Standard of the Camera & Imaging Products Association

CIPA DC-007-Translation-2021

Multi-Picture Format

This translation has been made based on the original Standard (CIPA DC-007-2021). In the event of any doubts arising as the contents, the original Standard is to be the final authority.

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Revision history

Feb, 2009 1st edition	CIPA DC-007-2009	Established Multi-Picture Format
Dec, 2021 Revised 2nd edition	CIPA DC-007-2021	▸Updated [2. Normative references] - The standard number of each reference has changed to the latest edition along with its revision. ▸Updated [7. Exif Tag Support Requirements] - Added a description about the tags specified by DCF (Reference 2) and the edition number of the reference corresponding to the described contents of tables to the opening sentences - Corresponding to the revision of Exif (Reference 1), updated the described contents of table 10 and table 11 - In relation to the inconsistency between Exif and DCF, corrected table 10 partly and added notes for table 10 and table 12 - Corrected errors on table 9, table 12 and table 13 ▸Throughout - Deleted an expression limiting the edition at the place (text or table) where Exif is referred

1. Scope

This document specifies an image data format and metadata tags used by digital cameras and other imaging products including software

2. Normative references

The following official standards contain provisions that constitute provisions of this standard through reference in this text

1) CIPA DC-008-2019 Exchangeable image file format for digital still cameras : Exif Version 2.32

2) CIPA DC-009-2010 Design rule for Camera File system : DCF Version 2.0 (Edition 2010)

3. Definition of Terms

The following definitions apply to terminology used in this document.

Table 1 Definition of Terms

Term	Definition/meaning
MP format	Format for storing multiple, associated images in a single image file. MP stands for Multi Picture.
APPn	JPEG application marker segments which Exif specification refers to.
Individual Image	A JPEG compliant image as specified in Exif specification delimited by a set of SOI-EOI markers. Images in APPn are not considered Individual Images. (See Figure 1)
first Individual Image	The top-most Individual Image contained in a File.
MP extensions	General term referring to the information (tags) that define the overall structure of the Individual Images, including those that are specific to a particular type of Individual Image.
MP file	The file with MP extensions.
MP index fields	Information contained in the header of the First Individual Image describing the overall structure of the Individual Images in the file.
MP attribute fields	Set of tags for a particular Individual Image.

MP type	The image type of an Individual Image contained in the MP File.
representative image	An Individual Image that represents the entire MP image set. The Representative Image Flag of this image is set to 1.
dependent image	An Individual Image that has a dependency relationship with another Individual Image within the same MP File.
primary image	An Individual Image created as the main image data, except a dependent image.
Baseline MP primary image	The primary image within a Baseline MP File.
Exif thumbnail	The thumbnail image in the APP1 marker segment as specified in the Exif 2.21 specification.
multi-view image	Multiple images taken from varying perspectives.
large thumbnail image	An image formatted to a specific size and aspect ratio appropriate for certain viewing devices.
large thumbnail source image	The Individual Image that is the source image of the large thumbnail image.
panorama image	A Target Object image divided across multiple shots/frames that are stitched together to form the final image.
viewpoint number	Number that represents the position of the camera during shooting.
convergence angle	The angle formed by the first line of sight from the base viewpoint and the line which is the vertical projection of the second line of sight from the other viewpoint onto the plane containing the first line of sight.
baseline length	The distance between two viewpoints.
target object	The subject of a Multi-View Image.
collimation axis	The axis that passing through the base viewpoint and the Target Object.
horizontal axis	The axis that passes horizontally through the Target Object and goes orthogonally to the Collimation Axis.
vertical axis	The axis that passes through the Target Object and is perpendicular to the plane defined by the Horizontal and Collimation axes.
yaw angle	The angle of rotation along the Vertical Axis.
pitch angle	The angle of rotation along the Horizontal Axis.
roll angle	The angle of rotation along the Collimation Axis.
disparity image	An image that is shot from a viewpoint specified by the Convergence Angle and Baseline Length.
multi-angle image	An image that is shot from a viewpoint specified by the Yaw Angle, Pitch Angle and Roll Angle.

For numerical representation, ".H" appended to a numerical value means it is hexadecimal notation. Other numerical value means it is decimal notation.
Table 2 shows the expression of provisions used in this document.

Table 2 Expression of provisions

Level of provision	Verbal form
Requirement	"shall"
Recommendation	"should"
Permission	"may"
Prohibition	"shall not"

4. Overview

This specification describes a method for storing multiple images in a single file. It also describes multi-picture format utilizing the method for storing images re-formatted for optimized viewing performance on viewing devices such as TVs and other applications using associated multiple images in a single file.

4.1. Objective

In recent years, the overall performance and capabilities of digital cameras and other digital imaging products have greatly improved. At the same time, the digital photography environment has expanded to include products such as TVs, communication devices, and other hardware and software applications. This phenomenon has led to new and exciting applications for digital photography - of which many require the use of multiple associated images to deliver a particular photo experience. This specification has been developed to address this need by defining a method for storing multiple still images and associated metadata into a single file.

An Exif 2.21 compliant file contains only one Primary Image, along with a tiny thumbnail image. Hence, in order to handle multiple, associated, still images, each image shall be stored in separate files, and the association of these images (files) shall to be managed somehow by the user or by some specialized application. One simple method, for example, is to form a DCF object consisting of multiple Exif image files. However, in this case the user would still be burdened with the task of maintaining the association of these images, which could be cumbersome and difficult to manage since there are no tags defined in Exif 2.x to facilitate this task. Furthermore, the potential risk of inadvertently splitting up the images and their association during transfer and sharing operations is quite high. Clearly, a better

method is needed.

The following specification describes multi-picture (or "MP") format, which enables a chain of still images to be stored in a single file along with tags that will allow these images to be associated and used for a particular purpose.

4.2. General Structure

This document specifies a file format to achieve the above objectives. The file format includes MP extensions which enable to store multiple Individual Images in a single file. Individual Image has the same structure as Exif JPEG data.

