-T Recommendation H.242: "System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s".

[6] ITU-T Recommendation T.81: "Information technology - Digital compression and coding of continuous-tone still images - Requirements and guidelines".

Page 19, subclause 5.2, second and third paragraphs

When operating with CIF the number of bits created by coding any single picture shall not exceed 256 kbits (K = 1 024).

When operating with QCIF the number of bits created by coding any single picture shall not exceed 64 kbits (K = 1 024).

Page 25, clause D.5, third bullet

- the maximum number of bits allowed per frame (sub-image) should not be exceeded (256 kbit/s for CIF and 64 kbit/s for QCIF, where K is equal to 1 024);

Addition of annex ZA

Add a new annex ZA as follows:

Annex ZA (normative): Conformance testing of ITU-T Recommendation H.261 (March 1993)

ZA.1 General principles adopted for the ITU-T Recommendation H.261 conformance tests

1) The conformance test should aim to test for compliance to the respective ETS to the extent which it is necessary to ensure compatible interworking of different suppliers equipment.

2) The only inputs and outputs of the equipment under test in the conformance verification are those normally provided to the user and the test shall not rely on directly accessing additional internal test modes in the equipment.

3) The specification is constrained to only testing the ITU-T Recommendation H.261 bitstream which can be assumed to have been correctly isolated from the ITU-T Recommendation H.221 framing, audio, etc.

4) The tests should be constructed to allow for devices which only have visual inputs and outputs (e.g. a video phone). The existence of composite (or other) electrical interfaces cannot be assumed.

5) If electrical video inputs and outputs do exist (e.g. composite interfaces) then they should be fully tested in respect of transmitted/received active picture area, etc.

6) The testing of decoders is likely to be more exhaustive than testing of the encoders due to the fact that decoders will always have a digital channel input. Assuming that the encoder and decoder of the same manufacturer perform well together, then advantages will be taken of sophisticated decoder tests. An indication of the correct behaviour of the decoder, will likely implicate that the complementary part in the encoder is correct as well.

7) Examples of input sequences (video stimulus etc.) will be given as annexes to the conformance specification. These examples will be given to aid the construction of conformance test suites. Tests will not be constrained to only using these examples.

Table ZA.1: List of tests

	Items	Encoder	Decoder
1	Video levels	E	D
2	Geometrical distortion	E	
3	Frame rates	E	D
4	QCIF support	E	D
5	Valid motion vectors	E	D
6	Loop filter		D
7	Inverse DCT		D
8	Clipping		D
9	Forced updating	E	
10	Video multiplex	E	
11	Video demultiplex		D
12	Scanning order		D
13	Freeze picture		D
14	Fast update request	E	
15	Maximum Bits per picture	E	D
16	Error correction	E	D
17	FEC stuffing (optional)	E	D
18	Arithmetic loop conformance		D
19	HRD compliance	E	D
20	Extra Insertion Information	E	D

ZA.2 Description of tests

ZA.2.1 Video levels (ITU-T Recommendation H.261 § 3.1)

PURPOSE:

As the way to produce digital input signals is not a part of ITU-T Recommendation H.261, the only purpose of this test is to verify that the encoder supports input values from 1 to 254 for luminance and the two colour difference components. This test can only be performed when digital I/O are available.

A complete test of the video levels should take place in a complete system quality conformance (black level/white level/linearity).

ZA.2.1.1 Encoder

METHOD:

Connect a digital source pattern which contains all the permitted values to the encoder under test and connect the output of the encoder under test to the reference decoder.

RESULTS:

Check the pictures decoded with the reference decoder. Inputs from black to white shall imply outputs to black to white.

ZA.2.1.2 Decoder

METHOD:

Encode the same digital source pattern with the reference encoder and decode the produced bitstream with the decoder under test. Digital source pattern: uniform picture with programmable values Y, CB and CR from 1 to 254.

RESULTS:

Check the pictures decoded with the decoder under test. Pattern values corresponding to black to white shall imply outputs to black to white. Value 128 shall give grey picture.

ZA.2.2 Geometrical Distortion (ITU-T Recommendation H.261 § 3.1)

ZA.2.2.1 Encoder

PURPOSE:

A CIF encoder shall take luminance and colour difference samples in accordance with the requirements of ITU-T Recommendation H.261, § 3.2 and shall maintain an aspect ratio of 4:3. The purpose of this test is to verify that sampling and aspect ratio.

METHOD:

If the encoder under test is capable of operating at CIF, then, with the encoder operating at that resolution, provide an image containing a square, circle and cross all centred on the centre of the image (see figure ZA.1). Connect the output of the encoder under test to the reference decoder.

RESULT:

Check the pictures decoded with the reference decoder. Verify that there has been no geometrical distortion of the image.

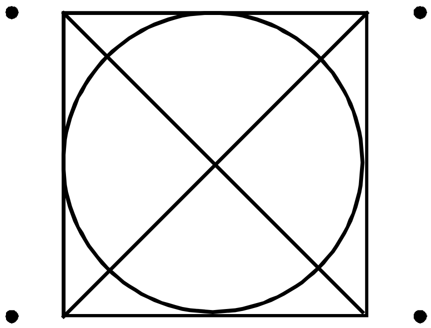

Figure ZA.1

ZA.2.3 Frame rates (ITU-T Recommendation H.261 § 3.1)

ZA.2.3.1 Encoder

PURPOSE:

An encoder shall control its output bitstream to comply with the requirements of the Hypothetical Reference Decoder (HRD) defined in ITU-T Recommendation H.261, annex B.

In ITU-T Recommendation H.261, § 3.1 is stated: *"Means shall be provided to restrict the maximum picture rate of encoders by having at least 0, 1, 2 or 3 non-transmitted pictures between transmitted ones. Selection of this minimum number and CIF or QCIF shall be by external means (for example via ITU-T Recommendation H.221)"*.

The purpose of the test is to verify that an encoder never sends more pictures per second than signalled by the decoder.

METHOD:

At the encoder provide an image sequence which contains the following, low detail stills, long periods of high motion, panning, zooming, scene cuts, and high detail stills. The output bitstream (ITU-T Recommendation H.261 part) is stored for off-line analysis. A minimum of 55 minutes of picture date should be stored.

NOTE: To reduce storage requirements the following could be stored instead:

- accurate time stamps for the Picture Start Codes (PSCs);
- temporal reference count;
- the number of bits between each PSC.

All allowable bit rates which are within the encoders declared range should be tested.

Input this video sequence to an encoder. Signal to the encoder the decoder capabilities of 0, 1, 2, 3 non transmitted pictures between transmitted ones. Supervise the Temporal Reference in the picture layer. Supervise the hypothetical buffer verifier. Perform the test for QCIF and CIF (if the encoder claims to encode also CIF).

RESULTS:

An encoder can only be said to be compliant if the mean rate of Picture Start Codes is 29,97 Hz ± 50 ppm and it satisfies the HRD.

a) The exchange of decoder capabilities (ITU-T Recommendations H.221 and H.242) results in allowed values for the Temporal Reference (TR) in the picture layer.

   The allowed maximum encoder picture rate is (29,97 Hz ± 50 ppm) / (n+1); n = 0, 1, 2, 3.

   Then the corresponding modulo 32 difference between an actual TR and the TR of the last encoded picture can have all integer values between n+1, n+2, ... 31.

b) In all cases the buffer of the Hypothetical Reference Decoder (ITU-T Recommendation H.261, annex B) shall not overflow (the data stream shall conform to the hypothetical buffer verifier).

EXAMPLE: Signalled is n = 2; then the maximum allowed picture rate is 29,97 Hz divided by 3 (approximately 10 Hz). The modulo 32 difference between an actual TR and the TR of the last received picture can have all values between 3 and 31.

ZA.2.3.2 Decoder

PURPOSE:

Purpose of the test is to verify that a decoder which claims to have capability to decode sequences with encoded picture rates of:

(29,97 Hz ± 50 ppm) / (n+1); n = 0, 1, 2, 3

really does it for all picture material.

