International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

T.808

Amendment 3
(06/2008)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

Still-image compression – JPEG 2000

Information technology – JPEG 2000 image coding system: Interactivity tools, APIs and protocols

Amendment 3: JPIP extensions to 3D data

Recommendation ITU-T T.808 (2005) – Amendment 3

ITU-T

International Telecommunication Union

ITU-T T-SERIES RECOMMENDATIONS

TERMINALS FOR TELEMATIC SERVICES

Facsimile – Framework	T.0–T.19
Still-image compression – Test charts	T.20–T.29
Facsimile – Group 3 protocols	T.30–T.39
Colour representation	T.40–T.49
Character coding	T.50–T.59
Facsimile – Group 4 protocols	T.60–T.69
Telematic services – Framework	T.70–T.79
Still-image compression – JPEG-1, Bi-level and JBIG	T.80–T.89
Telematic services – ISDN Terminals and protocols	T.90–T.99
Videotext – Framework	T.100–T.109
Data protocols for multimedia conferencing	T.120–T.149
Telewriting	T.150–T.159
Multimedia and hypermedia framework	T.170–T.189
Cooperative document handling	T.190–T.199
Telematic services – Interworking	T.300–T.399
Open document architecture	T.400–T.429
Document transfer and manipulation	T.430–T.449
Document application profile	T.500–T.509
Communication application profile	T.510–T.559
Telematic services – Equipment characteristics	T.560–T.649
Still-image compression – JPEG 2000	**T.800–T.849**
Still-image compression – JPEG-1 extensions	T.850–T.899

For further details, please refer to the list of ITU-T Recommendations.

INTERNATIONAL STANDARD ISO/IEC 15444-9
RECOMMENDATION ITU-T T.808

Information technology – JPEG 2000 image coding system: Interactivity tools, APIs and protocols

Amendment 3

JPIP extensions to 3D data

Summary

Amendment 3 (2008) to Recommendation ITU-T T.808 (2005) | ISO/IEC 15444-9:2005 extends the fields in JPIP for use with 3-D and higher dimensional data. All fields related to the frame and region of the requested image are extended to multiple dimensions, as part of this amendment.

This work item (ISO/IEC Project) was formerly referred to as "Amendment 4". Subsequent to the renumbering of Amendment 3 approved in 2007 as Amendment 2 for publication purposes, all subsequent work items were renumbered by ISO/IEC JTC1 SC29 decreasing the numbering by one. Hence, the attached text went to the approval process as Amendment 3 (2008), in order to maintain the sequential numbering of attachments.

Source

Amendment 3 to Recommendation ITU-T T.808 (2005) was approved on 13 June 2008 by ITU-T Study Group 16 (2005-2008) under Recommendation ITU-T A.8 procedure. An identical text is also published as ISO/IEC 15444-9, Amendment 3.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). 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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. 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, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

CONTENTS

INTERNATIONAL STANDARD
RECOMMENDATION ITU-T

Information technology – JPEG 2000 image coding system: Interactivity tools, APIs and protocols

Amendment 3

JPIP extensions to 3D data

1) Subclause 3.3

Add the following item:

3.3.23 **slice**: A subset of voxels in a volumetric image with constant Z coordinates.

2) Subclause 3.4

Add the following items:

fz z-axis frame size for client request view-window

fz' z-axis frame size for suitable codestream resolution

fz'' modified jpx z-axis frame size for suitable resolution

oz z-axis offset for client request view-window

oz' z-axis offset for suitable codestream/component region

oz'' modified z-axis offset for suitable region

sz z-axis size of client request view-window

sz' z-axis size for suitable codestream region

sz'' modified jpx z-axis size for suitable region

3) Subclause A.3.2.1

After the third paragraph, add the following:

For volumetric images encoded in JP3D (Rec. ITU-T T.809 | ISO/IEC 15444-10), the sequence number of precincts within a tile-component is computed as follows: All precincts of the lowest resolution level, i.e., those containing only the [L|X][L|X][L|X] samples are sequenced first, starting from zero, following a raster scan order as defined by 3.11 of Rec. ITU-T T.809 | ISO/IEC 15444-10. The precincts from each successive resolution level are sequenced in turn, again following the raster scan order of 3.11. The precinct with sequence number 0 thus refers to the front most, upper left hand precinct of the lowest resolution sub-band of the image component 0 in tile 0.