4.2.1. Baseline MP File

A Baseline MP file consists of a Primary Image and an additional duplicate image that has been formatted for optimal viewing on TVs and other viewing devices. Baseline MP file uses Exif extensions, and specifies a file format including MP extensions which enable to store the Primary Image and additional image(s).

4.2.2. Extended MP File

An Extended MP file consists of a collection of images that correspond to one of the MP Types defined in this specification. Multi-view is defined as MP Type, and Multi-view has 3 sub-types: Panorama, Disparity, and Multi-Angle. Other images may also be recorded with this file format. Extended MP file uses Exif extensions, and specifies a file format including MP extensions which enable to store multiple images.

The Extended MP file has a new file extension.

5. Data Structure

5.1. Basic MP File Structure

Figure 1 shows the basic structure of an MP File. An MP File contains two or more Individual Images - of which the top most Individual Image is called the First Individual Image. The MP Extensions are specified in the APP2 marker segment which follows immediately after the Exif Attributes in the APP1 marker segment expect as specified in § 7. Each Individual Image adheres to the structured of a

valid JPEG image, delimited by an SOI and EOI marker. This specification does not define any restrictions for data between the EOI marker of one Individual Image and the SOI marker of the following Individual Image.

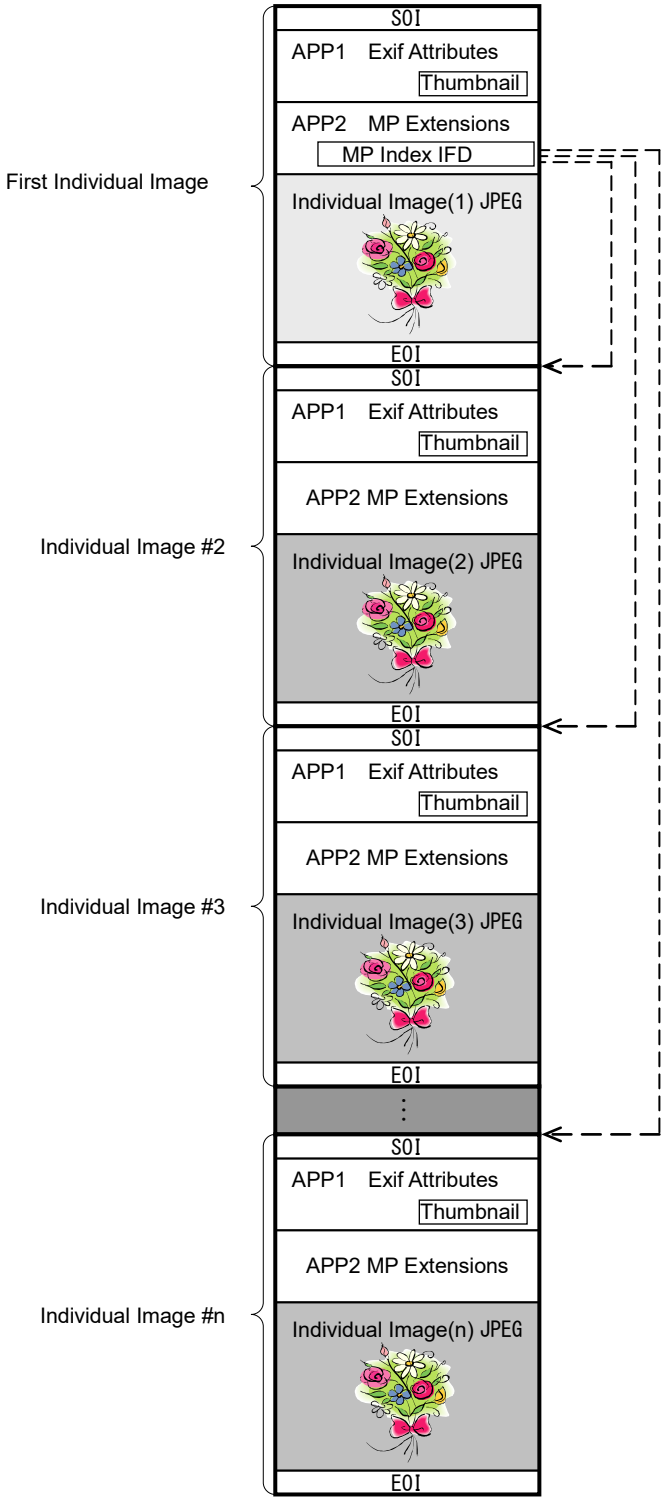


Figure 1 Basic MP File format data structure

5.2. MP Extensions

Figure 2 shows the structure of the MP Extensions for First Individual Image. The MP Header and the MP Index IFD shall be specified after APP2 marker, APP2 Length and the MP Format Identifier for the First Individual Image. Optionally, an MP Attribute IFD may be added after the MP Index IFD.

Figure 3 shows the structure of the MP Extensions for all the other Individual Images except the First Individual Image. The MP Attribute IFD may be specified after APP2 marker, APP2 Length and the MP Format Identifier. The MP Index IFD shall not be specified for all the other Individual Images except the First Individual Image.