METHOD:

Input a data stream conforming to ITU-T Recommendation H.261 describing a video sequence (as the one used in subclause ZA.2.3.1) to a decoder at the lowest claimed value of n for at least 55 minutes. Care should be taken to ensure the data stream describes a sequence encoded at the claimed value of n (i.e. there is no picture dropping).

RESULTS:

The decoded pictures should be the same as on the reference decoder.

EXAMPLE: Most critical should be, e.g. the following sequence:

- a synthetic picture sequence consisting of pictures with diagonal stripes (high saturation, diagonal frequency corresponding to approx. 1 MHz), the stripes being unmoved for some time and then being moved with 1 pel per encoded frame both horizontally and vertically.

ZA.2.4 QCIF Support (ITU-T Recommendation H.261 § 3.1)

PURPOSE:

The ITU-T Recommendation H.261 indicates that two formats are allowed as input to the video coder: the Common Intermediate Format (CIF) and another format known as Quarter-CIF (QCIF) having half the number of pel and half the number of lines of the former. In the first format (CIF), the luminance sampling structure is 352 pels per line, 288 lines per picture in an orthogonal arrangement. Sampling of each of the two colour difference components is at 144 lines, 176 pixels per line, orthogonal.

ITU-T Recommendation H.261 also specifies that the picture area covered by this number of pixels and lines has an aspect ratio of 4:3. In addition ITU-T Recommendation H.261 also states that all codecs shall be able to operate using QCIF. This statement prevents the possibility for an encoder to always transmit the entire picture in the CIF form at and leaving to a decoder, only able to operate on QCIF, the task of selecting from the video stream the portion corresponding to its need. From this consideration the need arises of testing the QCIF support for both encoder and decoder. In fact when an encoder operates with the QCIF format the decoder shall be able to show a correct picture and conversely if a decoder is only supporting the QCIF the encoder shall be able to transmit a coded bitstream containing only the information related to a QCIF picture.

ZA.2.4.1 Encoder

METHOD:

The encoder is set in QCIF mode and the video encoder output is connected to a testing system implementing a reference decoder (either real time or not) enriched by the capability of analysing the bitstream at the Group Of Block (GOB) layer and at the picture layer. Bit 4 of the type information in the picture layer (PTYPE) may only have the value of 0. The range of permitted values for the Group Number (GN) is limited to 1,3,5. Other values of PTYPE or GN are not allowed.

Other features of the coded and displayed images shall be checked through the conformance testing involving the active picture area and the block structure.

RESULTS:

If analyzing the values of the GN contained in the coded bitstream, the presence of values different from 1,3 or 5 is detected, this certainly reveals a non correct coding of the QCIF picture.

If the image obtained by a reference decoder which is decoding any image coming from the coder under test, doesn't appear as a rectangle and/or it doesn't have an aspect ratio of 4:3, this again emphasizes that the encoder is not correctly handling the QCIF picture.

ZA.2.4.2 Decoder

METHOD:

A suitable test pattern (e.g. a regular sequence of black MBs interlaced with white MBs), exactly covering an entire QCIF image, is transmitted by a reference encoder or by a test pattern generator to the decoder under test and a visual verification is performed.

The verification concerns the MBs which have been reconstructed. Their number shall exactly correspond to the number of MBs contained in a QCIF picture, while concerning content and position of each MB reference should be made to tests of those specific topics.

RESULTS:

The regular pattern transmitted by the reference encoder shall be reconstructed by the decoder under test with the same number of MBs (11 MBs per line, 9 MBs per row) forming a rectangle having an aspect ratio of 4:3.

ZA.2.5 Valid motion vectors (ITU-T Recommendation H.261 § 3.2.2)

ZA.2.5.1 Encoder

PURPOSE:

Differential motion vector test.

METHOD:

Input a sequence with increasing motion from left to right within GOB's.

RESULTS:

The MV's resulting from the differential MV's should not exceed ± 15.

PURPOSE:

The motion estimation/motion vector range of the encoder.

METHOD:

The test input should include test of all 4 directions, that is a white macro-block moving on a dark background should enter and leave through the left, right, top and bottom edge of the picture. A criteria for when a vector is pointing outside the picture can be as follows:

- monitor the produced bitstream and extract the motion vectors, summing differential values to obtain absolute vectors. Eight different restrictions applies to vector magnitudes depending on which MB the vector belongs to, see figure ZA.2.

5	3	6
1	0	2
7	4	8

1: All MB along picture left edge
2: All MB along picture right edge
3: All MB along picture top edge
4: All MB along picture bottom edge
5: Top left corner MB
6: Top right corner MB
7: Bottom left corner MB
8: Bottom right corner MB
0: All other, no restrictions

Restrictions:

1: $x \geq 0$	5: $x \geq 0$, $y \geq 0$
2: $x \leq 0$	6: $x \leq 0$, $y \geq 0$
3: $y \geq 0$	7: $x \geq 0$, $y \leq 0$
4: $y \leq 0$	8: $x \leq 0$, $y \leq 0$

Figure ZA.2

RESULTS:

The motion estimater should never produce vectors pointing outside the active pixel area. Fail test if pels are referenced outside the coded picture area.

PURPOSE:

Check reset of MV's:

The motion vector data that is transmitted is a differential vector except for three cases:

- mb 1, 12 and 23;
- MBA is not equal to 1. For the first transmitted macro block in GOB the Macro Block Address (MBA) is an absolute address. For subsequent MB's it is a differential address;
- MTYPE of the previous block was not MC.

The purpose of the test is to verify this reset in the encoder motion vector data range which is between +15 and -15.

METHOD:

Input several sequences and monitor the output bitstream.

RESULTS:

Fail test if a vector exceeds +15 or -15 for any macro block which mb = 1, 12 or 23, MBA not equal to 1 or MTYPE the previous macro block was not MC.

ZA.2.5.2 Decoder

PURPOSE:

Decoder motion vector range.

METHOD:

Move (a part of) a scene around by supplying motion vectors, no transform coefficients and filter off to the decoder. For both components of the motion vector, values of -15, 0 and +15 should be used, giving 8 possible combinations/directions.

RESULTS:

The moved part of the scene should stay intact.

PURPOSE:

Decoder loop test: motion compensation.

METHOD:

Input a bitstream representing a frame with two grey blocks on a black background; then move these blocks around using motion vectors, no coefficients and filter off such that they overlap exactly after a number of movements.

RESULTS:

If the blocks match exactly, the motion compensation is said to pass.

PURPOSE:

Decoder loop test: motion compensation reset of differential MV's.

METHOD:

Input a bitstream representing a test pattern. Then input a bitstream with critical conditions for the reset of the differential motion vectors.

The motion vector data that is transmitted is a differential vector except for three cases:

- mb 1, 12 and 23;
- MBA is not equal to 1. For the first transmitted macro block in GOB the Macro Block Address (MBA) is an absolute address. For subsequent MB's it is a differential address;
- MTYPE of the previous block was not MC.

The purpose of the test is to verify this reset in the decoder motion vector data range which is between +15 and -15.

RESULTS:

The test pattern should stay intact.

ZA.2.6 Loop filter (ITU-T Recommendation H.261 § 3.2.3)

ZA.2.6.1 Decoder

PURPOSE:

The loop filter is part of the prediction of the hybrid coding scheme specified in ITU-T Recommendation H.261. It can be applied to all inter-MC MBs regardless of the value of the motion vector and is controlled on a MB basis by the MB type "MTYPE". For conformance testing the following items should be checked:

- controllability of the filter on MB basis;
- characteristic of the two-dimensional filter;
- precision of the arithmetic of the filter.

REMARK:

The only interfaces available at all ITU-T Recommendation H.261 video decoders are the line interface and the monitor for displaying the received and decoded pictures. Methods for testing the conformance to ITU-T Recommendation H.261 shall make use of these two interfaces. A compensation method with visible results is proposed for the test of the loop filter. This method shows the controllability and the principal characteristic of the filter but is not able to provide exact information about the precision of the arithmetic of the filter.

The principal process for testing the loop filter in the decoder is demonstrated with a single block. The method can easily be adapted to the real needs of a conformance test.

