DRAFT

BIIF PROFILE
for
JPEG 2000, VERSION 01.00
in
NITFS/BIIF/NSIF

TEST REQUIREMENTS DOCUMENT
DRAFT VERSION 0.40

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Foreword

The International Standard (IS) 12087-5:1998, Basic Image Interchange Format (BIIF) provides guidance for creating profiles of BIIF. The NATO Secondary Imagery Format Version 01.00 (NSIF01.00) is a profile of BIIF intended to promote interoperability for the exchange of Imagery among military Command, Control, Communications, and Intelligence (C3I) systems. The NSIF01.00 profile of BIIF allows for the compression of image data using the provisions of ISO/IEC 15444, JPEG 2000 Part 1: Image coding system: Core coding system. The BIIF Profile for JPEG 2000, Version 01.00 (BPJ2K01.00) is the applicable implementation profile for the JPEG 2000 compression of digital imagery, incorporating the compressed digital imagery into NSIF files, and exchanging them within the C3I user community.

This document provides the test requirements for determining comformance with BPJ2K01.00. The objective is to promote interoperability between NSIF01.00 encoders and decoders implementing BPJ2K01.00 by testing these systems for conformance with this profile. Conformance testing is the testing of a candidate implementation for the existence of specific characteristics required by a standard or a specific profile of a standard. It involves testing the capabilities of an implementation against both the conformance requirements in the relevant standard and the statement of the implementation's capability.

The test requirements, criteria, and measures specified in this document are derived from the detailed requirements and conformance criteria found in the BPJ2K01.00 and the provisions of ISO/IEC 15444-4 Information technology – JPEG 2000 image coding system - Part 4: Conformance testing.

This test requirements document was cooperatively developed between the ISO and the North Atlantic Treaty Organisation (NATO). It is submitted in support of NATO Standardardization Agreement (STANAG) 4545 and the NSIF01.00 Profile of BIIF, promulgated by the Chairman, Military Agency for Standardization (MAS) under the authority vested in him by the NATO Military Committee.

Introduction

ISO/IEC 15444-1: JPEG 2000 Part 1: Image coding system: Core coding system, an international standard for compression of imagery data, has been adopted as an imagery compression option for use within the North Atlantic Treaty Organization (NATO) Secondary Imagery Format (NSIF) profile of ISO/IEC 12087-5, Basic Image Interchange Format (BIIF). ISO/IEC 15444-1 is a standard that describes an image compression system that allows great flexibility, not only for the compression of images but also for access into the codestream. The codestream provides a number of mechanisms for locating and extracting portions of the compressed image data for the purpose of retransmission, storage, display, or editing. This access allows storage and retrieval of compressed image data appropriate for a given application without decoding.

The BIIF Profile for JPEG 2000, Version 01.00 (BPJ2K01.00) is the profile applicable to NSIF for the JPEG 2000 compression of digital imagery. All compliant NSIF decoders are required to decode all compliant data within the implemented NSIF complexity level that is compressed within the limits of the BPJ2K01.00 profile (any JPEG 2000 Part 1 Profile 1 codestream). All compliant NSIF encoders capable of producing JPEG 2000 compressed data are required to do so strictly within the limits of the BPJ2K01.00 profile for the implemented NSIF complexity level.

The BPJ2K01.00 also defines an NSIF Prefered JPEG 2000 Encoding (NPJE) that places further constraints on the generation of compressed codestreams by systems designated to implement NPJE. The NPJE restrictions are applicable to imagery generated/compressed within a large distribution system that includes several levels of collection systems (encoders), libraries/distributors (transcoders), and end users (decoders) to help ensure adequate scalability without resorting to recompression.

Several portions in the NSIF file format contain information directly related to the JPEG 2000 codestream content. The BPJ2K01.00 shows how the JPEG 2000 codestream fits into the context of the overall NSIF file format and provides information about file header, image subheader and Tagged Record Extension (TRE) settings that are related to the JPEG 2000 codestream content for which NSIF implementations are required to comply.

1 Scope

This document specifies the test requirements and criteria to be achieved to claim conformance to the BIIF Profile of JPEG 2000, version 01.00. It provides a framework for applying the abstract test suites provided in ISO/IEC 15444-4, defining additional abstract test suites specific to BPJ2K01.00, specifying executable test cases, and for establishing the procedures to be followed during conformance testing.

This document provides test requirements to establish conformance for:

- Encoding within the JPEG 2000, Part 1, Profile 1 constraints
- Encoding within the NSIF Preferred JPEG 2000 Encoding (NPJE) constraints
- Decoding codestreams compliant with JPEG 2000 Part 1, Profile 1 constraints
- Decoding codestreams compliant with NPJE constraints
- Parsing, chipping, and repackaging JPEG 2000 codestreams
- Decoding J2P file format
- NSIF file structure and field population when using JPEG 2000
- Application and use of the J2KLRA Tagged Record Extension (TRE)
- NSIF complexity level constraints when using JPEG 2000
- Encoding within the Exploitation Preferred JPEG 2000 Encoding (EPJE) constraints **TBR001**
- Decoding within the Exploitation Preferred JPEG 2000 Encoding (EPJE) constraints **TBR001**

2 References

The following references document the technical details, legal codestream syntax, and testing methodology that serve as a basis for the test requirements provided in this document. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on these Recommations and Standards are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Normative References

ITU-T Recommendation T.800 | ISO/IEC 15444-1, Information technology — JPEG 2000 Image Coding System.

ITU-T Recommendation T.800 | ISO/IEC 15444-1 Amendment 1, Information technology — JPEG 2000 Image Coding System, Amendment 1.

ITU-T Recommendation T.800 | ISO/IEC 15444-1 Amendment 2, Information technology — JPEG 2000 Image Coding System, Amendment 2.

ITU-T Recommendation T.800 | ISO/IEC 15444-1 Corrigendum 1, Information technology — JPEG 2000 Image Coding System.

ITU-T Recommendation T.800 | ISO/IEC 15444-1 Corrigendum 2, Information technology — JPEG 2000 Image Coding System.

ITU-T Recommendation T.800 | ISO/IEC 15444-1 Corrigendum 3, Information technology — JPEG 2000 Image Coding System.

ISO/IEC 12087-5 Information Technology; Computer graphics and image processing; Image Processing and Interchange; Functional Specification - Part 5: Basic Image Interchange Format, 1 December 1998

NSIF01.00 BIIF Profile: NATO Secondary Imagery Format (NSIF) Version 01.00

BPJ2K01.00 BIIF Profile for JPEG 2000

ISO/IEC 15444-4:2002 Information Technology - JPEG 2000 Image coding system – Part 4: Conformance Testing

2.2 Non-Normative References

MIL-STD-2500B. National Imagery Transmission Format (Version 2.1) for the National Imagery Transmission Format Standard, 22 August 1997. Notice 1, 2 October 1998; Notice 2, 1 March 2001.

MIL-STD-188-198A. Joint Photographic Experts Group (JPEG) Image Compression for the National Imagery Transmission Format Standard, 15 December 1993. Notice 1, 12 October 1994; Notice 2, 14 March 1997.

Copies of U.S. military standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094, or the The Department of Defense Single Stock Point for Military Specifications, Standards and Related Publications website (http://dodssp.daps.mil/).

3 Definitions

3.1 Encode

To create or construct a J2K codestream from a given image array or data set.

3.2 Cclass

Three Compliance Classes are defined in Annex A of ISO/IEC WD15444-4:2002. These Cclasses define level of image quality gurantees for decoders and guidance for encoders to produce J2K Codestreams.

3.3 Decode

To create or construct an image array or dataset from a given a J2K codestream

3.4 Implementation Under Test (IUT)

A candidate implementaion for which conformance testing is being performed.

3.5 Implementor

Programmer who develops or assembles software, which complies with J2K features, requirements or constraints as described in this document and those listed in the Normative References section.

3.6 J2K Compliance

The ability of an implementation to create and output J2K compliant files and/or to accept and decode J2K files.

3.7 Parse

3.8 Repack

3.9 Reformat

4 Abbreviations

ACCESSID	Access ID
BIIF	Basic Image Interchange Format
Bit	Binary Digit
bpp	Bits-Per-Pixel
C	Components
CCS	Common Coordinate System
CLEVEL(s)	Complexity Level(s)

COD	Coding Style Default Marker
COMRAT	Compression Rate Code
CPRL	Component Position Resolution Layer
DCT	Discrete Cosine Transform
DTED	Digital Terrain Elevation Data
DWT	Discrete Wavelet Transformation
EOC	End Of Codestream
EPJE	Exploitation Preferred JPEG Encoding
ETS	Executable Test Suite
IC	Image Compression
ICAT	Image Category
ICS	Implementation Compliance Statement
IDWT	Inverse Discrete Wavelet Transformation
IEC	International Electrotechnical Commission
ILOC	Image Location
IMODE	Imagery Mode
IMODE B	Band Interleaved by Block
ISO	International Standards Organization
ITU	International Telecommunication Union
IUT	Implementation Under Test
J2K	JPEG 2000
JP2	JPEG 2000 minimal interchange format
JPC	JPEG Codestream
JPEG	Joint Photographic Experts Group
JPX	JPEG 2000 XML based file format
LRCP	Layer Resolution Component Position
LUT	Look-up Table
MIL-STD	Military Standard (US)
NBN	NITFS/BIIF/NSIF, NSIF/BIIF/NITFS
NBPP	Number of Bits-Per-Pixel
NBPC	Number of Blocks Per Column
NBPR	Number of Blocks Per Row
NCOLS	Number of Columns
NITF	National Imagery Transmission Format
NITFS	NITF Standard
NPJE	NSIF Preferred JPEG 2000 Encoding
NPPBH	Number of Pixels Per Block Horizontal
NPPBV	Number of Pixels Per Block Vertical
NROWS	Number of Rows
OSTAID	Originating Station ID