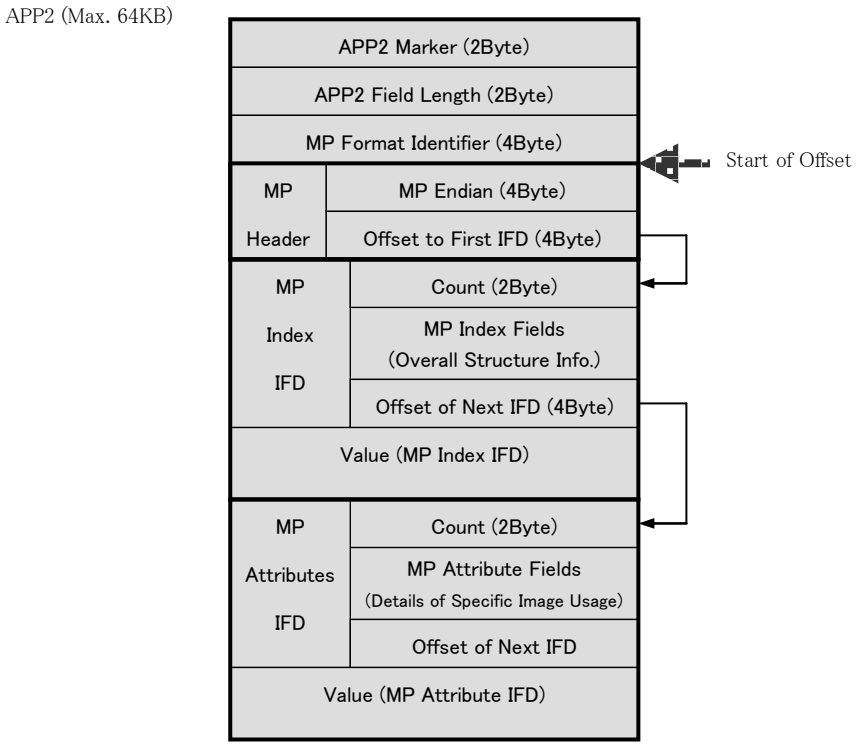


Figure 2 MP Extensions (in the First Individual Image)

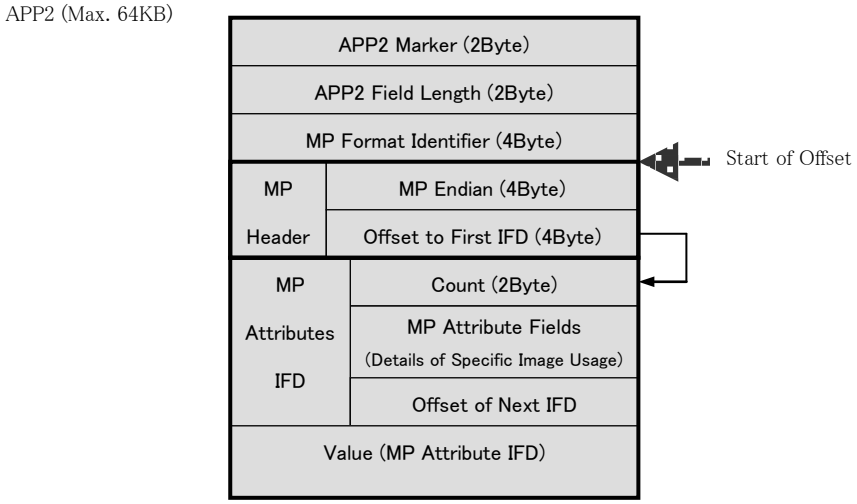


Figure 3 MP Extensions (in all other Individual Image)

The based address from which all of the offset addresses in the MP Extensions are calculated is the address of the MP Endian field in the MP Header (see "Start of Offset" in Figure 2 and Figure 3).

For the First Individual Image, the offset to the MP Index IFD shall be specified in the Offset to First IFD field in the MP Header. Similarly, the offset to the MP Attribute IFD shall be specified in the Offset to Next IFD field in the MP Index IFD.

For all other Individual Images, excluding the First Individual Image, the offset address to the MP Attribute IFD is specified in the Offset to First IFD tag in the MP Header, because there is no MP Index IFD.

5.2.1. The MP Format Identifier

Each APP2 marker segment of an Individual Image, including the First Individual Image, shall contain the following information in this order: APP2 marker, APP2 Field Length, MP Format Identifier, MP Endian, and Offset to First IFD. Structure of the MP Format Identifier is shown in Figure 4.

Offset Address (Hex)	Code (Hex)	Description
+00	FF	Marker Prefix
+01	E2	APP2
+02		APP2 Field Length
+04	4D	'M'
+05	50	'P'
+06	46	'F'
+07	00	NULL

Figure 4 Structure of the MP Format Identifier

There can be only one APP2 marker segment for MP Extensions in each Individual Image.

5.2.2. MP Header

5.2.2.1. MP Endian

This field specifies the byte order (big endian or little endian) of the information contained in the MP Extensions. It has the same structure as the first 4 bytes of a TIFF header (see Figure 5).

	Code (Hex)
+00	49
+01	49
+02	2A
+03	00

Little Endian

	Code (Hex)
+00	4D
+01	4D
+02	00
+03	2A

Big Endian

Figure 5 MP endian tag structure

The byte ordering of the MP Extensions should be the same as the TIFF header in the APP1 marker segment.

5.2.2.2. Offset to First IFD

The Offset to First IFD shall point to either the MP Index IFD or the MP Attributes IFD. If either the MP Index IFD or the MP Attributes IFD is specified immediately after Offset to First IFD, the value for Offset to First IFD shall be 8.

5.2.3. MP Index IFD

Table 3 lists the various tags defined in the MP index IFD. The MP Index IFD tags shall be specified in the order of their tag IDs. There are no requirements with respect to the order or location of the tag values.

Table 3 MP Index IFD Tags

Tag Name	Field Name	Tag ID		Type	Count
		Dec	Hex		
MP Format Version Number	*MPFVersion*	45056	B000	UNDEFINED	4
Number of Images	*NumberOfImages*	45057	B001	LONG	1
MP Entry	*MPEntry*	45058	B002	UNDEFINED	16×*NumberOfImages*
Individual Image Unique ID list	*ImageUIDList*	45059	B003	UNDEFINED	33×*NumberOfImages*
Total Number of Captured Frames	*TotalFrames*	45060	B004	LONG	1