METHOD:

The test of the filter starts with the decoding of a intra-coded block comprising only a DC value and one big AC coefficient in the middle horizontal frequency region (see figure ZA.3).

RESULTS:

This results in a basic picture of the IDCT showing a vertical wave, clearly visible on the screen of the monitor (see figure ZA.4).

METHOD:

In the next step this block is processed by the filter in the loop signalling a MB type INTER+MC+FILTER (TCOEFF = O; MV = O,O). The block is modified only by the filter in the loop.

RESULTS:

The lights and darks of the wave are dimmed, the block becomes more grey (see figure ZA.5).

METHOD:

This dimmed wave is suppressed by an opposite coded block in the following step. Therefore, all pixel values of the dimmed wave are calculated and the discrete cosine transform is performed on it. Inverting the signs of all AC-coefficients results in an inverse pattern (see figures ZA.6 and ZA.7).

The inverse AC-pattern is provided to the decoder as an INTER-coded block.

RESULTS:

The result of the decoding of the inverse AC-pattern and the addition to the predicted block is a grey block without any visible pattern. The structure of the predicted block has been compensated by the opposite structure of an inter-coded block, which incorporates the effect of the filter process of the filter in the loop (see figure ZA.8).

Filters violating the standard will result in a visible pattern because of the non complete compensation by the "inverse" block.

This described the principal method for testing single elements of the decoding loop. More complex block patterns can be used for gaining more significant results.

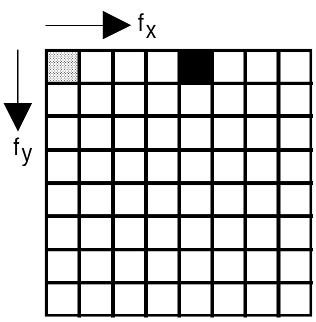

figure ZA.3

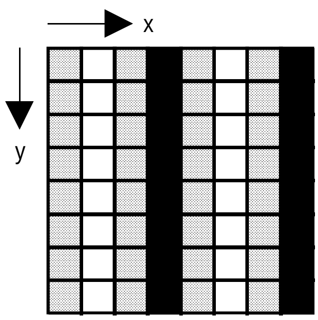

figure ZA.4

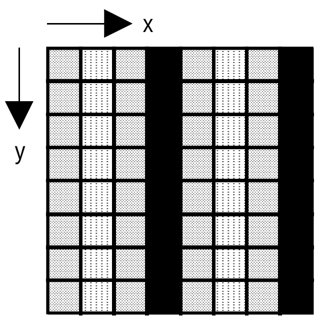

figure ZA.5

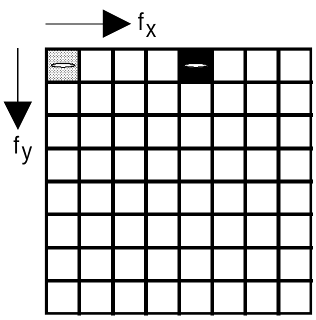

figure ZA.6

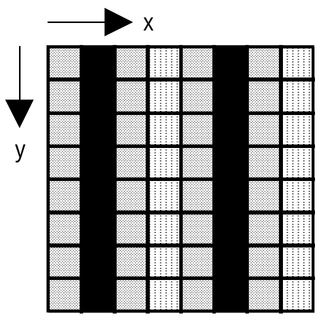

figure ZA.7

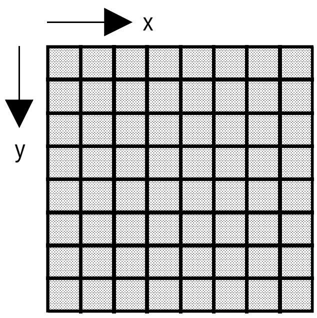

figure ZA.8

ZA.2.7 Inverse DCT (ITU-T Recommendation H.261 § 3.2.4)

ZA.2.7.1 Decoder

PURPOSE:

ITU-T Recommendation H.261 specifies the usage of an 8 x 8 inverse DCT for the transformation of the transmitted coefficients into the spatial domain.

The purpose of this test is to ensure that an 8 x 8 inverse DCT is used for processing the transmitted coefficients. This test is closely related to the test of the loop filter performance and the IDCT mismatch.

METHOD:

The test involves a coded bitstream according to ITU-T Recommendation H.261 as stimulus and the decoded and displayed picture as measure. Only rough estimations about the compliance can be obtained.

For getting visible results with good confidence the basic pattern of an IDCT produced by a particular coefficient can be applied. Each basic pattern shows the picture produced by one of the 64 coefficient of the IDCT; this test being performed using intra mode.

RESULTS:

The 64 basic patterns of the tested IDCT are visually compared with the result of a reference IDCT. The pictures of the tested device and the reference should be looking similarly though differences might be caused by the optional post processing and the display.

ZA.2.8 Clipping (ITU-T Recommendation H.261 § 3.2.6)

ZA.2.8.1 Decoder

PURPOSE:

Check that in the decoder loop a clipping function is applied to the reconstructed pictures.

METHOD:

A test bitstream is sent to the decoder under test.

The bitstream contains a saturated green (respectively purple) uniform picture encoded in INTRA mode, which DC = 00000001 (respectively DC = 1111 1110), followed by several frames encoded in INTER mode in which the DC component is equal to a programmable negative (respectively positive) value.

RESULTS:

The decoded pictures shall always be saturated normally-green (respectively normally-purple). (Else: error message: no valid clipping).

ZA.2.9 Forced updating (ITU-T Recommendation H.261 § 3.4)

ZA.2.9.1 Encoder

PURPOSE:

ITU-T Recommendation H.261 specifies that a MB should be forcibly updated at least once per every 132 times it is transmitted, in order to control the accumulation of the inverse transform mismatch error. This function is achieved by forcing the use of the INTRA mode of the coding algorithm.

An easy and convenient way by which the updating can be implemented is through the use of a regular pattern of intra coded MBs, but it is also possible to use a free scheme taking into account the specific need of each MB. Consequently, the recommendation does not define any particular update pattern.

The aim of this conformance testing is to verify that the encoder satisfies this request of updating. Several possibilities exist on how to get information on this encoder capability. In the following a method using an off-line analysis of the bitstream will be described.

METHOD:

The application of this method is constrained by the recording capability of the testing system. If the analysis of a longer bitstream is needed, real time testing is required.

The starting point for this analysis is the availability of the ITU-T Recommendation H.261 bitstream alone either directly provided by the encoder or obtained from a protocol tester applied to the ITU-T Recommendation H.221 output of the encoder under test.

Moving input material, like a panning sequence, should be analysed to ensure the occurrence of the event of updating for each MB. This output from the encoder shall be recorded (e.g. on a PC hard disk) and later used as input to a software programme performing the actions described hereafter:

- a byte variable is assigned to each Macro Block (MB) (396 for CIF image format or 99 for QCIF) and at the start these variables are initialized to zero in order to be used afterwards as counters;
- a Boolean variable for each MB is initialized to FALSE and it will be used to have an indication about the test significance;
- the bitstream is parsed identifying the header of each transmitted MB. For each one of them an index referring to the counters is assigned derived from the value of the Group Number (GN) and from the value of the Macro Block Address (MBA). This index ranges from 1 to 396 for CIF pictures and from 1 to 99 for QCIF pictures;
- for each MB the associated MTYPE information is also extracted;
- each time MTYPE is INTRA the counter corresponding to the MB is reset, and the associated Boolean variable becomes TRUE;
- otherwise the value of the counter is incremented by one and afterwards the counter value is compared to 132; if a value greater or equal to 132 is detected an error flag is set;
- this sequence of operations is performed until the bitstream has been completely parsed.

RESULTS:

The pass condition is obtained when no error flags have been set during the parsing of the whole bitstream. On the contrary if an error message has been produced, this means that a MB has been inter frame transmitted (even just motion compensated) for more than 132 times without the requested refresh.