4) Subclause C.4.1

Replace the third paragraph with:

Codestream image regions are described using 3 n-dimensional parameters where n is the number of dimensions required to describe this image. The size parameters and offset parameters specify the extent and location of the desired codestream image region with respect to a whole image that has the given frame size. Figure C.1 demonstrates this set-up for regular images with n = 2, but the construction carries over naturally to a higher number of dimensions. For the rest of this subclause, we will consider only this case, naming the frame size fx and fy, the offset of the region ox and oy and its size sx and sy as indicated in Figure C.1.

5) Subclause C.4.1

At the end of C.4.1, add the following:

The above considerations for two dimensional images carry over naturally to images of higher dimensionality, e.g., to the case $n = 3$ where a third coordinate is added to each group of parameters. Specifically, the frame size is then represented by three numbers fx, fy and fz, the offset by ox, oy and oz and the region size by sx, sy and sz. In that case, Equation C-1 extends to:

$$\mathrm{ZOsiz}' = \left\lceil \frac{\mathrm{ZOsiz}}{2^r} \right\rceil \qquad \mathrm{Zsiz}' = \left\lceil \frac{\mathrm{Zsiz}}{2^r} \right\rceil$$

where ZOsiz and Zsiz specify the original image offset and canvas size in the Z direction, respectively. Equation C-2 extends to:

$$\mathrm{oz}' = \left\lfloor \mathrm{oz} \cdot \left(\frac{\mathrm{fz}'}{\mathrm{fz}} \right) \right\rfloor \qquad \mathrm{sz}' = \left\lceil (\mathrm{sz} + \mathrm{oz}) \cdot \frac{\mathrm{fz}'}{\mathrm{fz}} \right\rceil - \mathrm{oz}'$$

For images represented within Rec. ITU-T T.809 | ISO/IEC 15444-10 codestream, ZOsiz and Zsiz are taken from the relevant NSI marker segment.

In addition, a server may choose to identify a Rec. ITU-T T.801 | ISO/IEC 15444-2 codestream making use of wavelet transformations as a multi-component transformation with a volume image using generated components to represent the third (Z) dimension. The identification by which generated components constitute which slice is then at the discretion of the server, and so is the choice of suitable values for ZOsiz and Zsiz. In this situation, clients may either choose to use the two-dimensional or three-dimensional request syntax to fetch data from the client. For two-dimensional requests, it is up to the client to identify slices with components and make the necessary requests; for three-dimensional requests, it is the duty of the server to find the relevant components for the requested image volume. In the latter case, servers are not required to honour the comp and mctres fields, see C.4.5 and C.4.11, and their usage is discouraged in this case.

Application Note:

In case servers have to identify a Rec. ITU-T T.801 | ISO/IEC 15444-2 encoded image with volumetric data, they are recommended to use the following choices for ZOsiz and Zsiz to provide an efficient and consistent definition of resolution levels in the Z direction:

- ZOsiz shall be taken identical to the minimum of all Omcc^i values in all MCC markers within the codestream identified by the request, see Annex A.3.8 of Rec. ITU-T T.801 | ISO/IEC 15444-2. This choice ensures a reasonable definition of the resolution levels in the Z direction compatible to the origin of the wavelet transformation, and eases the extraction of lower-resolution images from the stream.
- Zsiz is to be taken identical to the number of slices identified by methods described below plus ZOsiz as computed by the procedure above.

It is recommended to use the following procedure to identify the generated components that make up a slice in case a Rec. ITU-T T.801 | ISO/IEC 15444-2 conforming file format is available for the target of the request:

- Identify all compositing layers of the file that use the codestream the request targets at. Each compositing layer in this set defines exactly one slice of the volumetric image. The Z coordinate to be assigned to the first compositing layer in this set is to be ZOsiz, as defined above, and all following slices are assigned continuously ascending Z coordinates in the order they appear in the file.
- Within each compositing layer, scan for a channel definition box. If there is a channel definition box, identify the channels that are associated to a colour by testing the Asoc field of the cdef box for that channel and perform the next step. Otherwise, apply the next step to all channels.
- Identify within the compositing layer the generated components providing the data for the channels found in the step above. For direct mapping, this is a 1:1 relation, but for palette mapped images, the component mapping box must be parsed.