PC	Personal Computer
PLM	Packet Length, in Main header
PLT	Packet Length, in Tile-part header
QCD	Quantization Default Marker
RGB	Red-Green-Blue
RGN	Region of Interest
RPCL	Resolution Position Component Layer
SOC	Start of Codestream Marker
SOD	Start of Data Marker
SOT	Start of Tile-part Marker
Ssiz	Precision in bits
SIZ	Image and Tile Size Marker
TBD	To Be Determined
TBR	To Be Revised
TLM	Tile-part Length Markers
TRE	Tagged Record Extension
XOsiz	Horizontal offset from the origin of the reference grid to the left side of the image area
Xsiz	Width of the reference grid
XTsiz	Width of one reference tile with respect to the reference grid
XRsiz	Horizontal separation of samples with respect to the reference grid
YOsiz	Verical offset from the origin of the reference grid to the top side of the image area
Ysiz	Height of the reference grid
YTsiz	Height of one reference tile with respect to the reference grid
YRsiz	Horizontal separation of samples with respect to the reference grid
YCbCr	Y=Brightness of signal, Cb=Chrominance (blue), Cr=Chrominance (red)

5 Conformance

The following section describes the features and functions that an IUT, when applicable, will be tested against and must successfully perform inorder to achieve NITFS/BIIF/NSIF (NBN) JPEG 2000 (J2K) conformance. The test requirements are divided into five areas; encode, decode, repack, file format and Clevel constraints.

ISO/IEC 15444-4 describes conformance for JPEG 2000 decoders in terms of a system of guarantees. These guarantees serve to discourage encoders from producing codestreams that will be exceedingly difficult or impossible for a decoder to process, to encourage decoders to provide quality images from any reasonable codestream, and to encourage use of the flexibility and scalability of JPEG 2000 codestreams.

Profiles define a subset of technology, from ITU-T T.800 | ISO/IEC 15444-1: JPEG 2000, to meet the needs of a given application with limits on parameters within a selected technology. Profiles limit

bitstreams. Decoders define capabilities for all bitstreams within a profile. Encoders achieve quality guarantees for particular decoders by encoding bitstreams that meet a particular profile definition.

Compliance classes (Cclass) define guarantees of a given level of image quality for a decoder and guidance for encoders to produce codestreams that are easily decodable by compliant decoders. Essentially, if a JPEG 2000 encoder produces a codestream with certain properties, then a decoder of a certain Cclass will be capable of producing an image with some defined level of quality. The compliance class of a decoder is based solely on passing certain tests. The tests in ISO/IEC 15444-4 are designed to require a compliant decoder to be capable of decoding all codestreams with a set of defined properties.

Profiles and compliance classes

Two profiles are defined in ITU-T T.800 | ISO/IEC 15444-1 Amendment 1, labeled Profile 0 and Profile 1. The two profiles describe bitstream constraints for an ITU-T T.800 | ISO/IEC 15444-1 encoder. Profile 0 is a subset of Profile 1. Hence, any implementation capable of decoding Profile 1 test streams shall be capable of passing the compliance tests for Profile 0 of the same Cclass. The BPJ2K01.00 requires compliance with Profile 1. The Cclasses define levels of image quality guarantees for decoders and guidance for encoders to produce codestreams that are easily decodable by compliant decoders. Cclass guarantees increase with the increasing Cclass numbers.

Decoders

NSIF compliant decoders are required to fully decode any JPEG 2000 Part-1, Profile-1 file produced within the constraints of the NSIF complexity level implemented by the NSIF decoder. In order to determine the accuracy of NSIF JPEG 2000 decoders, the implementation must have the means to save decoded images into an uncompressed NBN file. This will allow for comparison between the decoded image and a reference test image.

Encoders and codestreams

ITU-T T.800 | ISO/IEC 15444-1 Amendment 1 describes two restricted profiles (Profile 0 and Profile 1) that provide guarantees concerning the parameter ranges and information placement in a codestream. Since codestream limitations may also adversely affect scalability and interoperability, the smallest possible number of limitations are imposed by these profiles. Encoders may also be required to conform to certain guarantees in particular application areas of interest that are outside the scope of IEC/ISO 15444-4. Accordingly, BPJ2K01.00 imposes constraints on encoders required to comply with the NPJE rules.

Implementation compliance statement

Evaluation of compliance for a particular implementation requires a statement of the options that have been implemented. This will allow the implementation to be tested for compliance against only the relevant requirements of BPJ2K01.00. Such a statement is called an Implementation Compliance Statement (ICS). The ICS shall contain only options within the framework of requirements specified in

the ISO/IEC 15444-1 Standard and the BPJ2K01.00. Examples of these can be found in ISO/IEC 15444-4 Annex E for decoders and Annex F for encoders.

Abstract test suites

The Abstract Test Suites (ATS) define general tests for sub-systems of ISO/IEC 15444-1. In addition to the ATS available in ISO/IEC 15444-4, ATS specific to the BPJ2K01.00 will be used to provide the basis for developing executable test cases tailored to the test requirements specified herein. Each ATS will include the following parts as defined in ISO/IEC 15444-4, Annex C.

a) Test purpose: What the test requirement is.

b) Test Method: The procedures to be followed for the given ATS.

c) Reference: The portion of the ISO document that is being tested by the given ATS.

Reference Decoder

The Reference decoder is used for the evaluation of compliance of an encoder. The reference decoder is defined in ITU-T T.800 | IS 15444-5. The reference decoder has been developed by the ISO WG 1 committee for purpose of guidance for implementor and data providers. The reference decoder should be able to decode all encoder-developed codestreams that fall within reasonable limits of encoder applications.

Encoder Compliance

It is not a requirement to implement and/or support all possible encoding modes or capabilities of JPEG2000. However many modes and capabilities are desirable for many applications. It is not a requirement for an encoder to produce any specific codestream. However, any codestream that is produced must be a legal JPEG2000 codestream. A reasonable way this can be verified is by decoding the codestream with the reference decoder.

Decoder Compliance Classes

Compliant implementations of the decoder are not required to decode each codestream in its entirety but are required to guarantee performance up to one of a collection of Profiles and Cclasses. These guarantees are directly connected with the resources required by a decoder. They may be interpreted as a contract by the implementation to recover, decode and transform a well-defined minimal subset of the information contained in any codestream. This contract is described in a manner that scales with the Cclass. The contract may be exploited by content providers to optimize recovered image quality over a family of decoders according to their known Cclasses. For a given Profile, decoder guarantees are expressed in terms of several parameters including decoded image dimensions, H (height) and W (width), and a number of components, C, for the Cclass. The parameters are not dependent on the codestream that is actually being decoded. ISO/IEC 15444-4, Annex C defines the parameters and the classes for which compliance claims may be made and tested. When decoding NPJE constrained

codestreams, decoders are required to fully decode such codestreams within their NBN complexity level capabilities. For all other JPEG 2000 Part 1 Profile 1 codestreams contained in NBN files, the decoder must also correctly decode the file up to the limits of the complexity level capabilities.

6 Test Requirements

6.1 Encode JPEG 2000, Part 1 Profile 1 Compliant Codestreams

This section describes the features and constraints of a J2K codestream created by an implementation under the BIIF Profile for JPEG 2000. An IUT must correctly encode image arrays into J2K codestreams. Implementors can find the J2K codestream syntax, marker segment definitions, filtering process and coding algorithms in ISO/IEC 15444-1:2002 JPEG 2000 Image Coding System Part 1. Listed below are test requirements or criteria of Profile 1 of ISO/IEC 15444-1:2002 JPEG 2000 Part 1: Image Coding System.

6.1.1 SOC Marker.

The SOC marker (0xFF4F) is the first marker segment in the J2K codestream. The SOC Marker only appears in the main header of the J2K codestream.

6.1.2 SOT Marker.

The SOT marker (0xFF90) is the first marker segment in each tile part of the J2K codestream. The SOT marker only appears in tile headers of the J2K codestream.

6.1.3 SOD Marker.

The SOD marker (0xFF93) is the last marker segment of each tile part header in the J2K codestream. The SOD marker only appears in tile headers of the J2K codestream.

6.1.4 EOC Marker.

The EOC marker (0xFFD9) is the last marker segment in the J2K codestream. The EOC marker only appears in the bitstream portion of the J2K codestream.

6.1.5 SIZ Marker.

The SIZ marker (0xFF51) is the second marker segment in the main header of the J2K codestream. The SIZ marker only appears in the main header of the J2K codestream.

6.1.6 COD Marker.

The COD marker (0xFF52) appears in the main header of the J2K codestream and appears no more than once in the first tile-part header of any tile. COD markers do not appear in the bitstream of the J2K codestream.

6.1.7 COC Marker.

The COC marker (0xFF53) appears no more than once per component within the main header or in the first tile-part header of a given tile in the J2K codestream. (Use of COC markers is optional.) COC markers do not appear in the bitstream of the J2K codestream.