At the end of the test the Boolean variables shall be checked and all of them shall have the TRUE value. In the other case, this means that at least one MB has been transmitted less than 132 times. This cannot be the case if a regular updating pattern is used, for in this case it is sufficient to consider a sequence of more 132 frames to avoid this condition. If the regular pattern has not been used, two cases are possible: in the first one the testing process could not be considering a long enough sequence, in the second one it could be a problem involving a different kind of test, in particular the one concerning the active picture area.

ZA.2.10 Video multiplex (ITU-T Recommendation H.261 § 4.2)

ZA.2.10.1 Encoder

PURPOSE:

The video multiplex is arranged in a hierarchical structure with four layers, which are called from top to bottom: picture layer, Group of Block (GOB) layer, Macro Block (MB) layer and Block layer.

The purpose of this test is to check whether the information to the decoder is multiplexed in the bitstream in the right hierarchical order, producing an acceptable ITU-T Recommendation H.261 bitstream.

METHOD:

All kind of input data is provided to the camera of the encoder. The produced (extracted) ITU-T Recommendation H.261 bitstream is analysed continuously by a bitstream analyser, which checks the validity of the code word order and up to a certain degree their meaning.

RESULTS:

If the bitstream analyser during the test period (5 minutes) never jumps to the error state, the bitstream is accepted as a ITU-T Recommendation H.261 bitstream. The bitstream analyser is a state machine which decides whether a certain code word is accepted, depending on the state it is in (meaning depending on previously decoded code words). Some checks are included such as the number of coefficients in a block (no more than 64), the number of MBs in a GOB (no more than 33), etc.

An example of such a state machine including some tests can be found in subclause ZA.2.10.2.

ZA.2.10.2 Example

The following four tests can easily be included in a bitstream analyser:

- check the GOB number when a GOB start code is found. Is this the correct GOB number or not?

- when a MB address is expected, we know the number of MBs already decoded in that particular GOB, so we know which MBAs are acceptable and which are not. If neither a correct MBA nor stuffing is found, checks whether the next code word is a GSC. If not, an error is detected;

- whenever an EOB code is found, it can easily be checked whether the position of the last non zero coefficient is not greater than 64 (adding the run);

- whenever no match can be found within the acceptable code words, the error state is reached. This will for instance occur when a GSC is found in an unacceptable position.

Some conditions in figure ZA.9 seem to be missing, but they are in reality incorporated in the scheme via the tests.

Experience has shown that errors easily can be detected when a GSC is not found when it ought to be found. Mostly the error in the bitstream was way back in the GOB, but due to the VLC codes, most of the things seem reasonable. The most general way of detecting this is, when a correct MBA can not be found (maximum 33 macro block in a GOB). Then it is assumed that the other MBs in the GOB are fixed and in that case the next GOB is expected. When this is not the case the bitstream contained an error.

ZA.2.10.3 Practical implementation

As for the practical implementation of the state machine, it is very doubtful whether a PLD or another simple chip (not dedicated) will be able to perform this job, since the bitstream in any case has to be decoded and several additional tests need to be performed. The use of a micro-processor might be recommended (see also figure ZA.9).

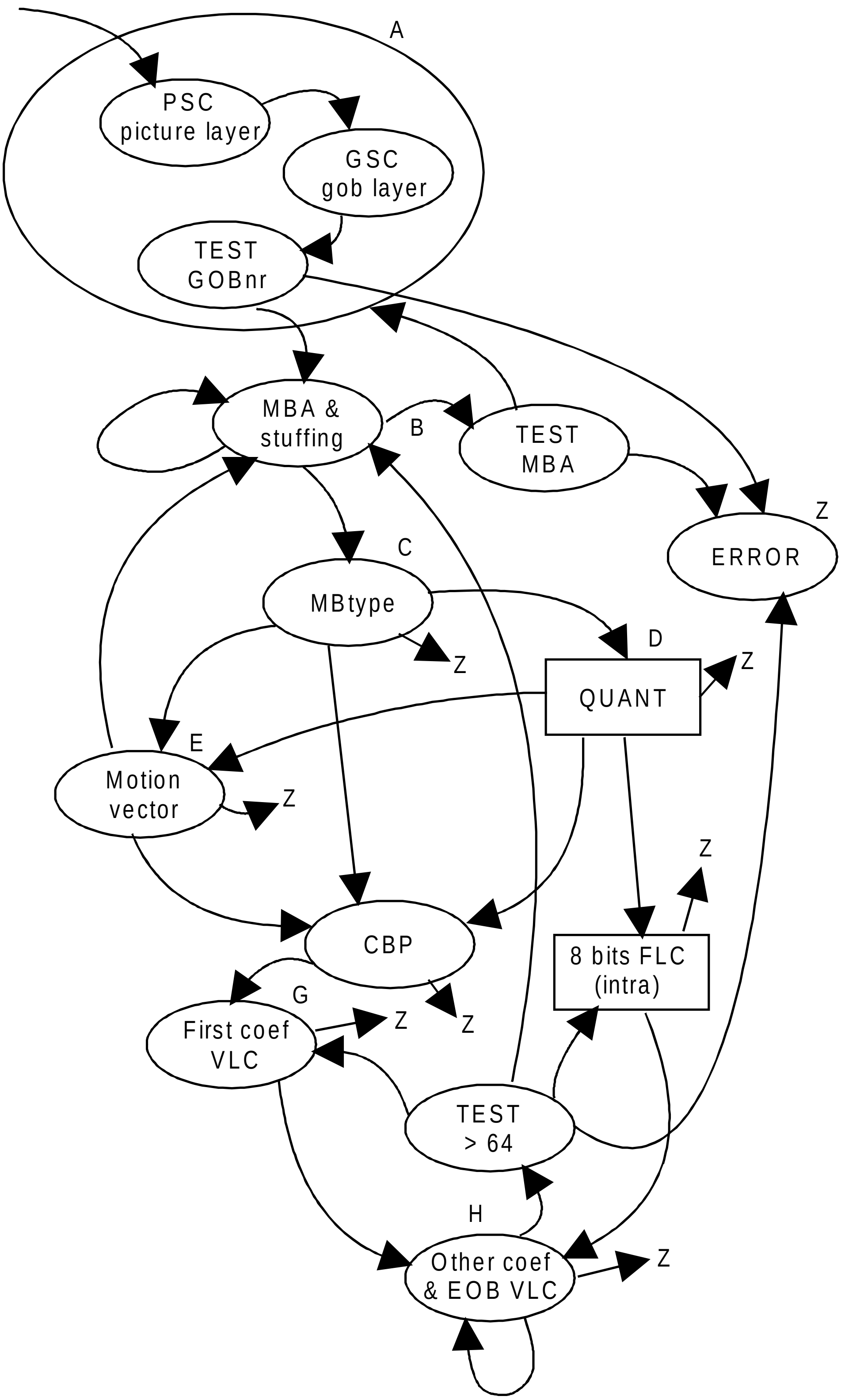

Figure ZA.9

ZA.2.11 Video demultiplex (ITU-T Recommendation H.261 § 4.2)

ZA.2.11.1 Decoder

PURPOSE:

Test whether the decoder accepts, demultiplexes and interprets all possible ITU-T Recommendation H.261 bitstreams correctly.

METHOD:

To check whether all possible bitstreams are accepted and interpreted correctly by the decoder, several bitstreams are input to the decoder and their display output - which is well described - is visually checked on the screen.

Different bitstreams will test different functions of the decoder, as e.g. motion vectors, MB type, quantizer step size, the coded block pattern, the DC coefficient of the intra blocks and the complete 2D-VLC table which is in a way related to the scanning order.

Some examples of possible tests are described in subclause ZA.2.11.2.

RESULTS:

If the output on the screen does not correspond to the described output of that certain bitstream, the decoder is said to be not conforming to this ETS.

ZA.2.11.2 Examples of test bitstreams

General remark.

To help verifying the output on the screen some of the test sequences are chosen in such a way that the left and right hand side of the screen should look the same even though they are constructed differently. On the one hand we have an already tested function, while on the other hand the one to be evaluated. Examples of this are shown in tests A.4 to A.6

ZA.2.11.2.1 Motion vectors

The flow of motion vectors for all the MBs can be tested using a test pattern which is generated mainly by motion vectors. Coloured (macro) blocks are running around on the screen. The motion vectors can have a different size in different parts of the picture. This will result in a different speed for the MBs. Examples are illustrated by figures ZA.10 and ZA.11.