If no Rec. ITU-T T.801 | ISO/IEC 15444-2 conforming file format is available, other metadata outside the scope of this Recommendation | International Standard might be available to identify which generated components define which slice. In this case, servers are expected to use whatever metadata is available and be consistent with the specifications made there.

In case no additional meta-data, neither inside 15444 nor outside of it, is available, the following algorithm can be used as a last resort to come to a reasonable definition of slices:

A codestream is identified as grey scale volume image if each generated component is reconstructed by exactly one transformation stage in the sense of Annex J of Rec. ITU-T T.801 | ISO/IEC 15444-2, and if that type of the transformation stage is a wavelet transformation. A codestream is identified as colour volume image, if each generated component is reconstructed by exactly two transformation stages of which the first one, which is applied to the spatial components of the codestream, is a wavelet transformation, and of which the second one is not a wavelet transformation, but a decorrelation or dependency transformation. All other set-ups cannot be handled.

The Z coordinate of the slice a generated component contributes to is identified as follows: For generated component g, identify the MCC marker MCC^i that describes the wavelet transformation step taken to compute g from the spatial components of the canvas system. According to the above definition, there should be exactly one such marker. If the image is a grey-scale image, find the index j in the output component collection of that marker such that $Wmcc^{ij}$ equals g, i.e., find the output slot in the transformation generating this component. Then generated component g contributes then to the slice with $Z = j + Omcc^i$. This will define a Z coordinate for the component g based on the ordering of the output of the wavelet transformation step.

For colour images, first identify all intermediate input components of the dependency or decorrelation transformation required to reconstruct the generated component g, and find for each of them its Z coordinate as described above. It is required that this Z coordinate does not depend on which of the intermediate components required to reconstruct generated component g has been chosen; otherwise, this algorithm fails.

6) Subclause C.4.5

Insert the following after C.4.4 and update the following subclause numbers accordingly:

C.4.5 Frame size for variable dimension data (fvsiz)

```
fvsiz = "fvsiz" "=" 1#UINT ["," round-direction]
```

```
round-direction = "round-up" / "round-down" / "closest"
```

This request takes a variable number of arguments. There shall be as many numerical arguments as there are dimensions in the source codestream. Specifically, if the image is a regular two-dimensional image, this request field is equivalent to the `fsiz` field with the first argument defining `fx` and the second defining `fy`. If the source stream represents volumetric data, there shall be three numerical arguments, specifying the view-window extents `fx`, `fy` and `fz`, in that order.

This field is used to identify the resolution associated with the requested view-window. The numerical arguments specify the desired image resolution, one per dimension. The `round-direction` value specifies how an available codestream image resolution shall be selected for each requested codestream, if the requested image resolution is not available within that codestream. The requested frame size is mapped to a codestream image resolution, following the procedure described in C.4.1, possibly with the addition of coordinate transformations requested via the Codestream Context request field (see C.4.7).

7) Subclauses C.4.6 and C.4.7

Insert the following after C.4.5 and update the following subclause numbers accordingly:

C.4.6 Offset for variable dimension data (rvoff)

```
rvoff = "rvoff" "=" #1UINT
```

This field is used to identify the upper left (front) corner (offset) of the spatial region associated with the requested view-window; if not present, the offset defaults to 0. The actual displacement of a codestream image region from the upper left (front) corner of the image, at the actual codestream image resolution selected by the server, is obtained following the procedure described in C.4.1, possibly with the addition of coordinate transformation requested via a Codestream Context request field (see C.4.7). This field takes a variable number of arguments, there shall be as many arguments to the `rvoff` field as there are dimensions in the source stream. Specifically, for regular two-dimensional images exactly, two arguments are required and this field is equivalent to `roff`. For volumetric images, exactly three arguments are required, which define `ox`, `oy` and `oz`.