6.1.8 RGN Marker.

RGN marker (0xFF5E) only appears in the main header or first tile-part header of a given tile in the J2K codestream. (Use of RGN markers is optional.) RGN markers do not appear in the bitstream of the J2K codestream.

6.1.9 QCD Marker.

There is one, and only one, QCD marker (0xFF5C) in the main header of the J2K codestream and no more than one in the first tile-part header of any tile. QCD markers do not appear in the bitstream of the J2K codestream.

6.1.10 QCC Marker.

The QCC marker (0xFF5D) appears no more than once per component, within the main header or in the first tile-part header of a given tile in the J2K codestream. (Use of QCC markers is optional.) QCC markers do not appear in the bitstream of the J2K codestream.

6.1.11 POC Marker.

POC markers (0xFF5F) only one appears in any main or tile header of the J2K codestream. POC markers do not appear in the bitstream of the J2K codestream. (Use of POC markers or Progression order changes in a J2K codestream is optional.)

6.1.12 TLM Marker.

TLM markers (0xFF55) only appear in the main header of the J2K codestream. (Use of TLM markers is optional.)

6.1.13 PLM Marker.

PLM markers (0xFF57) only appear in the main header of the J2K codestream. (Use of PLM markers is optional.)

6.1.14 PLT Marker.

PLT markers (0xFF58) only appear in the tile header of the J2K codestream. The PLT marker must appear in any tile-part header before the packets whose lengths they describe. (Use of PLT markers is optional.)

6.1.15 PPM Marker.

PPM markers (0xFF60) only appear in the main header of the J2K codestream. All packet headers are present in the main header of the J2K codestream. (Use of PPM markers is optional.) PPT markers (0xFF61) do not appear in the same J2K codestream with PPM markers.

6.1.16 PPT Marker.

A PPT marker (0xFF61) only appears in the tile header of the J2K codestream. The PPT marker must appear in any tile-part header before the packets whose headers are contained in the PPT appear. (Use of PPT markers is optional.)

6.1.17 SOP Marker.

A SOP marker (0xFF91) only appears in the bit stream portion of the J2K codestream. (Use of SOP markers is optional.)

6.1.18 EPH Marker.

If indicated by the proper COD marker segment, the EPH marker (0xFF92) appears in the J2K codestream.

6.1.19 CRG Marker.

The CRG marker (0xFF63) only appears in the main header of the J2K codestream. (Use of CRG markers is optional.)

6.1.20 COM Marker.

COM markers (0xFF64) only appear in the main header of the J2K codestream. (Use of COM markers is optional.)

6.1.21 9-7I Filtering.

9-7 irreversible filtering is used for other than numerically lossless encoding.

6.1.22 5-3R Filtering.

5-3 reversible filtering is used for numerically lossless encoding.

6.1.23 Progression Order.

The J2K codestream contains any of the allowed progression orders, to include: LRCP, RLCP, RPCL, PCRL, and CPRL. (0 = Progression Order field value = 4.)

Table 1. Progression Order Field

Values (bits) MSB LSB	Progression Order
0000 0000	Layer – resolution level – component – position progression (LRCP)
0000 0001	Resolution level- layer – component – position progression (RLCP)
0000 0010	Resolution level – position – component – layer progression (RPCL)
0000 0011	Position – component – resolution level – layer progression (PCRL)
0000 0100	Component – position – resolution level – layer progression (CPRL)
	All other values reserved

6.1.24 Wavelet Decomposition.

The J2K codestream contains between 0 and 32 decomposition levels. (0 = N_{levels} field value = 32.)

6.1.25 Profile Indicator.

The J2K codestream contains a profile indicator value between 0 and 2. (0 = Rsiz field value = 2.)

6.1.26 Empty Tiles.

Per user selection, the J2K codestream contains empty tiles.

6.1.27 Components.

The J2K codestream contains a maximum of 16384 components. (1 = Csiz field value = 16384.)

6.1.28 RGN Marker Limit.

The SPrgn value is less than or equal to 37.

6.1.29 Code Block Size.

The code block height and width value is 64 or less. (xcb = 6, ycb = 6 .)

6.1.30 Encode LL Resolution.

TBD002 For each tile in the image, the LL(0) subband is = 128.

6.1.31 Multiple Codestreams

Multiple J2K compressed image segments created from a single image contain identical compression parameters. ie. quantization, layering, wavelet transform filter, number of decomposition levels, progression order, tiling size, codeblock size, precint size, and coding defaults.

6.2 Encode NPJE Contrained Codestreams

An IUT correctly encodes image arrays into J2K codestreams within the criteria of ISO/IEC 15444-1:2002 JPEG 2000 Image Coding System, listed in section 6.1.1, and the NSIF/BIIF/NITF (NBN) Preferred JPEG 2000 Encoding contraints described in the BIIF Profile for JPEG 2000 and summarized below.

6.2.1 L-R-C-P Progression Order.

J2K codestreams are in Layer-Resolution-Component-Position progression order. (Progression Order field = 0x0) All packets for the 1st tile layer resolution and component, followed by the 2nd component, then the 3rd component and so on through all components. This is followed by all packets for the 1st tile, layer, 2nd resolution and all its components. See figure 1, LRCP Packet Order.

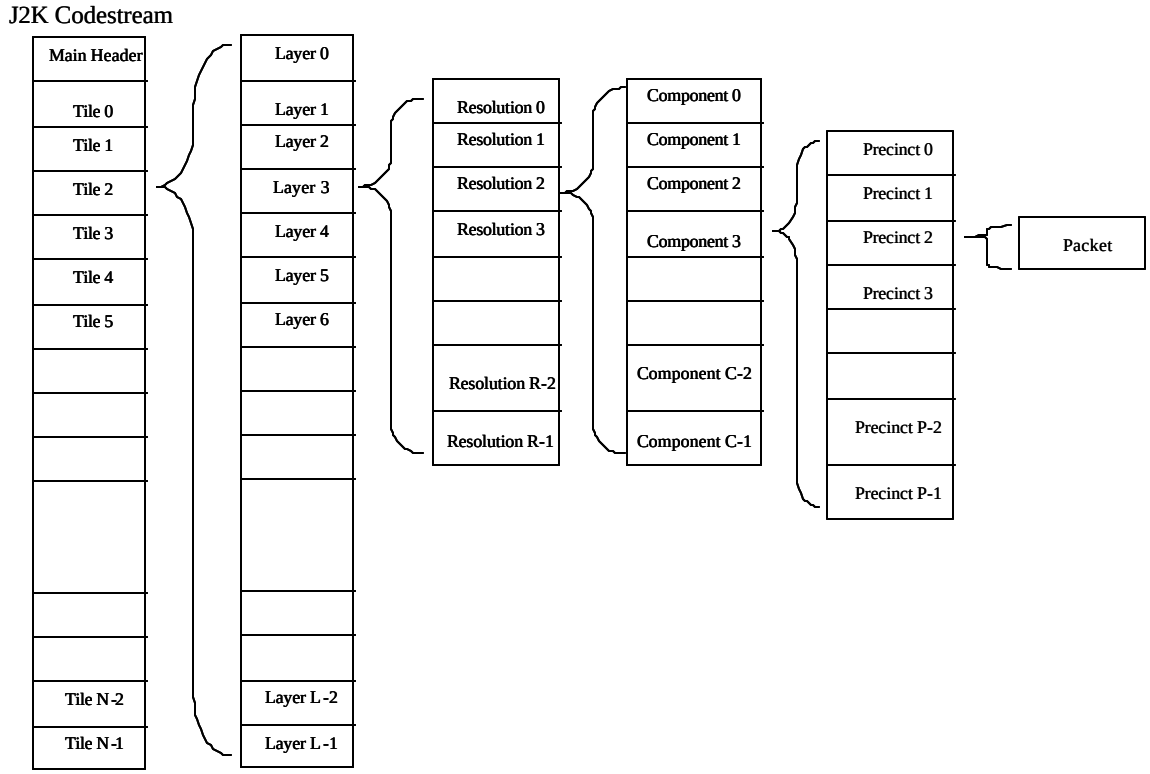

Figure 1. LRCP Packet Order

6.2.2 Wavelet Decomposition.

The J2K codestream contains 5 wavelet decomposition levels. ($N_{levels} = 5$.)

6.2.3 Profile Indicator.

The J2K codestream contains a profile indicator value of 1 or 2. (Rsiz field value = 0x0002 or 0x0001)

6.2.4 Quality Layers. **TBD003**

The J2K codestream contains approximately 20 quality layers for lossless compressed single band 8 bit-per-pixel imagery. (NLAYERS_O ≅ 20 + 20 * $\log_{10}$(# bands))

6.2.5 Discrete layers.

J2K codestream layers have unique bit rates. Target rates are summarized in the BIIF Profile for JPEG 2000.

6.2.6 Tiling.

Size of the J2K reference tiles is 1024 x 1024 (XTsiz=YTsiz= 0x0400).

6.2.7 Tile Parts.

Encoded tiles within the J2K codestream contain only one tile-part.

6.2.8 Fixed Tiles.

All tiles within the J2K codestream have the same number of components, layers, and decomposition levels.

6.2.9 TLM Markers.

J2K codestream contains TLM markers.

6.2.10 PLT Markers.

J2K codestream contains PLT markers.

6.2.11 Code Block Size.

J2K codestream utilizes a code block size of 64 by 64 (xcb=ycb=6).

