INTERNATIONAL TELECOMMUNICATION UNION

ITU-T T.45

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(02/2000)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

Run-length colour encoding

ITU-T Recommendation T.45

(Previously CCITT Recommendation)

ITU-T RECOMMENDATION T.45

RUN-LENGTH COLOUR ENCODING

Summary

This Recommendation, "Run-length colour encoding", specifies a run-length encoding procedure which has been optimised for the encoding of lists of colour values. Use of T.45 to encode the colour values of the T.88 (JBIG2) related colour tag procedure is one targeted application. Recommendation T.88 has been shown to be particularly effective in the coding of coloured text when the colours of the foreground layer associated with a T.88 encoded MRC mask layer (i.e. text shapes) are represented by colour tags (i.e. colour values). Use of the Recommendation T.88 together with the colour tag provision can realise more than twice the compression gains associated with conventional bitmap image encoding of text colours. The colour tag provision takes advantage of the fact that T.88 codes text regions by generating discrete symbols (i.e. symbols are used to represent text characters) and the text characters are usually a single flat colour. Colour tagging uses a single colour value (i.e. a colour tag) to represent the colour of each T.88 symbol occurrence, one colour value for each corresponding mask layer (X, Y, ID) symbol triplet. The colour values are ordered identically to the symbol occurrences. The ordered list of foreground layer colour tags (i.e. colour values) are compressed using T.45 "Run-length colour encoding".

Source

ITU-T Recommendation T.45 was prepared by ITU-T Study Group 8 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on 10 February 2000.

FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Recommendation T.45

RUN-LENGTH COLOUR ENCODING

(Geneva, 2000)

1 Scope

This run-length colour encoding Recommendation is restricted to the coding of a sequence of colour values or palette indices. It is general enough to handle any number of colour components at any depth. Colour interpretation of the colour values or palette indices is beyond the scope of this Recommendation and shall be defined elsewhere.

2 Coding method

The coding method begins with a six-octet header. The header specifies the number of colour components, a count of the number of octets used to specify each component value and a count of the number of colour values coded. The data is stored as a sequence of runs, which is composed of a count of the times in succession that the colour value or palette index appears.

Colour interpretation parameters, such as colour space, gamut range, illuminant or colour values associated with palette indices, which are required to interpret the colour values are stored outside of this run-length colour encoding mechanism.

2.1 Structure

All multi-octet values shall be stored in "bigendian" format, with the highest order octet coming first and the lowest-order octet coming last.

The encoding structure consists of a header immediately followed by data.

2.1.1 Header

The coding method shall begin with a six-octet header of the form:

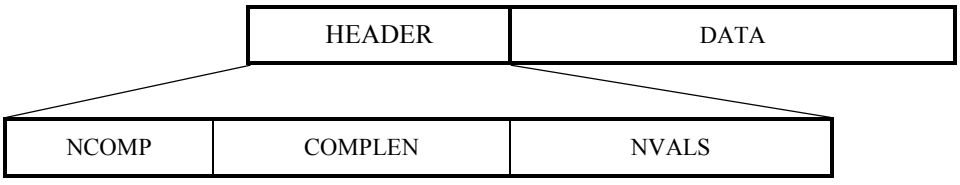
NCOMP	1 octet
COMPLEN	1 octet
NVALS	4 octets

The NCOMP (Number of Components) field specifies how many colour components there are. NCOMP shall consist of one octet. It shall take on a value from 1 to 255.

The COMPLEN (Component Length) field specifies the length (in octets) of each component's value. COMPLEN shall consist of one octet. It shall take on one of the values 1, 2 or 4.

The NVALS (Number of Values) field specifies how many colour values are coded. NVALS shall consist of four octets. It shall take on a value from 0 to (2^32 – 1).

To code indexes into a colour palette, set NCOMP = 1, COMPLEN = 1 (or 2 if there are >256 entries in the palette; or 4 if there are >65536 entries in the palette) and use the NVALS to specify the number of indexes in the palette.