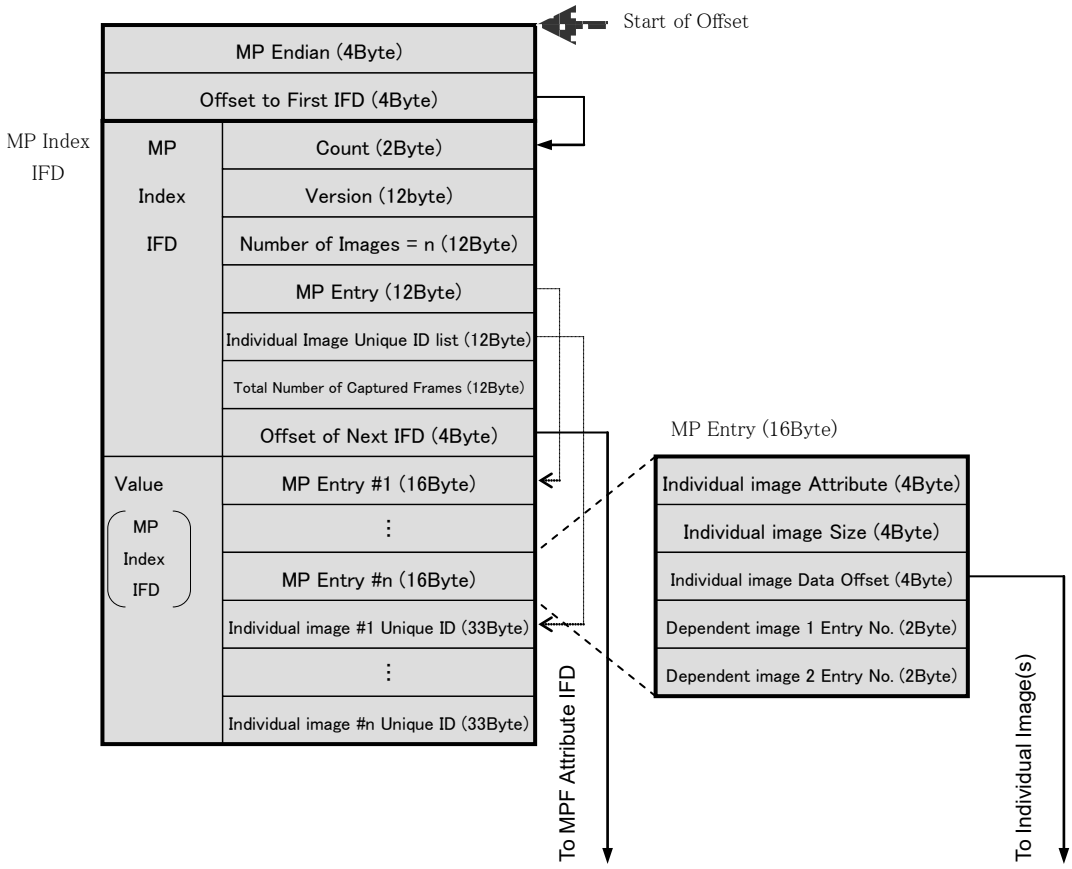


Figure 6 Internal Structure of the MP Index IFD

5.2.3.1. MP Format Version

This tag specifies the version of the MP Extensions. An MP File that complies with this specification shall specify a 4 byte ASCII value of "0100." Note that since the type is UNDEFINED, the value shall not be terminated with a (NULL).

MP Format Version MPFVersion

Tag= 45056 (B000.H)

Type = UNDEFINED

Count = 4

Default = "0100"

5.2.3.2. Number of Images

This tag specifies the number of Individual Images contained in the MP File.

Number of Images NumberOfImages

Tag= 45057 (B001.H)

Type = LONG

Count = 1

Default = none

5.2.3.3. MP Entry

An MP Entry tag contains the following information pertaining to an Individual Image: Type, Size, Data Offset, and Link(s) to Dependent Image(s).

MP Entry MPEntry

Tag= 45058 (B002.H)

Type = UNDEFINED

Count = 16×*NumberOfImages*

Default = none

The number of MP Entry tags shall coincide with the number of images contained in the MP File. The MP Entry values in the Value area of the MP Index IFD shall be aligned sequentially, without any gaps. Figure 7 describes the structure of an MP Entry.

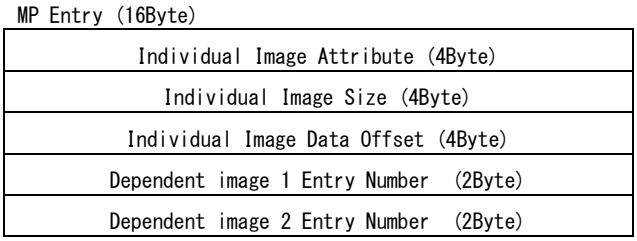


Figure 7 MP Entry Internal Fields

5.2.3.3.1. Individual Image Attribute

This field specifies the type attributes of the Individual Image. The field is specified as a LONG value, and the byte order depends on MP Endian (see Figure 8).

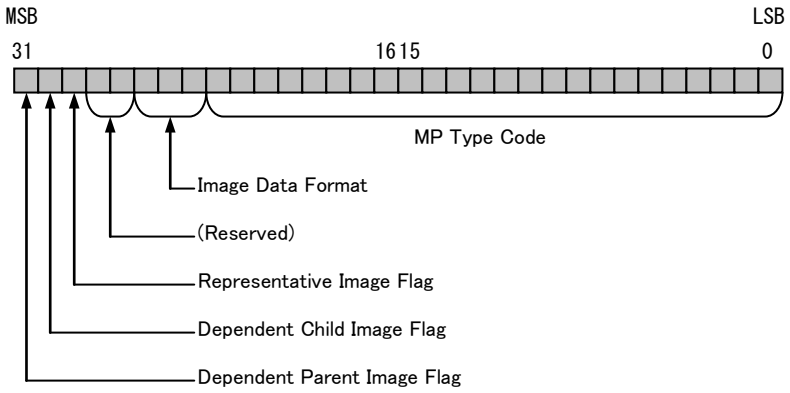


Figure 8 Individual Image Attribute Field Structure

Dependent Parent Image Flag: this flag shall be set to 1 if the Individual Image is the parent image of another dependent Individual Image. Otherwise it shall be set to 0.

Dependent Child Image Flag: this flag shall be set to 1 if the Individual Image is the dependent child image of another Individual Image. Otherwise it shall be set to 0.