6.2.12 Image Offset.

Image offset values (XOsiz and YOsiz) are set to zero.

6.2.13 Tile Offset.

Tile offset values (XTOsiz and YTOsiz) are set to zero.

6.2.14 Component Scaling/Separation.

The sample separation values, XRsiz and YRsiz, are set to "1".

6.2.15 J2KLRA Tagged Record Extension (TRE).

J2KLRA TRE is included in NBN files containing J2K encoded data. Detailed requirements for the structure of the J2KLRA are described in section 6.7 of this document.

6.2.16 Precinct Size.

J2K code stream contains a precinct size of 2^15 x 2^15. (PPx = 0xF, PPy = 0xF)

6.2.17 Minimal J2K File Formats. **TBR004**

NBN files containing J2K codestreams include only the minimal JPEG 2000 file format within the NITFS/BIIF/NSIF wrapper that is critical for NBN applications to decode the associated image data. For example JPC versus JP2, or JP2 versus the JPX format.

6.3 Decode JPEG 2000 Part 1 Profile-1

An IUT must correctly decode any valid JPEG 2000 ISO 15444 Part-1, Profile-1, codestream to the limit of its available resources, and clevel constraints. In many cases clevel limitations will be met long before the decoding limits of JPEG 2000 Profile-1 codestreams. This section describes the features and restrictions, of J2K Part-1, Profile-1 codestreams that an IUT must be able to ingest and decode. Since Profile 0 is a subset of Profile 1 the implementation must also be capable of passing compliance tests for Profile 0.

6.3.1 9-7I Filtering.

IUT decodes J2K codestreams created with 9-7 irreversible filtering.

6.3.2 5-3R Filtering.

IUT decodes J2K codestreams created with 5-3 reversible filtering.

6.3.3 Progression Order.

IUT decodes J2K codestreams created with each of the following progression orders: LRCP, RLCP, RPCL, PCRL, and CPRL.

6.3.4 Wavelet Decomposition.

IUT decodes J2K codestreams created with 32 decomposition levels.

6.3.5 Quality Layers.

IUT decodes J2K codestreams created with 65535 quality layers.

6.3.6 Image/Grid Size.

IUT decodes J2K codestreams created with reference grid sizes from 1x1 to $(2^{31}-1)$ x $(2^{31}-1)$.

6.3.7 Tile Size.

IUT decodes J2K codestreams created with tile sizes from 1x1 to $(2^{31}-1)$ x $(2^{31}-1)$.

6.3.8 Precinct Size.

IUT decodes J2K codestreams created with precinct exponent values from 0 to 15. (0x0 = PPx = 0xF, 0x0 = PPy = 0xF.)

6.3.9 Empty Tiles.

IUT decodes J2K codestreams containing empty tiles.

6.3.10 Missing Tiles.

IUT decodes J2K codestreams in which packets for entire tiles are missing.

6.3.11 Components.

IUT decodes J2K codestreams containing up to 16384 components.

6.3.12 8-Bit Precision.

IUT decodes J2K codestreams containing 8-bit precision encoded data.

6.3.13 11-Bit Precision.

IUT decodes J2K codestreams containing 11-bit precision encoded data.

6.3.14 12-Bit Precision.

IUT decodes J2K codestreams containing 12-bit precision encoded data.

6.3.15 16-Bit Precision.

IUT decodes J2K codestreams containing 16-bit precision encoded data.

6.3.16 32-Bit Precision.

IUT decodes J2K codestreams containing 32-bit precision encoded data.

6.3.17 Image Origin.

IUT decodes J2K codestreams created with image offset from origin values from 0 to (2^{31}-2).

6.3.18 Tile Origin.

IUT decodes J2K codestreams with tile offset from origin value from 0 to (2^{31}-2).

6.3.19 Code Block Size.

IUT decodes J2K codestreams with code block height or width exponent offset values from 2 to 10. (Code block exponent offset are further restricted so that xcb + ycb <=12).

6.3.20 COC Marker.

IUT decodes J2K codestreams containing COC marker (0xFF53) segments.

6.3.21 RGN Marker.

IUT decodes J2K codestreams containing Region of Interest marker (0xF5E) segments.

6.3.22 QCD Marker.

IUT decodes J2K codestreams containing Quantization Default marker (0xF5C) segments.

6.3.23 QCC Marker.

IUT decodes J2K codestreams containing QCC marker (0xFF5D) segments.

6.3.24 POC Marker.

IUT decodes J2K codestreams containing POC marker (0xFF5F) segments.

6.3.25 TLM Marker.

IUT decodes J2K codestreams containing TLM marker (0xFF55) segments.

6.3.26 PLM Marker.

IUT decodes J2K codestreams containing PLM marker (0xFF57) segments.

6.3.27 PLT Marker.

IUT decodes J2K codestreams containing PLT marker (0xFF58) segments.

6.3.28 PPM Marker.

IUT decodes J2K codestreams containing PPM marker (0xFF60) segments.

6.3.29 PPT Marker.

IUT decodes J2K codestreams containing PPT marker (0xFF61) segments.

6.3.30 SOP Marker.

IUT decodes J2K codestreams containing SOP marker (0xFF91) segments.

6.3.31 EPH Marker.

IUT decodes J2K codestreams containing EPH marker (0xFF92) segments.

6.3.32 CRG Marker.

IUT decodes J2K codestreams containing CRG marker (0xFF63) segments.

6.3.33 COM Marker.

IUT decodes J2K codestreams containing COM marker (0xFF64) segments.

6.3.34 Marker Precedence

IUT decodes J2K codestreams giving precedence to markers in the tile header versus the JPEG main header.

6.3.35 Decoder Cclass Guarantee.

IUT has sufficient resources to accurately decode J2K codestreams according to the codestream's compliance class (Cclass), J2K Profile and IUT's Clevel. Table 2 summarizes the J2K codestream Cclass that an IUT must fully decode given the CLEVEL support requirement of the IUT. The definitions of J2K Cclasses codestream parameters are described in ISO/IEC 15444-4:2002 Information Technology - JPEG 2000 Image coding system – Part 4, Annex A. Table 3 provides NITF/NSIF file CLEVEL compliance ranges as well as their mapping to JPEG 2000 Cclasses.

6.3.35.1 Cclass 0/ Clevel.

IUT accurately decodes Profile 1, Cclass 0 ISO test codestreams.

6.3.35.2 Cclass 1/ Clevel.

IUT accurately decodes Profile 1, Cclass 1 ISO test codestreams.

6.3.35.3 Cclass 2/ Clevel.

IUT accurately decodes Profile 1, Cclass 2 ISO test codestreams.

Table 2. Cclass vs NBN System Complexity Levels

IUT Support Requirement	IUT Complexity Level Support Requirement			
J2K Cclasses	3	5	6	7, 9
0	S	S	S	S
1	S	S	S	S
2	P^1	P^2	P^3	S

S = Guaranteed resources to fully decode the J2K ISO subcommittee's test codestreams.
P = Resources to partially decode, or quit while decoding J2K codestream.
Note 1: IUT guarantees resources for all Cclass parameters, except Size, Components, N_{cb}, and N_{comp}.
Note 2: IUT guarantees resources for all Cclass parameters, except Size, N_{cb}, and N_{comp}.
Note 3: IUT guarantees resources for all Cclass parameters, except N_{cb}, and N_{comp}.

6.3.36 Quit Decoding. **TBD006**

IUT quits decoding J2K codestreams that exceed the Cclass level parameter limitations described in ISO/IEC 15444-4:2002 Part 4, Annex A without adversely affecting the operation of the IUT. An IUT need not decode, or may quit decoding a J2K codestream once that codestream exceeds the Cclass level parameter guarantees.

6.3.37 Reduced Resolution.

IUT decodes and displays J2K codestreams to any user-selected resolution encoded within the J2K codestream.

6.3.38 Display NBN J2K.

When displaying imagery decoded from NBN J2K files, IUT displays the image data according to guidelines for displaying NBN images, ie attention to Display and Attachment levels, IREPBAND, NROWS, NCOLS and ILOC values.

6.3.39 Truncated File.

IUT decodes and displays available image data from a J2K codestreams that has been truncated.

6.3.40 Truncated File Warning.

IUT alerts users that compressed file is truncated or incomplete with respect to the JPEG 2000 header and format information.

6.3.41 NSIF Data Length Precedence

IUT ingest and decodes NSIF segments giving precedence to the segment data length specified in the NSIF main header versus lengths or parameters specified within the segment data area.

6.4 Decode NPJE Constrainted Codestreams

An IUT must correctly decode any NPJE contraint codestream to the limit of its available resources, and clevel constraints. This section describes the features and restrictions of NPJE codestreams that an IUT must be able to ingest and decode.

6.4.1 NPJE Progress Order.

IUT decodes J2K codestreams created with the LRCP progression orders.

6.4.2 NPJE Wavelet Decomposition.

IUT decodes J2K codestreams created with 5 decomposition levels.

6.4.3 NPJE Quality Layers.

IUT decodes J2K codestreams created with 20 quality layers.

6.4.4 Clevel Image/Grid Size.

IUT decodes J2K codestreams created with grid size equal to the largest allowed image size for the NBN Clevel for which compliance is sought.

6.4.5 NPJE Tile Size.

IUT decodes J2K codestreams created with a tile size of 1024 by 1024.