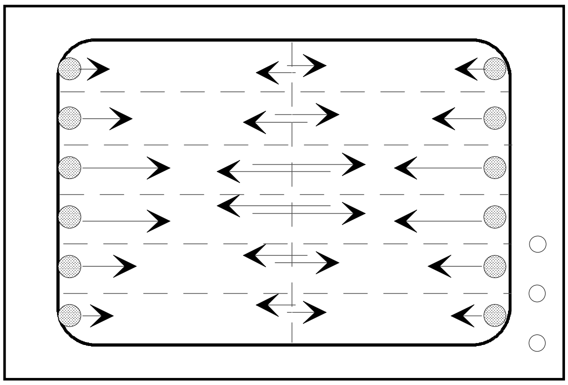

Figure ZA.10

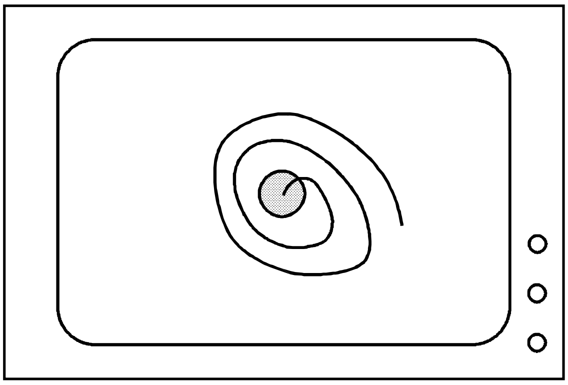

Figure ZA.11

ZA.2.11.2.2 Quantizer

Every decoder should be able to accept a change of quantizer within a GOB (mquant). Beside that, the information flow should go the right way. This can be tested with a test bitstream which radically changes quantizer step size within a group of block. For instance a simulation of a "head and shoulders" sequence can be used, where the first part of each GOB is coded with a fine quantizer, while the last part of each GOB is coded with a rough quantizer.

The picture quality will be very poor, but it will easily be seen whether the quantizer changes are accepted or not.

A suggestion for quantizer changes can be seen in figure ZA.12. The parts in the picture where e.g. a fine quantizer is used are shaded. Such simulations can e.g. be performed on Claire, creating a test bitstream.

ZA.2.11.2.3 Block type

A test bitstream can be produced to check whether all possible block types can be decoded. The block types to be tested are listed in table ZA.2.

Table ZA.2

Prediction	MQUANT	MVD	CBP	TCOEFF	VLC
Intra (coded)				x	0001
Intra (coded, quant)	x			x	0000 001
Inter (coded)			x	x	1
Inter (coded, quant)	x		x	x	0000 1
Inter (mc)		x			0000 0000 1
Inter (mc, coded)		x	x	x	0000 0001
Inter (mc, coded, quant)	x	x	x	x	0000 0000 01
Inter (mc+filter)		x			001
Inter (mc+filter, coded)		x	x	x	01
Inter (mc+filter, coded, quant)	x	x	x	x	0000 01

The different GOBs can have different block types. This can be seen in figure ZA.13. The test sequence could for instance be a chessboard (all intra in the beginning). The quantizer given on GOB basis can for instance be 16. On the right side of the image, when coded the MBs can be given a finer quantizer, e.g. 3.

Then the real sequence can be built up. The different pieces are visible. In the intra parts of the picture they are built up in one image (immediately). The result is always the same, the picture gets never better, assuming always the same amount of bits is spent per macro block.

In the inter parts - under the same assumptions - the images get better every time (takes more time).

There is a difference in the right and the left part of the picture due to the quantizer (left part of the picture e.g. rough quantizer (16), right part of the picture e.g. fine quantizer (3)).

In the lower part of the picture we have motion. The chessboard is moving. Difference should be visible when the filter is on or not, since the edges should get blurred in the former case. To obtain the maximum effect out of this test the blocks of the chess board should not correspond to macro blocks.

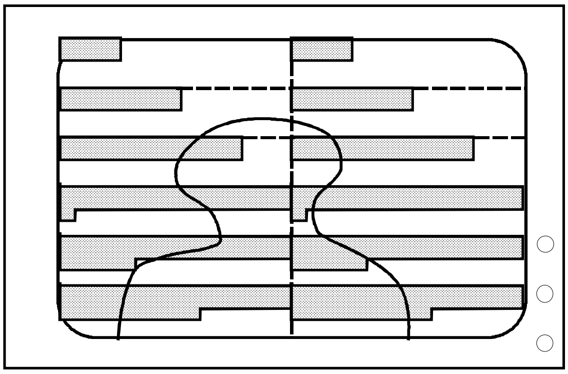

Figure ZA.12

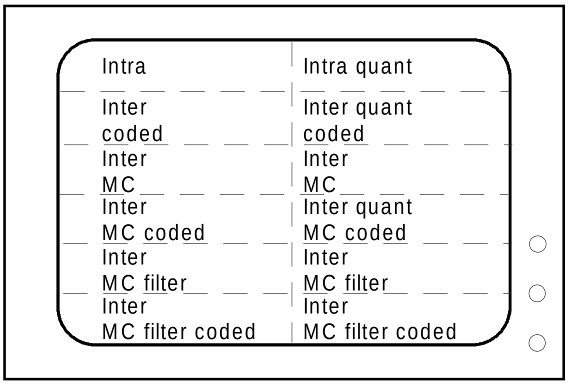

Figure ZA.13

ZA.2.11.2.4 Coded block pattern

There are 63 coded block patterns to test. A CIF image contains 18 rows of MB. All possible combinations of coded/not coded luminance blocks result in a total number of 16. Leaving the top and bottom row black, this means that all of them can be covered in one picture. Going to the sequence four times with respectively chrominance blocks U and V both not coded, U coded & V not coded, U not coded & V coded and both coded, we have covered all coded block patterns.

NOTE: One combination where none of the blocks is coded, is not allowed.

At the begin of each of the four passes the picture is completely black (all luminance blocks have a value of 16, all chrominance blocks a value of 128). Then most of the macro blocks except those on the top and bottom rows are coded. On the left side the inter mode is used and on the right half of the picture the intra mode. The blocks which are indicated to be not coded in the left side (CBP is used) of the picture have DC value of 16 respectively 128 (luminance respectively chrominance) in the right of the picture. All coded inter blocks contain just one event (run = 1, level = 1). The intra block have the matching DC value.

The pattern of coded/non-coded luminance blocks can be seen in figure ZA.14.

The decoder passes the test when the left and the right half of the picture always give the same visual result.