Representative Image Flag: if the Individual Image is a Representative Image, this flag is set to 1. Otherwise it is set to 0. There can be only one Individual Image in an MP File with the Representative Image Flag set to 1.

Image Data Format: this code specifies the image data format of an Individual Image
0 : JPEG
other : (Reserved)

MP Type Code: this code specifies the MP Type of an Individual Image

Table 4 lists the available MP Types supported by this specification. There are two sub- types supported by Large Thumbnails: Class1 and Class2. Class1 sub-types represent images that are VGA equivalent in size. Class2 sub-types similarly represent images that are Full HD equivalent size. See §6.1.2 for further details regarding Large Thumbnails.

Table 4 MP Types

MP Type(s)	Sub-Type(s)	Description	MP Type Code (Hex)
Baseline MP Primary Image			030000
Large Thumbnail	Class 1	VGA equivalent	010001
	Class 2	Full HD equivalent	010002
Multi-Frame Image	Panorama		020001
	Disparity		020002
	Multi-Angle		020003
Undefined			000000

Figure 9 shows the structure of the MP Type Code field. MP Format only supports the MP Type Codes listed in Table 4. All other codes are restricted.

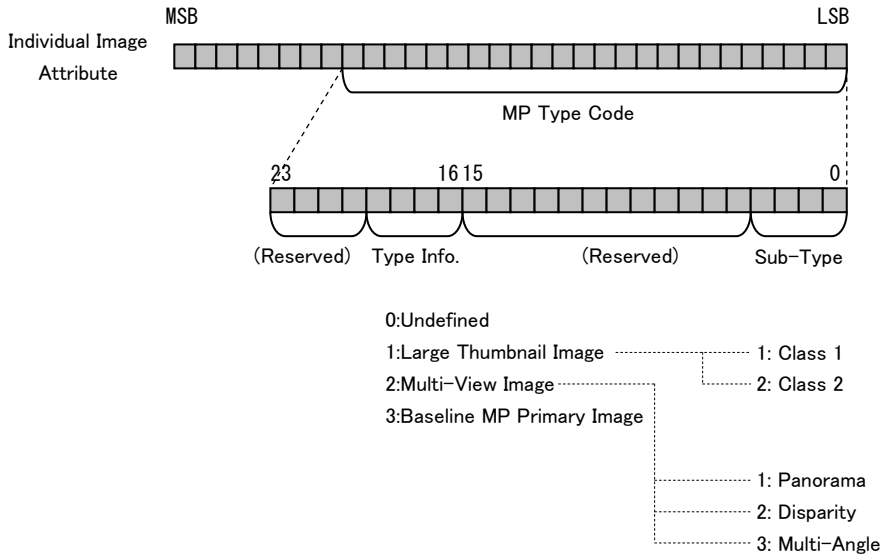


Figure 9 Structure of MP Type Code Field

5.2.3.3.2. Individual Image Size

This field specifies the size of the image data between the SOI and EOI markers of an Individual Image. The field is specified as a LONG value, and the byte order depends on MP Endian.

5.2.3.3.3. Individual Image Data Offset

This field specifies the data offset to the beginning (i.e. SOI marker) of an Individual Image. The field is specified as a LONG value, and the byte order depends on MP Endian. This offset is specified relative to the address of the MP Endian field in the MP Header (see §5.2), unless the image is a First Individual Image, in which case the value of the offset shall be NULL(00000000.H).

5.2.3.3.4. Dependent Image x Entry Number(s)

An Entry Number specifies the position of an arbitrary MP Entry relative to the first MP Entry. The field is specified as a SHORT value, and the byte order depends on MP Endian.

- The Entry Number of the first MP Entry is 1.
- If there are no Dependent Images then both the Dependent Image 1 Entry Number and the Dependent Image 2 Entry Number fields are set to 0.

- If the Individual Image is a parent image (i.e. the Dependent Parent Image Flag in the Individual Image Attribute field is set to 1) the flags in this field are set depending on the number of Dependent Images:

  a.) If there is one dependent child image the Dependent Image 1 Entry Number is set to the entry number of the dependent child image, and the Dependent Image 2 Entry Number flag is set to 0.

  b.) If there are two Dependent Images, the entry number of each respective child image is specified in the Dependent Image 1 and Dependent Image 2 Entry Number fields.
- An Individual Image may have up to two Dependent Images (§A.6 describes an example of how to create a Dependent Image).

5.2.3.4. Individual Image Unique ID List

An Image Unique ID tag [4216 (A420.H)] is specified in the Exif header of each Individual Image. This tag contains a list of the Image Unique IDs for all of the Individual Images contained in the MP File. The value in each Image Unique ID tag is specified in the form of 33 bytes of ASCII characters. The total count is equal to 33 times the total number of Individual Images specified by the NumberOfImages tag.

The value for this tag will be (NULL) if the image is a First Individual Image, or if the Image Unique ID is not specified.

Individual Image Unique ID List ImageUIDList

Tag= 45059 (B003.H)

Type = UNDEFINED

Count = 33×*NumberOfImages*

Default = none

5.2.3.5. Total Number of Captured Frames

This field specifies the number of images that were physically captured during shooting. Large Thumbnails or images that have been created later using multiple Individual Images, such as those described in §6.2.2 are not counted in this field.

See §A.2.3.3 for handling of total number of captured frames during editing.

Total Number of Captured Frames TotalFrames

Tag= 45060 (B004.H)

Type = LONG

Count = 1

Default = none

5.2.4. MP Attribute IFD

Table 5 lists the set of MP Attribute Fields that are specified in the MP Attribute IFD. Note that these tags shall be specified in the order of their Tag IDs. There are no requirements with respect to the order or location of the tag values.