6.4.6 NPJE Precint Size.

IUT decodes J2K codestreams created with precinct exponent value of 15. (PPx = 0xF, PPy = 0xF.)

6.4.7 NPJE Image Origin.

IUT decodes J2K codestreams created with the image offset from origin value equal to 0.

6.4.8 NPJE Tile Origin.

IUT decodes J2K codestreams with the tile offset from origin value equal to 0.

6.4.9 NPJE Code Block Size.

IUT decodes J2K codestreams containing code block height or width = 64. (Exponent offsets xcb and ycb = 6)

6.5 Repack JPEG 2000 Codestream

This section describes possible deltas in repackaged J2K codestreams. The J2K codestreams produced by an IUT that chooses to repackage or modify an exsisting J2K codestream must demonstrate the following requirements. For most of the criteria listed this section, the repakaging shall not be done by decoding the JPEG codestream packets and re-encoding the data or by labeling packets as not being present in the codestream. But rather, J2K packets from the original codestream will be rearranged and/or removed to form the desired J2K codestream. Implementations must be able to modify or create new marker segments and header information to describe the repackaged codestream. The IUT may use an automated process inorder to repackage the codestream, or allow the user to make specific choices in repackaging the compressed data. e.g. IUT automatically drops quality layers of tiles that do not contain pixel values exhibiting a certain contrast level across the tile, or IUT discards tiles not specifically selected by the operator via the user interface or a feature recognition algorithm.

6.5.1 Positional Subset (Chipping).

IUT repackages J2K codestreams with a subset of the pixels contained in an original JPEG 2000 test codestream.

6.5.1.1 On Tile Boundaries

IUT repackages J2K codestreams using a subset of the whole tiles contained in an original JPEG 2000 test codestream.

6.5.1.2 Off Tile Boundaries

IUT repackages J2K codestreams using a subset of the whole or partial tiles contained in an original JPEG 2000 test codestream. (IUT will have to recode tiles that have lost some of their original pixels).

6.5.1.3 On Codeblock Boundaries

IUT repackages J2K codestreams using a subset of the whole codeblocks contained in an original JPEG 2000 test codestream.

6.5.2 Empty Tiles.

IUT repackages J2K codestreams with more empty tiles when compared to the image encoded in the original JPEG 2000 test codestream.

6.5.3 Reduced Resolution.

IUT repackaged J2K codestream with a reduced resolution of the image encoded in the original JPEG 2000 test codestream.

6.5.4 Reduced Number of Components.

IUT repackages J2K codestream with fewer components than the image encoded in the original JPEG 2000 test codestream.

6.5.5 Reduced Number of Layers.

IUT repackages J2K codestream with fewer quality layers than the image encoded in the original JPEG 2000 test codestream.

6.5.6 Region of Interest.

IUT repackages J2K codestream with regions encoded with lower quality than the same region in the original JPEG 2000 test codestream. (e.g. On tile or precinct boundaries.)

6.5.7 Progression Order.

IUT repackages J2K codestream with a new progression change, or different progression order, than the image encoded in the original JPEG 2000 test codestream.

6.5.8 Repackage NPJE to NPJE Constrained Codestream.

IUT repacks an exsisting NPJE codestream into another NPJE constrained codestream.

6.5.9 Repackage NBN J2K to NBN J2K files.

IUT repacks an exsisting NBN J2K 2000 Part 1 Profile 1 files into another NBN J2K file.

6.5.10 Repackage NBN J2K to NPJE NBN files.

IUT repacks an exsisting NBN J2K 2000 Part 1 Profile 1 files into an NPJE constrained NBN file.

6.5.11 Header Correction

IUT updates header information to reflect newly repackaged J2K codestream.

6.2.11.1 JPEG 2000 Markers

IUT updates J2K header information to reflect newly repackaged J2K codestream.

6.2.11.2 NSIF Header

IUT updates NSIF image subheader information to reflect newly repackaged J2K codestream.

6.2.11.3 J2KLRA

IUT updates J2KLRA fields to reflect newly repackaged J2K codestream.

6.5.12 Parameter Broadening. **TBD008**

Xsiz, Ysiz, XOsiz, YOsiz, XRsiz, YRsiz, Ltlm, Ztlm, N_{Levels}, and N_{Layers}

6.6 Decode J2K File Format. TBD009

6.6.1 JP2 file.

IUT accurately decodes JP2 files. The IUT's decoding accuracy is determined by decoding the ISO reference JP2 test file. Annex C of this document list acceptible error levels for each reference JP2 file.

6.6.2 Multiple Images.

IUT decodes and displays the first compressed image from a JP2 file containing more than one image. ie Multiple Contiguous Codestream Boxes in the JP2 format. (Implementation may ignore subsequent images.)

6.7 File Structure

The following paragraphs describe contrainst and requirements for selected fields of NBN J2K files created by an IUT. NBN Image Subheader. Key fields in the image subheader are used to describe, and are functions of, values found in the associated JPEG 2000 codestream. This section describes those fields.

6.7.1 NROWS NCOLS.

NROWS = $\lceil Ysiz / IMAG\_New) \rceil - \lceil YOsiz / IMAG\_New) \rceil$, NCOLS = $\lceil Xsiz / IMAG\_New) \rceil - \lceil XOsiz / IMAG\_New) \rceil$. These fields reflect the maximal image samples in the row and column dimension over all image components of JPEG 2000 codestream.

6.7.2 PVTYPE.

The PVTYPE field contains a value determind by examination of values of Ssiz for all *i* components of the JPEG 2000 codestream. PVTYPE = B for $\max_i(Ssiz^i) = 0$, PVTYPE = INT for $\max_i(Ssiz^i) \in [1, 31]$, PVTYPE = SI for $\max_i(Ssiz^i) \in [128,159]$.

6.7.3 IREP.

IREP field contains the value appropriate for uncompressed image represented by the JPEG 2000 codestream.

6.7.4 ABPP.

The ABPP value is equal to the NBPP field value.

6.7.5 NBPP.

NBPP = $\max_i(Ssiz^i \& 0x7F)+1$. This field reflects the maximum component bitdepth over all *i* components in the JPEG 2000 codestream.

6.7.6 IC.

Image Compression code is set to C8.

6.7.7 COMRAT.

6.7.7.1 Rate.

Compression rate field is set to the approximate number of bits-per-pixel-per-band for the compressed image.

6.7.7.2 Type N.

This field also includes the N prefix to signal numerically lossless compression when the associated JPEG codestream indicates 5-3 reversible filtering.

6.7.7.3 Type V.

This field also includes the V prefix to signal visually lossless compression when the associated JPEG codestream indicates 9-7 irreversible filtering.

6.7.7.4 Type Blank.

This field will not have a prefix, thus signalling lossy compression, when the associated JPEG codestream indicates irreversible encoding or a compressed bit rate #3.5bpp for 8 bpp source imagery.

6.7.8 NBANDS XBANDS.

These fields contain a value equal to the Csiz value in the Image and tile size marker of the associated J2K codestream. The value indicates the number of components in the J2K codestreams.

6.7.9 IMODE.

This field is set to the value ‘B’.

6.7.10 NBPR NBPC.

NBPR = $\lceil (Xsiz - XTO)/Xtsiz \rceil$, NBPC = $\lceil (Ysiz - YTO)/Ytsiz \rceil$. These fields contain a value determined by examination of values for tiling geometry in the image and size marker of the JPEG 2000 codestream.

6.7.11 NPPBH NPPBV.

NPPBH = $\lfloor XTsiz/(\min_i(XRsiz^i)) \rfloor$, NPPBV = $\lfloor YTsiz/(\min_i(YRsiz^i)) \rfloor$. These fields contain a value determined by examination of values for tiling geometry and subsampling of all *i* components in the image and size marker of the JPEG 2000 codestream.

6.7.12 IMAG.

This field contains the approximate image magnification (or reduction) factor of the compressed image data relative to the original source image. IMAG = /2, if source image dimension is 512x512, and compressed image dimension is 256x256.

6.8 J2KLRA TRE

The J2KLRA tagged record extension shall be included with any imagery that is compressed following the NSIF/BIIF/NITF Preferred JPEG 2000 Encoding (NPJE) recommendation and any NPJE compliant repackaged product. Structure and specific field values for this TRE, and the NPJE are detailed in the BIIF Profile for JPEG 2000. This section lists requirements for key fields of the TRE.

6.8.1 Original TRE.

All TRE fields, except the conditional Nxxxx_I fields, are populated. At the original or primary compression of image data, the included J2KLRA summarizes the original compression. The subsequent conditional fields are not present.

6.8.2 NLEVELS_O.

NLEVELS_O field value equals the number of wavelet decomposition levels performed during the original image compression. For the original J2K codestream wrapped in the NBN file format, the NLEVELS_O value shall be equal to the N_{levels} value found in the coding style default marker segment. In a derived or repackaged J2K compressed product the NLEVELS_O value may or may not be equal to the included N_{levels} value but must remain equal to original N_{levels} value.

6.8.3 NBANDS_O.

NBANDS_O field value equals the number of components in the original image compression. For the original J2K codestream wrapped in a the NBN file format, the NBANDS_O value shall be equal to the Csiz value found in the image and tile size marker segment. In a derived or repackaged J2K compressed product the NBANDS_O value may or may not be equal to the included Csiz value but must remain equal to original Csiz value.