2.1.2 Data

The data shall begin immediately following the header and it shall be stored as a sequence of runs.

Each run shall have the form:

RUNLEN 1 or 3 octets

CVAL NCOMP * COMPLEN octets

The RUNLEN (Run Length) field specifies the number of times in succession that the colour value or palette index (CVAL) appears. RUNLEN shall consist of one or three octets. It shall take on a value from 0 to 65535.

The one-octet or three-octet RUNLEN coding sequence shall be as follows:

- If the first octet has a value in the range 0x01 to 0xFF, then RUNLEN shall have the value of that single octet.
- If the first octet has a value equal to 0x00, then the first octet shall be followed by two additional octets. RUNLEN shall have the value indicated by the two additional octets.

Example of RUNLEN one or three octet sequence:

The sequence of octets:

0x05

indicates a RUNLEN of 5

The sequence of octets:

0x00 0x01 0x04

indicates a RUNLEN of 260 (256 * 1 + 4)

The CVAL (Colour Value) field specifies the colour value or palette index of the run. CVAL shall consist of NCOMP fields. Each field shall consist of COMPLEN octets.

Example of CVAL sequences:

If the value of NCOMP is 3 and COMPLEN is 1, then the CVAL sequence of octets

0xFF 0xC0 0x00

corresponds to the colour triple (255, 192, 0). The interpretation of this colour triple is left to the colour interpretation system, which shall be specified outside of this Recommendation.

The end of the coding shall be determined when the sum of all the RUNLEN values decoded is equal to NVALS.

Example: If the values decoded were:

RUNLEN1

CVAL1

RUNLEN2

CVAL2

...

RUNLENn

CVALn

then the sequence of colour values represented by this encoded data stream is:

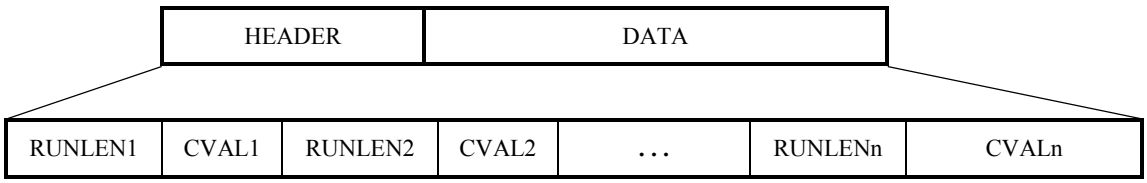
RUNLEN1 instances of CVAL1

RUNLEN2 instances of CVAL2

...

RUNLENn instances of CVALn

totalling NVALS colour values.



Appendix I

Example of a complete run-length colour encoded data stream

An example of a complete run-length colour encoded data stream is:

0x03 0x01 0x00 0x00 0x00 0x0A

0x03 0xFF 0xFF 0xFF

0x02 0x00 0x00 0x00

0x00 0x00 0x01 0xFF 0xFF 0xFF

0x04 0x80 0x80 0x00

In this data stream:

NCOMP = 3 – each colour value has 3 components

COMPLEN = 1 – each component is 1 octet long

NVALS = 10 – there are 10 total colour instances

RUNLEN1 = 3

CVAL1 = (255, 255, 255)

RUNLEN2 = 2

CVAL2 = (0, 0, 0)

RUNLEN3 = 1 (note that this is coded as three octets; one would have been sufficient, but the three-octet form is used for illustration)

CVAL3 = (255, 255, 255)

RUNLEN4 = 4

CVAL4 = (128, 128, 0)

Thus, the sequence of 10 3-component colour values decoded is:

(255, 255, 255)

(255, 255, 255)

(255, 255, 255)

(0, 0, 0)

(0, 0, 0)

(255, 255, 255)

(128, 128, 0)

(128, 128, 0)

(128, 128, 0)

(128, 128, 0)

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