Table 5 MP individual attribute tags

Tag Name		Field Name	Tag ID		Type	Count
			Dec	Hex		
Common Tags						
	MP Format Version	*MPFVersion*	45056	B000	UNDEFINED	4
	MP Individual Image Number	*MPIndividualNum*	45313	B101	LONG	1
Multi-View Image Tags						
	Panorama Scanning Orientation	*PanOrientation*	45569	B201	LONG	1
	Panorama Horizontal Overlap	*PanOverlap_H*	45570	B202	RATIONAL	1
	Panorama Vertical Overlap	*PanOverlap_V*	45571	B203	RATIONAL	1
	Base Viewpoint Number	*BaseViewpointNum*	45572	B204	LONG	1
	Convergence Angle	*ConvergenceAngle*	45573	B205	SRATIONAL	1
	Baseline Length	*BaselineLength*	45574	B206	RATIONAL	1
	Divergence Angle	*VerticalDivergence*	45575	B207	SRATIONAL	1
	Horizontal Axis Distance	*AxisDistance_X*	45576	B208	SRATIONAL	1
	Vertical Axis Distance	*AxisDistance_Y*	45577	B209	SRATIONAL	1
	Collimation Axis Distance	*AxisDistance_Z*	45578	B20A	SRATIONAL	1
	Yaw Angle	*YawAngle*	45579	B20B	SRATIONAL	1
	Pitch Angle	*PitchAngle*	45580	B20C	SRATIONAL	1
	Roll Angle	*RollAngle*	45581	B20D	SRATIONAL	1

5.2.4.1. MP Format Version

This tag contains the same value as the MP Format Version number within the MP Index IFD as specified in §5.2.3.1 Except for the First Individual Image, this

tag shall also be specified when specifying an MP Attribute IFD in any Individual Image (see Figure 3).

MP Format Version MPFVersion

Tag= 45056 (B000.H)

Type = UNDEFINED

Count = 4

Default = "0100"

5.2.4.2. MP Individual Image Number

This tag specifies a number for each Individual Image within an MP File. The values for Multi-View Images are specified in §6.2.2. The requirement level for this tag is different depending on the MP Type (see §5.2.5 for further details).

MP Individual Image Number MPIndividualNum

Tag= 45313 (B101.H)

Type = LONG

Count = 1

Default = none

5.2.4.3. Panorama Scanning Orientation

This tag is used to specify the direction, sequence, and positioning of the images that comprise the final Panorama Image (see below).

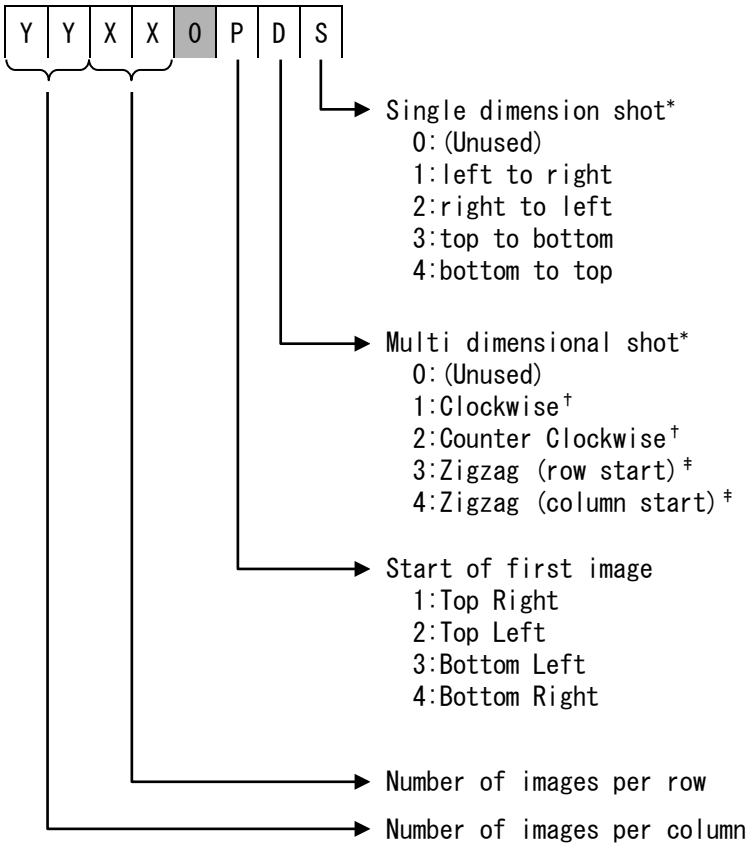
Panorama Scanning Orientation PanOrientation

Tag= 45569 (B201.H)

Type = LONG

Count = 1

Default = none



*Shall be one or the other, and cannot be specified at the same time. Unused flag shall be set to 0.

† Shall also specify starting position (top right, top left, bottom left, bottom right), and also the number of images per row

‡ Shall also specify starting position (top right, top left, bottom left, bottom right), and also the number of images per row and column

[Examples of panorama shot sequences]

(left to right)

1	2	3

00030001.H

(clockwise)

1	2	3
8	9	4
7	6	5

03030210.H

(counter-clockwise)

3	2	1
4	9	8
5	6	7

03030120.H

(zig-zag [row])

1	2	3	4
8	7	6	5
9	10	11	12

03040240.H

(zig-zag [column])

1	6	7	12
2	5	8	11
3	4	9	10

03040230.H

5.2.4.4. Overlap Tags

The overlap tags specify the estimated amount of overlap there is between two adjacent images in a Panorama Image sequence. Either a horizontal or vertical overlap value can be specified based on how the images are oriented. The overlap values are represented as a percentage of the image size (width or height depending on the direction of the overlap). There are no requirements with respect to the level of precision, calculation method, or use of these overlap tags.

- Horizontal Overlap Value (PanOverlap_H)

This tag specifies the amount of overlap there is between two horizontally positioned Panorama Image sequences. Valid values are been 0 and 1, inclusively ($0 \leqq$ PanOverlap_H $\leqq 1$), where 1 represents 100%. The values are represented using a RATIONAL number.