6.8.4 NLAYERS_O.

NLAYERS_O field value equals the number of quality layers in the original image compression. For the original J2K codestream wrapped in a the NBN file format, the NLAYERS_O value shall be equal to

the N_{layers} value found in the coding style default marker segment In a derived or repackaged J2K compressed product the NLAYERS_O value may or may not be equal to the included N_{layers} value but must remain equal to original N_{layers} value.

6.8.5 $LAYER\_ID_{n.}$

$LAYER\_ID_n$ field repeats for each quality layer in the original J2K compressed codestream. $LAYER\_ID_n$ field value starts at zero and increases by one for each LAYER_Idn field.

6.8.6 $BITRATE_{n.}$

$BITRATE_n$ field repeats for each quality layer in the original J2K compressed codestream. $BITRATE_n$ field value is approximately equal to the compressed bit rate of layer n of the original J2K codestream.

6.8.7 Repackaged TRE.

ORIG field = "1". In a repackaged or derived J2K compressed NBN J2K file, all TRE fields are present to include the conditional Nxxxx_I fields.

6.8.8 NLEVELS_I.

NLEVELS_I = N_{levels}. The NLEVELS_I field value is equal to the number of wavlet decompositions in the associated J2K codestream.

6.8.9 NLAYERS_I.

NLAYERS_I = N_{layers}. The NLAYERS_I field value is equal to the number of quality layers in the associated J2K codestream.

6.8.10 NBANDS_I.

NBANDS_I = Csiz. The NBANDS_I field value is equal to the number of components in the associated J2K codestream.

6.9 Clevel Ranges

The following paragraphs describe CLEVEL constraints and test criteria for NBN J2K files and systems (see Table 3). An NBN system is expected to be able to correctly decode any JPEG 2000 Part 1 Profile 1 codestream within the bounds of its supported complexity levels. Table 2 provides NITFS/NSIF file CLEVEL compliance ranges as well as mapping to JPEG 2000 compliance classes (Cclass).

6.9.1 CLEVEL Marking.

IUT marks NBN J2K files at the lowest CLEVEL for which they qualify.

6.9.2 Interprete CLEVEL.

IUT can interprete NBN J2K files at the CLEVEL and all lower CLEVELs, for which compliance is sought.

6.9.3 Generate CLEVEL.

IUT can generate NBN J2K files at the CLEVEL and all lower CLEVELs, for which compliance is sought. (NOTE: May not apply to systems developed for specific limited functions. e.g. systems designed to only J2K compress large (> 8k x 8k) image arrays into NBN files.)

6.9.4 Clevel Components.

IUT decodes J2K codestreams containing up to the maximum number of allowed components for the NBN Clevel for which compliance is sought. (See Table 3 for component limits for each clevel)

Table 3. NITFS/NSIF Complexity Levels

Complexity Criteria	Complexity Level			
	3	5	6	7
Common Coordinate System Extent (Pixels)	(00000000, 00000000) to (00002047, 00002047)	(00000000, 00000000) to (00008191, 00008191)	(00000000, 00000000) to (00065535, 00065535)	(00000000, 00000000) to (99999999, 99999999)
Max File Size	52 428 799 bytes	1 073 741 823 bytes	2 147 483 647 bytes	10 737 418 239 bytes
Image Size	00000001 to 00002048 Rows X 00000001 to 00002048 Columns	00000001 to 00008192 Rows X 00000001 to 00008192 Columns	00000001 to 00065536 Rows X 00000001 to 00065536 Columns	00000001 to 99999999 Rows X 00000001 to 99999999 Columns
JPEG 2000 Cclass	0,1	0,1	0,1,2	0,1,2
JPEG 2000 Compression Monochrome (MONO)	1 band 1 – 32 bits per pixel per Band With and without LUT Note: LUTs are typically only usefull when the data is compressed numerically lossless.			
JPEG 2000 Compression Mapped Colour (RGB/LUT)	1 band 1 – 32 bits per pixel per Band With LUT Note: LUTs are typically only usefull when the data is compressed numerically lossless.			
JPEG 2000 Compression Colour (RGB)	3 band 1 – 32 bits per pixel per Band No LUT Note: The JPEG 2000 coluor transform may be used as part of the compression and decompression process when IREP = RGB			
JPEG 2000 Compression Colour (YCbCr601)	3 band 1 – 32 bits per pixel per Band No LUT Note: When IREP=YCbCr601, it signifies that the data representation was YCbCr prior to the JPEG 2000 compression process. The internal JPEG 2000 colour transform shall not be used.			

JPEG 2000 Compression Multiband (MULTI)	1 to 9 Bands 1 – 32 bits per pixel per Band With and without LUT	1 to 255 Bands 1 – 32 bits per pixel per Band With and without LUT	1 to 999 Bands 1 – 32 bits per pixel per Band With and without LUT

6.10 Encoded EPJE Contrained Codestreams TBR011

6.11 Decode EPJE Constrainted Codestreams TBR011

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Annex A Test Requirements Summary

Table A-1. Encode JPEG 2000, Part 1

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K / ISO N2678
1	SOC Marker		R	Table 7-1 & 7-2
2	SOT Marker		R	Table 7-1 & 7-3
3	SOD Marker		R	Table 7-1 & 7-4
4	EOC Marker		R	Table 7-1 & 7-5
5	SIZ Marker		R	Table 7-1 & 7-6
6	COD Marker		R	Table 7-1 & 7-7
7	COC Marker		R	Table 7-1 & 7-12
8	RGN Marker		R	Table 7-1 & 7-14
9	QCD Marker		R	Table 7-1 & 7-15
10	QCC Marker		R	Table 7-1 & 7-19
11	POC Marker		R	Table 7-1 & 7-20
12	TLM Marker		R	Table 7-1 & 7-21
13	PLM Marker		R	Table 7-1 & 7-23
14	PLT Marker		R	Table 7-1 & 7-24
15	PPM Marker		R	Table 7-1 & 7-25
16	PPT Marker		R	Table 7-1 & 7-26
17	SOP Marker		R	Table 7-1 & 7-27
18	EPH Marker		R	Table 7-1 & 7-28
19	CRG Marker		R	Table 7-1 & 7-29
20	COM Marker		R	Table 7-1 & 7-30
21	9-7I Filtering		R	Paragraph (para) 8.1, 3rd bullet / para 3.60
22	5-3R Filtering		R	Para 8.1, 4th bullet / para 3.59
23	Progression Order		R	Table 7-7 & C-1 / Table A-9
24	Wavelet Decomposition		R	Table 7-7 & &-12 / Table A-15
25	Profile Indicator		R	Table 7-6 Rsiz parameter, C-1 / Table A-45
26	Empty Tiles		O	Para A.7.1, A.7.2, B.2

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K / ISO N2678
27	Component		R	Table 7-6 / Table A-9
28	RGN Marker Limit		R	Table C-1
29	Code Block Size		R	Table C-1 / Table A-18
30	EncodeLL Resolution		R	Para 7.8, Table C-1 / Table A-45
31	Multiple Codestreams		R	Para 9.4

R = Required, O = Optional

Table A-2. Encode JPEG 2000 NPJE Constrained

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K
1	L-R-C-P Progression Order		R	Paragraph (para) 8.1, 1st bullet / table 8-10
2	Five level Wavelet Decomposition		R	Para 8.1 5th bullet, Table 8-10
3	Profile Indicator		R	Table 8-9 Rsiz row, Table C-1 Profile Indication
4	~20 Quality Layers		R	Para 8.1 1st bullet, para 8.4.7, Table 8-10
5	Discrete Layers		O	Table 8-17
6	1024 x 1024 Tile Size		R	Para 8.1 6th bullet, Table 8-9
7	One Tile-Part Per Tile		R	Para 8.1 7th bullet
8	Fixed Tiles	USE OF J2KLRA	R	????
9	TLM Markers Present		R	Para 8.1 8th bullet
10	PLT Markers Present		R	Para 8.1 9th bullet
11	64 x 64 Code Block Size		R	Para 8.1 10th bullet, Table 8-10
12	Image Offset (XOsiz and YOsiz) set to zero		R	Para 8.1 12th bullet, Table 8-9
13	Tile Offset (XTOsiz and YTOsiz) set to zero		R	Para 8.1 12th bullet, Table 8-9
14	Component Scaling (XRsiz and YRsiz) values set to "1"		R	Table 8-9
15	J2KLRA TRE Present		O	Para 9.2

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K
16	Precinct Size		R	Para 8.1 11th bullet, Table 8-10
17	Minimal J2K File Format, no JP2 Header		O	Para 9.1

R = Required, O = Optional

Table A-3. Decode JPEG 2000 Part 1 Profile-1

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K / ISO N2678
1	9-7I Filtering		R	Paragraph (para) 8.1, 3rd bullet / para 3.60
2	5-3R Filtering		R	Para 8.1, 4th bullet / para 3.59
3	Progression Order		R	Para 8, Table 7-9
4	Wavelet Decomposition		R	Para 8, Table 7-7
5	Quality Layers		R	Para 8, Table 7-7
6	Image/Grid Size		O	Para 8, Table C-1
7	Tile Size		O	Para 8, Table C-1
8	Precinct Size		O	
9	Empty Tiles		R	Para A.7.1, A.7.2, B.2
10	Missing Tiles		R	Para A.7.1, B.2
11	Components		O	Para 8
12	8-Bit Precision		R	
13	11-Bit Precision		R	
14	12-Bit Precision		R	
15	16-Bit Precision		R	
16	32-Bit Precision		R	
17	Image Origin		R	Para 8, Table C-1
18	Tile Origin		R	Para 8, Table C-1
19	Code Block Size		R	/ Table A-18
20	COC Marker		R	Table 7-1 & 7-12
21	RGN Marker		R	Para 8, Table 7-14 & C-1,
22	QCD Markrer		R	Table 7-1 & 7-15