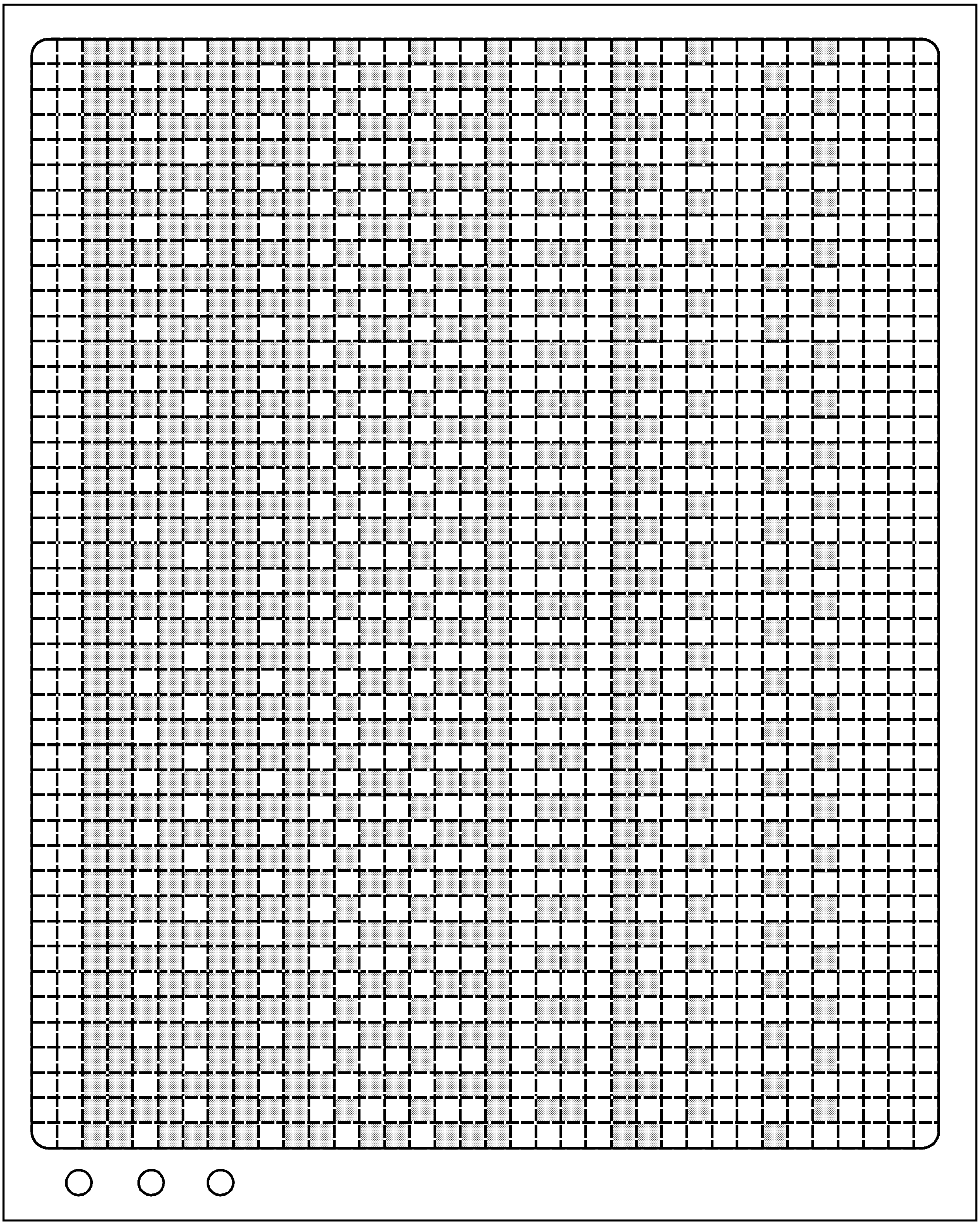

Figure ZA.14

ZA.2.11.2.5 DC values intra

All intra values for the intra DC values should be tested. This can be done by gradually go through all values, and compare them to inter block which should give the same result. This test is covered completely in the test A.4, where the blocks are gradually increase value. No discontinuity should be detected!

ZA.2.11.2.6 2-VLC (run and level)

The complete table will be tested in 2 passes. Again the same concept as in the previous tests applies. The macro blocks should look visually the same in both halves of the picture, although they are constructed differently.

In the fist pass the picture consists of three stripes, although this should not be visual since the stripes should all give the same result. In this test all VLC's with run equal to 1 are evaluated. They are compared to intra blocks giving the same value and also to other inter blocks where the same operation is performed but where the escape code is used. If the decoder passes the first pass, then we know that both VLC and escape codes for the VLC give the same performance. To evaluate that the intra blocks were used. See figure ZA.15.

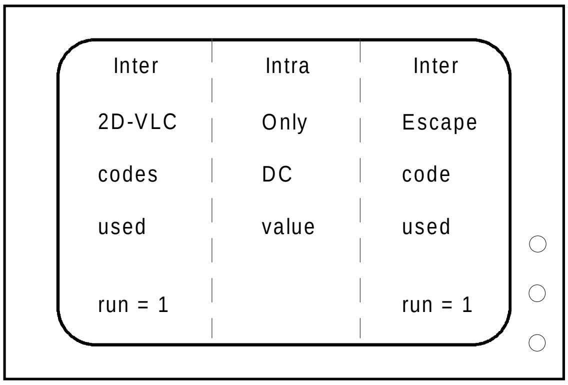

Figure ZA.15

In the second pass all other 2-VLC codes are tested, using the VLC code on the left hand side and the escape code on the right hand side of the picture. There should be visually no difference. See figure ZA.16.

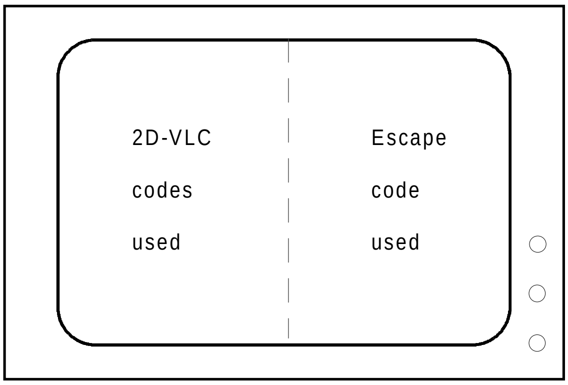

Figure ZA.16

ZA.2.11.2.7 Scanning order

The scanning order is in a way closely related to the previous test although it is not tested properly, since both sides of the picture make of course the same mistake. Some more exhaustive tests are described in the chapter called scanning order.

ZA.2.11.2.8 MB stuffing

All previous mentioned tests can be repeated but with the MB stuffing word included at all possible places in the bitstream. This should not influence the pictures.

ZA.2.12 Scanning order (ITU-T Recommendation H.261 § 4.2.4)

ZA.2.12.1 Decoder

PURPOSE:

The purpose of this test is to verify the scanning order of the transform coefficients in the decoder. The complementary part in the encoder will be assumed to be correct, in case they can work together.

METHOD:

To verify the scanning order of the transform coefficients of a decoder, the decoder under test and the reference decoder will be connected to a reference encoder. A stimulus will be applied to the camera of encoder. The display output of the decoder under test and the one of the reference decoder should be the same.

RESULTS:

The display output of the decoder should be watched. If the output image represents the input in a more or less correct way, the scanning order is probably correct. If not, the scanning order might be incorrect or some other requirements are not fulfilled. In any case there is an inconsistency between the encoder and the decoder and even though the cause of inconsistency is not identified, non conformance is proven.

EXTRA TEST (if no post-processing)

A controlled bitstream will be input to the decoder and the display output of the decoder will be visually checked.

RESULTS OF THE EXTRA TEST

If the patterns on the display are consistent to those described in the stimulus output description, the decoder passes the scanning conformance test. If not, the decoder fails.

NOTE: In the case that post-processing not can be switched off, no definite answer can be given to the cause of the failure to this extra test. An example of the stimulus is given in subclause ZA.2.12.2.

ZA.2.12.2 Example

The bitstream for the extra decoder test described in paragraph 4 and 5 consists of intra MBs in which always just one coefficient is different from zero. The position of this coefficient should generate a defined frequency pattern on the display (no post-processing).

ZA.2.13 Freeze picture (ITU-T Recommendation H.261 § 4.3.1)

ZA.2.13.1 Decoder

PURPOSE:

Check that the decoder under test freezes its displayed picture when a "Freeze Picture Request" is sent until a "Freeze Picture Release" is received or the time-out has expired.

"Freeze Picture Request" is sent by external means and "Freeze Picture Release" is received via the bitstream.

METHOD:

A test bitstream which contains one black frame and one white frame encoded in INTRA mode is continuously sent to the decoder under test. "Freeze Picture Request" (FPR) is first sent to the decoder. Two seconds later, bit 3 of PTYPE of one frame of the test bitstream is set to "1". Again two seconds later, a new FPR is sent.

RESULTS:

The decoded pictures shall be alternatively black and white. The first "Freeze Picture Request" shall cause the decoder to display a black (or white) still picture. (Else: error message: no response to Freeze Picture Request).

Two seconds later, it can be observed that the displayed picture is moving again (Else: error message: no response to Freeze Picture Release). Again two seconds later the picture shall be frozen. After a time-out period of at least 6 ^{s}, the decoder shall again display black and white "moving" pictures (Else: error message: no time-out Freeze Picture Release).