Horizontal Overlap Value PanOverlap_H

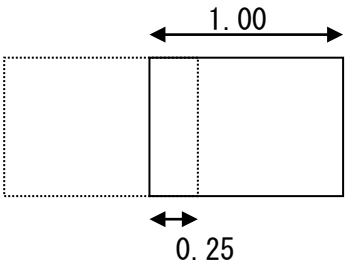
Tag= 45570 (B202.H)

Type = RATIONAL

Count = 1

Default = none

(Example: 25%=0.25)



- Vertical Overlap Value (PanOverlap_V)

This tag specifies the amount of overlap there is between two vertically positioned Panorama Image sequences. Valid values are been 0 and 1, inclusively ($0 \leqq$ PanOverlap_V $\leqq 1$), where 1 represents 100%. The values are represented using a RATIONAL number.

Vertical Overlap Value PanOverlap_V

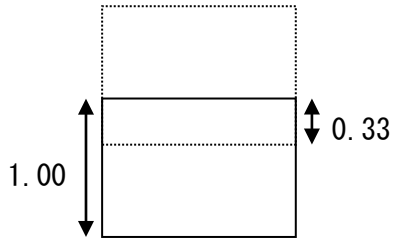
Tag= 45571 (B203.H)

Type = RATIONAL

Count = 1

Default = none

(Example: 33%=0.33)



5.2.4.5. Base Viewpoint Number

This tag specifies the Viewpoint Number of the base viewpoint of a Multi-View Image. This tag shall be specified for Disparity and Multi-Angle Images. For Disparity Images, this tag represents the base viewpoint number where the Convergence Angle, Baseline Length, and Divergence Angle are measured. For Multi-Angle Images, this tag represents the base viewpoint number where the distance along each axis and the rotation angle values are measured. Each Individual Image that comprises the Multi-View Image should have the same value.

Base Viewpoint Number BaseViewpointNum

Tag= 45572 (B204.H)

Type = LONG

Count = 1

Default = none

5.2.4.6. Convergence Angle

This tag specifies the Convergence Angle with respect to the reference viewpoint. The Convergence Angle is specified as an SRATIONAL value ranging from -180 to 180 degrees. If a viewpoint is situated on the right side of the line of site

originating from the reference viewpoint, then the value is between 0 and 180 degrees. Similarly, if the viewpoint is situated on the left side, then the value is between -180 and 0 degrees (see Figure 10).

If the Convergence Angle is unknown, then the value shall be FFFFFFFF.H/FFFFFFFF.H.

Convergence Angle ConvergenceAngle

Tag= 45573 (B205.H)

Type = SRATIONAL

Count = 1

Default = none

5.2.4.7. Baseline Length

This tag specifies the Baseline Length with respect to the reference viewpoint. The Baseline Length is specified as a RATIONAL value in units of meters (see Figure 10).

If the Baseline Length is unknown, then the value shall be FFFFFFFF.H/FFFFFFFF.H.

Baseline Length BaselineLength

Tag= 45574 (B206.H)

Type = RATIONAL

Count = 1

Default = none

5.2.4.8. Divergence Angle

This tag specifies the vertical Divergence Angle with respect to the horizontal plane that intersects with the reference viewpoint. The Divergence Angle is specified as an SRATIONAL value, ranging from -90 to 90 degrees (see Figure 10). This tag does not need to be specified if the vertical Divergence Angle from the horizontal plane is 0 degrees. If the Divergence Angle is unknown, then the value shall be FFFFFFFF.H/FFFFFFFF.H.

Divergence Angle VerticalDivergence

Tag= 45575 (B207.H)

Type = SRATIONAL

Count = 1

Default = none

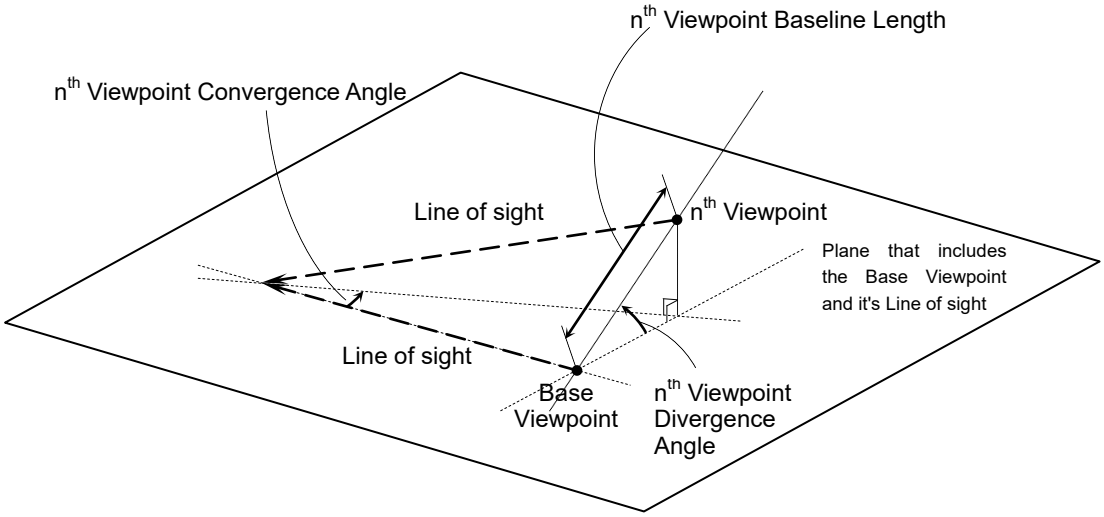


Figure 10 Convergence Angle, Baseline Length, and Divergence Angle

5.2.4.9. Vertical, Horizontal, and Collimation Axis Distances

The AxisDistance_X, AxisDistance_Y, and AxisDistance_Z tags specify the relative distance of the Target Object along each axis of a right-hand coordinate system (i.e. X, Y, and Z axis). The distance values along each axis are specified as an SRATIONAL number, and are relative to the assumption that the distance between the base viewpoint and the object is equal to 1 (see Figure 11).