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K / ISO N2678
23	QCC Marker		R	Table 7-1 & 7-19
24	POC Marker		R	Table 7-1 & 7-20
25	TLM Marker		R	Table 7-1 & 7-21
26	PLM Marker		R	Table 7-1 & 7-23
27	PLT Marker		R	Table 7-1 & 7-24
28	PPM Marker		R	Table 7-1 & 7-25
29	PPT Marker		R	Table 7-1 & 7-26
30	SOP Marker		R	Table 7-1 & 7-27
31	EPH Marker		R	Table 7-1 & 7-28
32	CRG Marker		R	Table 7-1 & 7-29
33	COM Marker		R	Table 7-1 & 7-30
34	Marker Precedence		R	para 8.4.3
35	Decoder Cclass Guarantee		R	
	Cclass 0/Clevel		R	
	Cclass 1/Clevel		R	
	Cclass 2/Clevel		O	
36	Quit Decoding		R	
37	Reduced Resolution		O	(para B.2.3.1.1, ISO/IEC WD15444-4:2002)
38	Display NBN J2K		R	
39	Truncated File		R	Para A.3.2
40	Truncated File Warning		R	
41	NSIF Data Length Precedence		R	

R = Required, O = Optional

Table A-4. Decode NPJE Constrained Codestream

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K / ISO N2678
1	NPJE Progression Order		R	Para 8.1, Table 8-10

Item	Compressed Stream Feature	Predicate	R/O	Reference BPJ2K / ISO N2678
2	NPJE Wavelet Decomposition		R	Para 8.1, Table 8-10
3	NPJE Quality Layers		R	Para 8.1, Table 8-10
4	Clevel Image/Grid Size		R	
5	NPJE Tile Size		R	Para 8.1, Table 8-10
6	NPJE Precinct		R	
7	NPJE Image Origin		R	Table 8-9
8	NPJE Tile Origin		R	Table 8-9
9	NPJE Code Block Size		R	Para 8, Table C-1

R = Required, O = Optional

Table A-5. Repack JPEG 2000 Codestream

Item	Repack Feature		Predicate	R/O	Reference BPJ2K
1	Chipping			O	Para A.7.1, A.7.2, B.2, B.3
		On Tile Boundaries		O	Para A.3.1, A.5, B.2
		Off Tile Boundaries		O	Para A.3.1, para B.3
		On Code Block Boundaries		O	Para B.3
2	Empty Tiles			O	Para A.7.1, A.7.2, B.2
3	Reduced Resolution			O	Para A.3.2, A.5.2.2, A.6, A.7, B.1
4	Reduced Component			O	Para A.7, A.7.1
5	Reduced Layers			O	Para A.3.2, A.5.2.1, A.7, B.4
6	Region of Interest			O	??
7	Progression Order			O	Para A.8
8	NPJE to NPJE			O	Para A.7
9	NBN J2K to NBN J2K			O	Para A.7
10	NBN J2K to NPJE NBN			O	Para A.7
11	Header Correction			R	Para A.7
12		JPEG 2000 Markers		R	Para A.7
13		NSIF Header		R	Para A.7

14		J2KLRA		R	Para A.7
15	Parameter Broadening			O	Para 8.1.1

R = Required, O = Optional

Table A-6. J2K File Format

Item	J2K File Format Feature	Predicate	R/O	Reference
1	JP2 file			
2	Multiple images			

R = Required, O = Optional

Table A-7. File Structure

Item	Image Subheader Field	Predicate	R/O	Reference BPJ2K
1	NROWS NCOLS		R	Para 9.9.2, Table 9-1
2	PVTYPE		R	Para 9.9.2, Table 9-1
3	IREP		R	Para 9.9.2, Table 9-1
4	ABPP		R	Para 9.9.2, Table 9-1
5	NBPP		R	Para 9.9.2, Table 9-1
6	IC		R	Para 9.9.2, Table 9-1
7	COMRAT		R	Para 9.9.2, Table 9-1
	Rate			
	Type N			
	Type V			
	Type Blank			
8	NBANDS XBANDS		R	Para 9.9.2, Table 9-1
9	IMODE		R	Para 9.9.2, Table 9-1
10	NBPR NBPC		R	Para 9.9.2, Table 9-1
11	NPPBH NPPBV		R	Para 9.9.2, Table 9-1
12	IMAG		R	Para 9.9.2, Table 9-1

R = Required, O = Optional

Table A-8. J2KLRA TRE

Item	J2KLRA Field	Predicate	R/O	Reference BPJ2K
1	Original TRE		R	Table 9-2
2	NLEVELS_O		R	Table 9-2
3	NBANDS_O		R	Table 9-2
4	NLAYERS_O			Table 9-2
5	$LAYER\_ID_n$		R	Table 9-2
6	$BITRATE_n$		R	Table 9-2
7	Repackaged TRE		R	Table 9-2
8	NLEVELS_I		R	Table 9-2
9	NLAYERS_I		R	Table 9-2
10	NBANDS_I		R	Table 9-2

R = Required, O = Optional

Table A-9. CLEVEL Ranges

Item	CLEVEL Criteria	Predicate	R/O	Reference
1	CLEVEL Marking		R	
2	Interprete CLEVEL		R	
3	Generate CLEVEL		O	
4	Clevel Components		R	

R = Required, O = Optional

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Annex B Profile 0 and 1 ETS

This annex defines four executable test suites (ETS) (Tables B-1 thru B-4), namely Cclass 0 and Cclass 1 decoders for Profile 0 and Profile 1 codestreams.

Table B-x. ETS Mapping

ETS	Cclass	Profile	Number of test codestreams
1	Cclass 0	Profile 0	16
2	Cclass 0	Profile 1	7
3	Cclass 1	Profile 0	16
4	Cclass 1	Profile 1	7

There are 16 test codestreams defined for Profile 0 and 7 test codestreams defined for Profile 1. Tables B-5 and B-6 describe the features being tested by each of the test codestreams. Each ETS consists of codestreams, reference decoded images, and maximum values for MSE and peak error. The error values are defined as a function of Cclass for each image and may be more difficult to achieve as Cclass increases for each image.

Table B-1. Class 0 Profile 0 Reference Images and Allowable Errors

TCS	Reference File	Resolution Reduction	Signed	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p0_01.j2k	c0p0_01.pgx	0	+	8	128	128	0	0
p0_02.j2k	c0p0_02.pgx	0	+	8	64	126	0	0
p0_03.j2k	c0p0_03r0.pgx	0	+	4	128	128	0	0
p0_03.j2k	c0p0_03r1.pgx	1	+	4	128	128	0	0
p0_04.j2k	c0p0_04.pgx	3	+	8	80	60	33	55.8
p0_05.j2k	c0p0_05.pgx	3	+	8	128	128	54	68
p0_06.j2k	c0p0_06.pgx	3	+	8	65	17	109	743
p0_07.j2k	c0p0_07.pgx	0	+	8	128	128	10	0.34
p0_08.j2k	c0p0_08.pgx	5	+	8	17	96	0	6.72
p0_09.j2k	c0p0_09.pgx	2	+	8	5	10	0	1.47
p0_10.j2k	c0p0_10.pgx	0	+	8	64	64	0	2.84
p0_11.j2k	c0p0_11.pgx	0	+	8	128	1	0	0
p0_12.j2k	c0p0_12.pgx	0	+	8	3	5	0	0
p0_13.j2k	c0p0_13.pgx	0	+	8	1	1	0	0
p0_14.j2k	c0p0_14.pgx	2	+	8	13	13	0	0

TCS	Reference File	Resolution Reduction	Signed	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p0_15.j2k	c0p0_15r0.pgx	0	+	4	128	128	0	0
p0_15.j2k	c0p0_15r1pgx	1	+	4	128	128	0	0
p0_16.j2k	c0p0_16.pgx	0	+	8	128	128	0	0

Table B-2. Class 0 Profile 1 Reference Images and Allowable Errors

TCS	Reference File	Resolution Reduction	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p0_01.j2k	c0p1_01.pgx	0	8	61	99	0	0
p1_02.j2k	c0p1_02.pgx	3	8	80	60	35	74.0
p1_03.j2k	c0p1_03.pgx	3	4	128	128	28	18.8
p1_04.j2k	c0p1_04r0.pgx	0	4	128	128	2	0.550
p1_04.j2k	c0p1_04r3.pgx	3	8	128	128	128	2042
p1_05.j2k	c0p1_05.pgx	4	8	32	32	128	16384
p1_06.j2k	c0p1_06.pgx	1	8	6	6	128	16384
p1_07.j2k	c0p1_07.pgx	0	8	2	12	0	0