NOTE: The 6 ^{s} time-out figure is mentioned in subclause ZA.2.4.3.1.

ZA.2.14 Fast Update Request (FUR) (ITU-T Recommendation H.261 § 4.3.2)

ZA.2.14.1 Encoder

PURPOSE:

The purpose of the test is to verify that the FUR mechanism is working properly at the encoder side.

METHOD:

1) bit 3 of PTYPE is analysed without any external action;

2) a "Fast Update Request" (FUR) is sent to the encoder. Bit 3 of PTYPE and all the MB TYPES of the bitstream have to be analysed.

NOTE: The FURs are sent to the encoder via external means.

RESULTS:

1) bit 3 of PTYPE shall always be "O" in the video multiplex produced by the encoder (Else: error message: inconsistent FPR);

2) a certain time after the FUR has been sent, it has to be observed that bit 3 of PTYPE is set to "1" by the encoder, indicating a "Freeze Picture Release" (FPR) to the distant decoder. (Else: error message: no response to FUR).

For each MTYPE of the frame which contains the FPR, the only permitted values are: "0001" or "0000 001". (Else: error message: non INTRA MB type in FPR picture).

Then, it has to be checked that, in the following picture, bit 3 of PTYPE is again "0". (Else: error message, FPR hold).

PTYPE bit 3

correct sequence:

0	0	0	0	0	0	0	0	1	0
							FUR		

4 erroneous sequences:

a)	1	1	1	1	1	1	1	1	1	1
b)	0	0	0	0	1	0	0	0	0	0
c)	0	0	0	0	0	0	0	0	0	0
					FUR					
d)	0	0	0	0	0	0	0	1	1	1
					FUR					

ZA.2.15 Maximum bits per picture (ITU-T Recommendation H.261 § 5.2)

ZA.2.15.1 Encoder

PURPOSE:

The purpose of this test is to ensure the encoder conforms to ITU-T Recommendation H.261, § 5.2. The encoder shall control its output bitstream. When operating with CIF the number of bits created by coding any single picture shall not exceed 256 kbits (K = 1 024).

When operating with QCIF the number of bits created by coding any single picture shall not exceed 64 kbits. (ITU-T Recommendation H.261, § 5.2).

METHOD:

At the encoder provide an image sequence which contains the following, long periods of high motion, panning, zooming and scene cuts. The number of bits generated between picture start codes (PSC) excluding FEC bits is continually monitored.

RESULTS:

The encoder fails if the number of bits generated between PSC exceeds the above values.

ZA.2.15.2 Decoder

PURPOSE:

The purpose of this test is to ensure the decoder conforms to ITU-T Recommendation H.261, § 5.2. The decoder shall be able to handle ITU-T Recommendation H.261 bitstreams which contain coded pictures with the maximum bits per picture. When operating with CIF the maximum bits per picture is 256 kbits (K = 1 024). When operating with QCIF the maximum bits per picture is 64 kbits.

METHOD:

If the decoder's stated capability is QCIF only then provide a valid ITU-T Recommendation H.261 bitstream which contains pictures with 64K coded bits per picture. If the decoder is capable of CIF then test in both QCIF and CIF modes. For QCIF mode provide a valid ITU-T Recommendation H.261 bitstream which contains pictures with 64K coded bits per picture. For CIF mode provide a valid ITU-T Recommendation H.261 bitstream which contains pictures with 256K coded bits per picture.

RESULTS:

The decoder fails if it is unable to be compared with the reference decoder.

ZA.2.16 Error correction (ITU-T Recommendation H.261 § 5.4.3)

ZA.2.16.1 Encoder

PURPOSE:

ITU-T Recommendation H.261 specifies the application of a BCH (511,493) forward error correction for the transmitted bitstream. The generation of the error corrector framing and the parity bits is mandatory at the encoder. Every decoder shall be able to cope with the error correction framing, but the usage of the parity bits for correction is optional.

The following items have to be confirmed to ensure conformance with ITU-T Recommendation H.261:

- the framing structure including the frame alignment pattern provided at the output;
- the generation of the correct parity bits.

METHOD:

The conformance of a FEC-encoder to ITU-T Recommendation H.261 can be verified by a reference FEC-decoder, which checks the items stated above (see figure ZA.17).

RESULTS:

The FEC reference decoder checks the bitstream coming from a real ITU-T Recommendation H.261-encoder and displays any occurrence of a mismatch between received data and expected values.

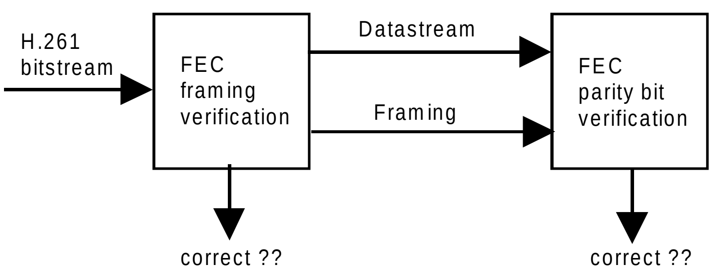

Figure ZA.17

ZA.2.16.2 Decoder

PURPOSE:

The following items have to be confirmed to ensure conformance with ITU-T Recommendation H.261:

- the capability to decode a correct ITU-T Recommendation H.261 datastream comprising a BCH(511,493) forward error correction;
- another item to be tested at the decoder is the framing relock time, which is specified by ITU-T Recommendation H.261 to guarantee proper operation in conjunction with a multipoint conferencing unit.

It is not necessary to test the error correction capabilities of the FEC-decoder as ITU-T Recommendation H.261 does not state any requirements.

METHOD:

As there is no specification of a standard interface for the decoded ITU-T Recommendation H.261 bitstream, the decoder test is made in a way that the test result can be clearly determined on a display showing the decoded pictures.

For testing the relock time of the FEC framing the following sequence should be embedded in the test sequence:

- a coded picture with a significant colour, e.g. a purely blue picture;
- at least one complete picture with no data to make sure that the previous picture is displayed;
- a sequence of bits which destroy the FEC synchronism, e.g. 34 000 ones;
- 34 000 bits consisting of stuffing FEC frames (= 67 frames). Within this sequence the FEC decoder has to achieve again the synchronization of the FEC framing;
- an intra coded picture leading to a significant different picture to the picture before the relock test followed by pictures with differences only.

RESULTS:

The ITU-T Recommendation H.261 datastream containing FEC framing bits and parity bits has to be decoded without any visible failures.

A decoder displaying the last mentioned intra coded picture has the capability to lock-in within 34 000 bits and thus conforms to the ITU-T Recommendation H.261 standard.

The FEC-decoder test can be embedded in the bitstream of the general ITU-T Recommendation H.261 video decoder test.

ZA.2.17 FEC stuffing (ITU-T Recommendation H.261 § 5.4.3)

PURPOSE:

ITU-T Recommendation H.261 provides the capability for stuffing within the application of a BCH (511,493) forward error correction for the transmitted bitstream. By setting the fill indicator bit to zero and filling the 492 data bits all with "1" a whole FEC frame can be used for stuffing. At the decoder the fill indicator is investigated after the error correction and the whole frame is discarded when the fill indicator is set to zero.

As ITU-T Recommendation H.261 provides another possibility for stuffing, there is no obligation to make use of the fill indicator at the encoder, but every decoder has to cope with FEC stuffing frames.

ZA.2.17.1 Encoder

METHOD:

The potential use of the FEC stuffing capability can be checked and verified by a reference FEC-decoder/destuffing unit, which investigates the stuffing frames if there are any.

The destuffed datastream is decoded and displayed on a screen.

RESULTS:

The reference decoder checks the bitstream coming from a real ITU-T Recommendation H.261-encoder and displays any occurrence of a failure. The decoded picture shall not show any signs of an interrupted data stream.

