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Application profiles for Recommendation T.88 – Lossy/lossless coding of bi-level images (JBIG2) for facsimile

ITU-T Recommendation T.89

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Summary

This Recommendation, "Application Profiles for Recommendation T.88", specifies application profiles of the JBIG2 coding scheme, defined in ITU-T Rec. T.88 | ISO/IEC 14492, for facsimile applications. The JBIG2 Recommendation specifies a collection of standard encoder/decoder components, referenced as a tool kit, that are used in generating and decoding JBIG2 conformant data streams. JBIG2 has standardized seven profiles, and encourages definition of additional application profiles to satisfy further needs of various application environments.

Source

ITU-T Recommendation T.89 was revised by ITU-T Study Group 16 (2001-2004) and approved under the WTSA Resolution 1 procedure on 5 September 2001.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 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.

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As of the date of approval of this Recommendation, 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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ITU-T Recommendation T.89

Application profiles for Recommendation T.88 – Lossy/lossless coding of bi-level images (JBIG2) for facsimile

1 Scope

This Recommendation defines application profiles of ITU-T Rec. T.88 | ISO/IEC 14492 "Lossy/lossless coding of bi-level images (JBIG2)" for facsimile applications.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-T Recommendation T.44 (1999), *Mixed raster content (MRC)*.
- ITU-T Recommendation T.4 (1999), *Standardization of Group 3 facsimile terminals for document transmission*.
- ITU-T Recommendation T.88 (2000) | ISO/IEC 14492:2001, *Information technology – Lossy/lossless coding of bi-level images*. (Commonly referred to as JBIG2 standard.)

3 Principle

This Recommendation specifies application profiles of ITU-T Rec. T.88 | ISO/IEC 14492 for facsimile applications.

JBIG2's tunable lossy/lossless compression of bi-level images is made possible by mixing and matching the various components and parameters within its tool-kit collection of components and parameters. The JBIG2 tool kit contains two basic categories of image and integer coding methods:

- 1) Arithmetic coding, as defined in Annex E/T.88, is used in the encoding of both image and integer data;
- 2) MMR coding, as defined in 6.2.6/T.88 and Huffman coding, as defined in Annex B/T.88, are used in the encoding of image and integer data respectively.

These encodings are selectively applied, using a variety of parameter values, to segmented image regions containing image types such as text, dithered (half-tone) and generic bit-map data.

This Recommendation defines a set of JBIG2 application profiles to be used in the decoding of a JBIG2 data stream. Given that the JBIG2 Recommendation (T.88) is a decoder-only standard, the profiles defined within this Recommendation do not address encoding. The profiles are categorized by image and integer coding methodology, image region types and memory constraining parameters. To insure interoperability between various implementations, this Recommendation defines a base profile, which shall be implemented by all facsimile implementations that use JBIG2. The base profile is augmented by a set of standardized optional profiles. Collectively these profiles deliver different levels of performance over a range of facsimile implementations.

Error-free or error-corrected transmission, as defined in Annex A/T.4, and the shared data structure defined in ITU-T Rec. T.44 shall be used in JBIG2 facsimile implementations. Mode 4 or higher of ITU-T Rec. T.44 and Annex H/T.4 ("Black-and-White Mixed Raster Content Profile (MRCbw)")

clause) shall be used when the "JBIG2 fax profiles", specified within this Recommendation, are implemented in colour and in black-and-white-only applications respectively.

4 Facsimile profiles

Multiple facsimile profiles are defined in 4.1 "JBIG2 fax profiles". These profiles are intended to accommodate applications spanning a range of implementation resource requirement from stand-alone terminals to laptop and desktop computers.

4.1 JBIG2 FAX profiles

Table 1 defines one mandatory profile – Profile 1: BASE – and four optional profiles – Profiles 2: Upper Huffman, Profile 3: Lower arithmetic, Profile 4: Medium lossy/lossless arithmetic and Profile 5: Medium lossy/lossless arithmetic/Huffman. The JBIG2 fax profiles table also contains the outline for an additional optional profile, which is provided for information as it is still under study and has not been approved for implementation. Profiles 1 through 5 have been reserved by the ITU and communicated to ISO/IEC JTC1 SC29, which has reserved profile identification numbers 0x00000100 through 0x00000FFF for ITU-T disposition. Profile identification numbers 0x00000101 through 0x00000105 are assigned to Profiles 1 through 5 above respectively. The relative complexity and working memory requirements of a profile generally increases as the value of its profile number increase for a particular base coder (i.e. arithmetic or Huffman). Accordingly, a reader supporting a profile with a higher value profile number shall be capable of also supporting a profile with a lower value profile number if it utilizes the same base coder.

The BASE profile (Profile 1 or 0x00000101) is designed to accommodate minimal implementation resources in a stand-alone application environment. It is effectively the minimum subset of the lowest level JBIG2 profile, Profile 0x00000007 (see Table F.7/T.88). Consistent with the most prevalent facsimile implementations of today, the BASE profile use MMR coding in the coding of bitmap data and Huffman coding scheme in the coding of numeric (integer) data. The main advantage of the profile is the greatly increased compression available through the use of "lossy" JBIG2 coding. The optional Upper Huffman profile (Profile 2 or 0x00000102), using MMR and Huffman coders for bitmap and numeric respectively, is based on the less constrained JBIG2 Huffman-based profile, Profile 0x00000005 (see Table F.5/T.88). Profile 2 is defined to provide enhanced performance, including specific half-tone region coding via pattern matching and provisions that accommodate use of "color tags" as defined in ITU-T Rec. T.44, to the stand-alone facsimile application environment. Use of Profiles 1 and 2 may be suitable for other low complexity and low-speed processor applications, such as high-speed printing. Definition of Profile 3 (0x00000103) "Lower arithmetic" recognizes the growing trend towards adoption of arithmetic-based coders in facsimile applications and uses arithmetic for both bitmap and numeric coding. Profile 3 is intended to provide a minimal subset of the most highly constrained JBIG2 arithmetic profile, Profile 0x00000006 (see Table F.6/T.88). The Medium lossy/lossless arithmetic profile (Profile 4 or 0x00000104) is defined to provide lossless enhancement to Profile 3. Profile 4 is a subset of the less constrained JBIG2 arithmetic profile, Profile 0x00000003 (see Table F.3/T.88). The Medium lossy/lossless arithmetic/Huffman profile (Profile 5 or 0x00000105) is defined to accommodate the flexibility of using arithmetic, Huffman and MMR base coders as appropriate, along with provisions for both lossy and lossless JBIG2 coding modes. Selectively, arithmetic or MMR may be used for bitmap, arithmetic or Huffman for numeric, and arithmetic for refinement region coding. Additionally, there is provision for specific half-tone region coding via pattern matching. The provisions that accommodate use of "colour tags", which are associated with Profiles 2 and 4, are retained in Profile 5. Profile 5 is a combined subset of the two less constrained and refinement enabled JBIG2 arithmetic and Huffman-based profiles, Profiles 0x00000003 and 0x00000004 (see Tables F.3/T.88 and F.4/T.88). Profiles 1 through 3 uses the "lossy" JBIG2 coding mode while Profiles 4 and 5 accommodate both "lossy" and "lossless" modes. Use of Profiles 3 through 5 may be suitable for medium complexity and medium-speed processor applications such