Use of the Offset field for Variable Dimension Data is valid only in conjunction with the Frame Size request field for Variable Dimension Data. If the view-window specified using Region Size and/or Offset turns out to be empty (no area), the server's response should not include any compressed image data. In particular, responses of type "jpp-stream" or "jpt-stream" should contain no messages which reference precinct, tile or tile-header data-bins. The server may, at its discretion, opt to return main header or metadata-bin messages that would have been returned in response to a request that omitted the Frame Size request field.

C.4.7 Region size for variable dimension data (rvsiz)

```
rvsiz = "rvsiz" "=" #1UINT
```

This field is used to identify the extent (size) of the spatial region associated with the requested view-window; if not present, the region extends to the lower right (back) corner of the image. The actual extent of the view-window, at the actual resolution level selected by the server, are computed following the procedure described in C.4.1. The view-window need not necessarily be fully contained within the image itself, in which case the server simply takes the intersection between the full image region and the requested view-window.

This field takes a variable number of arguments, and there shall be exactly as many arguments as there are dimensions in the target stream. If the view-window specified using Region Size and/or Offset turns out to be empty (no area), the server's response should not include any compressed image data. In particular, responses of type "jpp-stream" or "jpt-stream" should contain no messages which reference precinct, tile or tile-header data-bins. The server may, at its discretion, opt to return main header or metadata-bin messages that would have been returned in response to a request that omitted the Frame Size request for Variable Dimension Data field. In case the image is a regular two-dimensional image, this request takes two arguments, and is identical to the `rsiz` field. For volumetric images, the three arguments are `sx`, `sy` and `sz`, in this order.

8) Subclause C.4.5

At the end of C.4.5, add the following:

Usage of the comps field in combination with the Frame, Region or Region Offset request field for Variable Dimension Data with three or more numerical arguments on Rec. ITU-T T.801 | ISO/IEC 15444-2 codestreams is discouraged and servers cannot be expected to handle it.

9) Subclause C.4.7

At the end of C.4.7, add the following:

The above considerations, especially Equations C-3 and C-4, valid for two-dimensional image data only. They are extended naturally to higher dimensions by duplicating the computations for each additional dimension. Usage of the codestream context field is discouraged if the target of the request contains codestreams with differing numbers of dimensions, and servers cannot be expected to handle this case.

10) Subclause C.4.11

At the end of C.4.11, add the following:

Usage of the mctres field in combination with the Frame, Region or Region Offset request field for Variable Dimension Data with three or more numerical arguments on Rec. ITU-T T.801 | ISO/IEC 15444-2 codestreams is discouraged and servers cannot be expected to handle it.

11) Subclause D.2

Add the following subclauses to Annex D and update the following sublclause numbers accordingly:

D.2.8 Frame size for variable dimension data (JPIP-fvsiz)

```
JPIP-fvsiz = "JPIP-fvsiz" ":" #1UINT
```

The server should send this response header if the actual frame size differs in any way from that requested via the Frame Size or Frame Size for Variable Dimension Data field. The server may need to modify the frame size because the client requested a frame size that does not exist. It is at the discretion of the server to either return the `JPIP-fsiz` or the `JPIP-fvsiz` response header on two-dimensional data requests, both responses shall be considered equivalent in this case. In all other cases, only the `JPIP-fvsiz` response header shall be used.

D.2.9 Region size for variable dimension data (JPIP-rvsiz)

```
JPIP-rvsiz = "JPIP-rvsiz" ":" #1UINT
```

The server should send this response header if the size of the view-window differs in any way from that requested via the Region Size or Region Size for Variable Dimension Data request field. If two-dimensional data had been requested, it is at the discretion of the server to pick either this response header, or the `JPIP-rsiz` response header, and both shall be considered equivalent by the client. For all other cases, only the `JPIP-rvsiz` response header shall be used.

D.2.10 Offset for variable dimension data (JPIP-rvoff)

```
JPIP-rvoff = "JPIP-rvoff" ":" #1UINT
```

The server should send this response header if the view-window offset differs in any way from that requested via an Offset or Offset for Variable Dimension Data request field. The server may need to modify the offset if it is resizing a requested view-window. For two dimensional data, it is at the discretion of the server to pick either this response header, or the `JPIP-roff`response header, and the client shall consider both equivalent. For all other data, the `JPIP-rvoff`response header shall be used.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	**Terminals for telematic services**
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2008