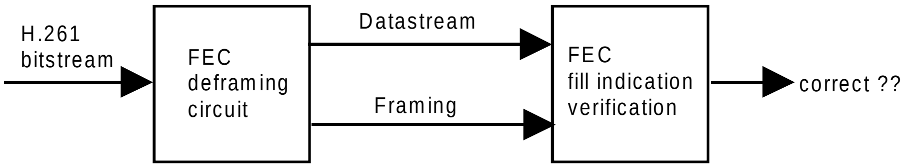

Figure ZA.18

ZA.2.17.2 Decoder

METHOD:

As there is no specification of a standard interface for the decoded ITU-T Recommendation H.261 bitstream, the decoder test is made in a way that the test result can be clearly determined on a display showing the decoded pictures. The bitstream for verifying the correct destuffing operation of the FEC decoder can be any ITU-T Recommendation H.261 conforming bitstream containing FEC frames, with the fill indicator set to zero and filled with 492 ones.

RESULTS:

The ITU-T Recommendation H.261 datastream containing FEC stuffing frames has to be decoded without any visible failures.

ZA.2.18 Arithmetic loop conformance (ITU-T Recommendation H.261 annex A)

ZA.2.18.1 Decoder

PURPOSE:

ITU-T Recommendation H.261 applies a differential coding scheme using a two dimensional DCT for the data compression of the difference between the predicted picture and the actual picture. Normally each transmitted picture is based on the previous transmitted one. Therefore identical arithmetic has to be applied for generating the reference picture at the encoder and the reconstructed picture at the decoder from the transmitted datastream.

ITU-T Recommendation H.261 does not specify the processing structure of the inverse DCT applied at the encoder and the decoder but provides a method for measuring the precision of any IDCT realization and gives figures for the maximum allowed mismatch. These figures are defined in such a way, that no visible pattern appears caused by the mismatch due to different realizations of a 8 x 8 IDCT. To exclude the long term accumulation of mismatch errors a systematic update method (forced updating) has been specified by means of an intra coded refresh at least after 131 inter coded updates.

METHOD:

A test has to be applied using a coded bitstream according to ITU-T Recommendation H.261 as stimulus and the decoded and displayed picture as measure. The test has to be performed at various bit rates. Only rough estimations about the compliance can be obtained.

The tested device has to be checked whether any mismatch pattern is visible after 131 inter coded updates without any intra coded updating.

A compensation method can be applied with randomly selected patterns for the first 130 updates and a final one, by which the obtained pattern is erased to an uniform grey picture. The coefficients of the final update are calculated by the usage of a floating point realization of the IDCT to obtain the picture after the first 130 updates. Care has to be taken about the selection of the quantizer step size.

The decoder should be stopped after the final update providing an uniform grey picture and the screen should be checked very carefully for any mismatch pattern.

REMARK:

The reference encoder and decoder have to meet the IDCT accuracy specification.

RESULTS:

A realization of an IDCT conforming to the specifications of ITU-T Recommendation H.261 should not produce any visible mismatch pattern after 131 updates without intra coding.

ZA.2.19 HRD compliance (ITU-T Recommendation H.261 annex B)

ZA.2.19.1 Encoder

PURPOSE:

A ITU-T Recommendation H.261 encoder shall control its output bitstream to comply with the requirements of the hypothetical reference decoder (HRD) defined in ITU-T Recommendation H.261 annex B.

METHOD:

At the encoder provide an image sequence which contains firstly a long period of blank input (encoder buffer should settle to a steady state). This is followed by low detail stills, long periods of high motion, panning, zooming, scene cuts and high detail stills.

Extract from the resulting ITU-T Recommendation H.261 bitstream the coded picture data and MBA stuffing but not error correction framing bits, Fill indicator (Fi), fill bits or error correction parity information.

This bitstream is then passed through the HRD which is defined below.

a) the HRD and the encoder have the same clock frequency as well as the same CIF rate, and are operated synchronously. The video clock rate of the encoder can be found from the results of the test in subclause ZA.2.3.1;

b) the HRD receiving buffer size is (B + 256 kbits). The value of B is defined as follows:

   B = 4Rmax/29,97 where Rmax is the maximum video bit rate to be used in the connection;

c) the HRD is initially empty;

d) the HRD is examined at CIF intervals (≅ 33 ms). If at least one complete coded picture is in the buffer then all the data for the earliest picture is instantaneously removed. Immediately after removing the above data the buffer occupancy shall be less than B.

RESULTS:

The encoder is said to pass if after removing data from the HRD the buffer occupancy is less than B.

ZA.2.19.2 Decoder

PURPOSE:

A ITU-T Recommendation H.261 decoder shall be able to accept and properly decode any ITU-T Recommendation H.261 bitstream that conforms to the hypothetical reference decoder defined in ITU-T Recommendation H.261, annex B.

METHOD:

A decoder should be supplied with a ITU-T Recommendation H.261 bitstream which utilizes the full limits of the permitted buffer excursions which fall within the decoder's declared capability.

RESULTS:

A decoder which accepts and properly decodes the above ITU-T Recommendation H.261 bit stream is said to pass.

ZA.2.20 Extra Insertion Information (ITU-T Recommendation H.261 § 4.2.1 - § 4.2.2)

PURPOSE:

The purpose of this test is to ensure that the encoder and decoder handle the spare information fields in ITU-T Recommendation H.261 § 4.2.1 and § 4.2.2.

There are bits in the picture layer and GOB layer which indicate the presence of optional data fields.

In the picture layer this is indicated by PEI. This is set to "1" when optional data follows. When PEI is "1" then 9 bits follow, 8 bits for PSPARE and another PEI bit (ITU-T Recommendation H.261, § 4.2.1).

A similar indication is in the GOB layer. They are GEI and GSPARE (ITU-T Recommendation H.261, § 4.2.2).

At the moment encoders shall not insert PSPARE or GSPARE; decoders shall discard PSPARE and GSPARZA.

Both the encoder and decoder should be tested to ensure that the encoder produces a valid ITU-T Recommendation H.261 bitstream and the decoder ignores optional data fields.

ZA.2.20.1 Encoder

METHOD:

The PEI and GEI bits from a ITU-T Recommendation H.261 encoder should be continuously monitored. These bits should never be set to "1".

RESULTS:

The encoder fails if PEI or GEI are ever set to "1".

ZA.2.20.2 Decoder

METHOD:

For PSPARE supply an ITU-T Recommendation H.261 bitstream to a decoder in which alternate pictures have the PEI bit set to "1". The decoder picture should not break up.

```
<PSC TR PTYPE PEI=0> . . . <PSC TR PTYPE PEI=1 PSPARE PEI=0> . . . <PSC TR PTYPE PEI=0> . . .
```

The number of PSPARE fields inserted should be varied between 1 and many.

For GSPARE supply a ITU-T Recommendation H.261 bitstream to a decoder in which alternate GOBs have the GEI bit set to "1". The decoder picture should not break up.

```
<GBSC GN GQUANT GEI=0> . . . <GBSC GN GQUANT GEI=1 GSPARE GEI=0> . . . <GBSC GN GQUANT GEI=0> . .
```

The number of GSPARE fields inserted should be varied between 1 and many.

For GSPARE supply a ITU-T Recommendation H.261 bitstream which generates a picture with a uniform background in the first 2 GOBs except for MB 11 in GOB 1, this should be coded such that it stands out from the background.

In alternate pictures supply the same bitstream for the first 2 GOBs but with GSPARE inserted into GOB 2. GSPARE should be:

```
GEI  GSPARE  GEI  GSPARE  GEI
<1><10010000><1><00100010><0>
```

(this emulates MBA = 1 MBTYPE = MC no coefficients HVEC = -6 VVEC = 3).

If GSPARE is discarded the macro block remains static in the sequence of pictures. If GSPARE is not discarded then the macro block will be seen to move from its original position towards GOB 2 MB 1 and back again.

The remainder of the GOBs should be coded to satisfy the decoder buffer.

The same test can be done at other points in the picture.

RESULTS:

The decoder fails if the output picture of the decoder under test is visibly different from that of the reference decoder.

History

Document history			
July 1995	Public Enquiry	PE 88:	1995-07-24 to 1995-11-17
April 1998	Vote	V 9824:	1998-04-14 to 1998-06-12