Table B-3. Class 1 Profile 0 Reference Images and Allowable Errors

TCS	Reference File	Resolution Reduction	Signed	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p0_01.j2k	c1p0_01-0.pgx	0	+	8	128	128	0	0
p0_02.j2k	c1p0_02-0.pgx	0	+	8	64	126	0	0
p0_03.j2k	c1p0_03-0.pgx	0	-	4	256	256	0	0
p0_04.j2k	c1p0_04-0.pgx	0	+	8	640	480	5	0.776
p0_04.j2k	c1p0_04-1.pgx	0	+	8	640	480	4	0.626
p0_04.j2k	c1p0_04-2.pgx	0	+	8	640	480	6	1.070
p0_05.j2k	c1p0_05-0.pgx	0	+	8	1024	1024	2	0.302
p0_05.j2k	c1p0_05-1.pgx	0	+	8	1024	1024	2	0.307
p0_05.j2k	c1p0_05-2.pgx	0	+	8	512	512	2	0.269

TCS	Reference File	Resolution Reduction	Signed	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p0_05.j2k	c1p0_05-3.pgx	0	+	8	512	512	0	0
p0_06.j2k	c1p0_06-0.pgx	0	+	12	513	129	635	11287
p0_06.j2k	c1p0_06-1.pgx	0	+	12	257	129	403	6124
p0_06.j2k	c1p0_06-2.pgx	0	+	12	513	65	378	3968
p0_06.j2k	c1p0_06-3.pgx	0	+	12	257	65	0	0
p0_07.j2k	c1p0_07-0.pgx	0	-	12	2048	2048	0	0
p0_07.j2k	c1p0_07-1.pgx	0	-	12	2048	2048	0	0
p0_07.j2k	c1p0_07-2.pgx	0	-	12	2048	2048	0	0
p0_08.j2k	c1p0_08-0.pgx	1	-	12	257	1536	0	0
p0_08.j2k	c1p0_08-1.pgx	1	-	12	257	1536	0	0
p0_08.j2k	c1p0_08-2.pgx	1	-	12	257	1536	0	0
p0_09.j2k	c1p0_09-0.pgx	0	+	8	17	37	0	0
p0_10.j2k	c1p0_10-0.pgx	0	+	8	64	64	0	0
p0_10.j2k	c1p0_10-1.pgx	0	+	8	64	64	0	0
p0_10.j2k	c1p0_10-2.pgx	0	+	8	64	64	0	0
p0_11.j2k	c1p0_11-0.pgx	0	+	8	128	1	0	0
p0_12.j2k	c1p0_12-0.pgx	0	+	8	3	5	0	0
p0_13.j2k	c1p0_13-0.pgx	0	+	8	1	1	0	0
p0_13.j2k	c1p0_13-1.pgx	0	+	8	1	1	0	0
p0_13.j2k	c1p0_13-2.pgx	0	+	8	1	1	0	0
p0_13.j2k	c1p0_13-3.pgx	0	+	8	1	1	0	0
p0_14.j2k	c1p0_14-0.pgx	2	+	8	49	49	0	0
p0_14.j2k	c1p0_14-1.pgx	2	+	8	49	49	0	0
p0_14.j2k	c1p0_14-2.pgx	2	+	8	49	49	0	0
p0_15.j2k	c1p0_15-0.pgx	0	-	4	256	256	0	0
p0_16.j2k	c1p0_16-0.pgx	0	+	8	128	128	0	0

Table B-4. Class 1 Profile 1 Reference Images and Allowable Errors

TCS	Reference File	Resolution Reduction	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p1_01.j2k	c1p1_01-0.pgx	0	8	61	99	0	0
p1_02.j2k	c1p1_02-0.pgx	0	8	640	480	5	0.765

TCS	Reference File	Resolution Reduction	Depth (bits)	Width (pixels)	Height (pixels)	Peak	MSE
p1_02.j2k	c1p1_02-1.pgx	0	8	640	480	4	0.616
p1_02.j2k	c1p1_02-2.pgx	0	8	640	480	6	1.051
p1_03.j2k	c1p1_03-0.pgx	0	8	1024	1024	2	0.300
p1_03.j2k	c1p1_03-1.pgx	0	8	1024	1024	2	0.210
p1_03.j2k	c1p1_03-2.pgx	0	8	512	512	1	0.200
p1_03.j2k	c1p1_03-3.pgx	0	8	512	512	0	0
p1_04.j2k	c1p1_04-0.pgx	0	12	1024	1024	627	3080
p1_05.j2k	c1p1_05-0.pgx	0	8	512	512	40	8.458
p1_05.j2k	c1p1_05-1.pgx	0	8	512	512	40	9.716
p1_05.j2k	c1p1_05-2.pgx	0	8	512	512	40	10.154
p1_06.j2k	c1p1_06-0.pgx	0	8	12	512	2	0.600
p1_06.j2k	c1p1_06-1.pgx	0	8	12	12	2	0.600
p1_06.j2k	c1p1_06-2.pgx	0	8	12	12	2	0.600
p1_07.j2k	c1p1_07-0.pgx	0	8	2	12	0	0
p1_07.j2k	c1p1_07-1.pgx	0	8	8	12	0	0

Table B-5. Items Tested by Profile 0 Codestreams

Codestream	Tests
p0_01.j2k	5x3 wavelet, 64x64 code-blocks, MQ-coder, context model
p0_02.j2k	component sabsampling, multiple layers, termination every coding pass, predictable termination, segmintation symbols, COD, QCD, EPH, SOP, and 0xFF30 marker segments, 32x32 code-blocks
p0_03.j2k	multiples tiles, signed data, 4 bit.component data, QCC, POC, CRG, TLM, and RGN marker segments
p0_04.j2k	multiple components, termination every coding pass, 9x7 wavelet, precint sizes in COD, irreversible component transform, scalar expond quantization
p0_05.j2k	different subsampling for different components, different wavelet filters and parameters for different components
p0_06.j2k	12-bit component samples, RGN in main and tile
p0_07.j2k	large number of tiles, (256 tiles)
p0_08.j2k	large image (Grid size 513x 3072)

Codestream	Tests
p0_09.j2k	9x7 wavelet transform overflow
p0_10.j2k	image source is pseudo-random, subsampling by 4, 0 guard bits, reversible color transform, tile parts
p0_11.j2k	1 sample high image, 0 decomposition level test, segmentation symbols
p0_12.j2k	special wavelet transform cases
p0_13.j2k	large number of components
p0_14.j2k	5-3 wavelet transform saturation
p0_15.j2k	RGN, POC, Signed, QCC, COM
p0_16.j2k	Empty packet header bit

Table B-6. Items Tested by Profile 1 Codestreams

Codestream	Tests
p1_01.j2k	Image and tile offsets, (Image Offset 5x128, Tile Offset 1x101)
p1_02.j2k	reset context probabilities, vertically casual contexts, precints sizes, PPT marker segment
p1_03.j2k	PPM marker segment
p1_04.j2k	QCD marker segment in tile header
p1_05.j2k	Odd size tile (37x37), non-square code block size (8x64), multiple PPM marker segments
p1_06.j2k	small tile size (3x3)
p1_07.j2k	small precincts (2x2,1x1, and 4x4, 2x2) , packet inclusion

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Annex C JP2 file format ETS

This annex defines the executable test suites (ETS) for decoding JP2 file format. Table C-1 lists decoded and upsampled size of test JP2 test files as well as allowabl

Table C-1. JP2 Reference Images and Allowable Error

Test file	Reference File	Components	Depth (bits)	Width (pixels)	Height (pixels)	Peak
file1.jp2	jp2_1.tif	3	8	768	512	4
file2.jp2	jp2_2.tif	3	8	480	640	4
file3.jp2	jp2_3.tif	3	8	480	640	4
file4.jp2	jp2_4.tif	1	8	768	512	4
file5.jp2	jp2_5.tif	3	8	768	512	4
file6.jp2	jp2_6.tif	1	12	768	512	4
file7.jp2	jp2_7.tif	3	16	480	640	4
file8.jp2	jp2_8.tif	1	8	700	400	4
file9.jp2	jp2_9.tif	1	8	768	512	4

Table C-2 provides additional information about each of JP2 test files.

Table C-2. JP2 File Description

Test Files	Summary Information
file1.jp2	Three 8-bit components in the sRGB colourspace. This files also includes XML metadata.
file2.jp2	Three 8-bit components in the sRGB-YCC colourspace. All components are at full resolution, but stored inn revere order in the codestream. File contains a Channel Definition box that correctly associates each physical component with the correct color in the sRGB-YCC definition.
file3.jp2	Three 8-bit components in the sRGB-YCC colourspace, with the Cb and Cr components being subsampled 2x in both the horizontal and vertical derections. The components are stored in standard order.
file4.jp2	One 8-bit component in the sRGB-grey colourspace.

Test Files	Summary Information
file5.jp2	Three 8-bit components in the ROMM-RGB colourspace, encapsulated in a JP2 compatible JPX file. The colourspace is specified using both a Restricted ICC profile using the JPX-defined enumerated code for the ROMM-RGB colourspace.
file6.jp2	One 12-bit component in the sRGB-grey colourspace.
file7.jp2	Three 16-bit components in the e-sRGB colourspace, encapsulated in a JP2 compatible JPX file. The colourspace is specified using both a Restricted ICC profile and using the JPX-defined enumerated code for the e-sRGB colourspace.
file8.jp2	One 8-bit component in a gamm 1.8 space. The colourspace is specified using a Restricted ICC profile.
file9.jp2	One 8-bit component, which is used as input to a 256-entry palette that maps the singles component to three 8-bit components. The depaletized components are in the sRGB colourspace.