- Horizontal Axis Distance

Horizontal Axis Distance AxisDistance_X

Tag= 45576 (B208.H)

Type = SRATIONAL

Count = 1

Default = none

- Vertical Axis Distance

  Vertical Axis Distance AxisDistance_Y

  Tag= 45577 (B209.H)

  Type = SRATIONAL

  Count = 1

  Default = none

- Collimation Axis Distance

  Collimation Axis Distance AxisDistance_Z

  Tag= 45578 (B20A.H)

  Type = SRATIONAL

  Count = 1

  Default = none

5.2.4.10. Yaw Angle, Pitch Angle and Roll Angle

The YawAngle, PitchAngle, and RollAngle tags specify the amount of rotation in degrees, with the clockwise rotation being the positive direction. The value is specified as an SRATIONAL number between -180 and 180 degrees. All three tag values for the line of sight from the base viewpoint will be 0 (see Figure 11).

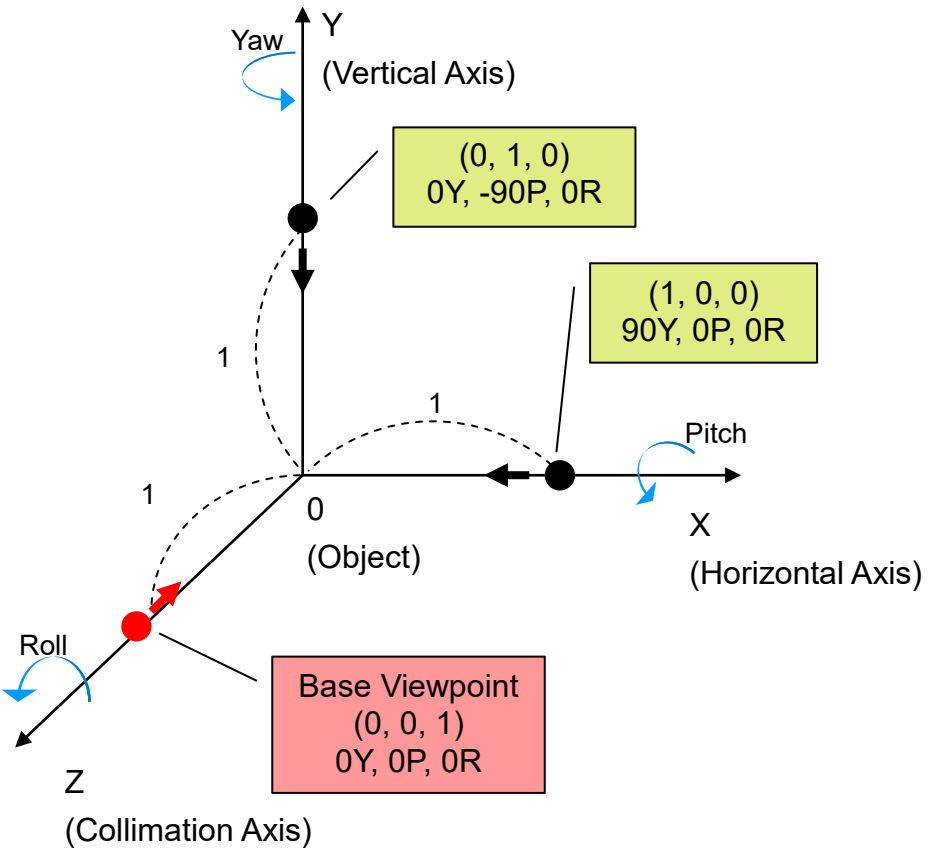


Figure 11 Axis distance and Rotation angles

- Yaw Angle

  Yaw Angle YawAngle

  Tag= 45579 (B20B.H)

  Type = SRATIONAL

  Count = 1

  Default = none

- Pitch Angle

  Pitch Angle PitchAngle

  Tag= 45580 (B20C.H)

  Type = SRATIONAL

  Count = 1

  Default = none

- Roll Angle

Roll Angle RollAngle
Tag= 45581 (B20D.H)
Type = SRATIONAL
Count = 1
Default = none

5.2.5. Requirement Level for Tag Support

Table 6 lists the support level requirements for the tags within the MP Index IFD. Table 7 lists the support level requirements for the MP Attribute IFD in a Baseline MP File. Table 8 lists the support level requirements for MP Attribute IFD in an Extended MP File.

Table 6 MP Index IFD Tag Support Level

Tag Name	Field Name	Tag ID		Level
		Dec	Hex	
MP Format Version Number	*MPFVersion*	45056	B000	M
Number of Images	*NumberOfImages*	45057	B001	M
MP Entry Information	*MPEntry*	45058	B002	M
Individual Image Unique ID list	*ImageUIDList*	45059	B003	O
Total Number of Captured Frames	*TotalFrames*	45060	B004	O

Level: specifies the tag support requirements
M: Mandatory
O: Optional

Table 7　MP Attribute IFD Tag Support Level (for Baseline MP Files)

Tag Name		Field Name	Tag ID		Level
			Dec	Hex	
Common Tags					
	MP Format Version	*MPFVersion*	45056	B000	N
	MP Individual Image Number	*MPIndividualNum*	45313	B101	N
Multi-View Image Tags					
	Panorama Scanning Orientation	*PanOrientation*	45569	B201	N
	Panorama Horizontal Overlap	*PanOverlap_H*	45570	B202	N
	Panorama Vertical Overlap	*PanOverlap_V*	45571	B203	N
	Base Viewpoint Number	*BaseViewpointNum*	45572	B204	N
	Convergence Angle	*ConvergenceAngle*	45573	B205	N
	Baseline Length	*BaselineLength*	45574	B206	N
	Divergence Angle	*VerticalDivergence*	45575	B207	N
	Horizontal Axis Distance	*AxisDistance_X*	45576	B208	N
	Vertical Axis Distance	*AxisDistance_Y*	45577	B209	N
	Collimation Axis Distance	*AxisDistance_Z*	45578	B20A	N
	Yaw Angle	*YawAngle*	45579	B20B	N
	Pitch Angle	*PitchAngle*	45580	B20C	N
	Roll Angle	*RollAngle*	45581	B20D	N

Level: specifies the tag support requirements

N: Not Specified

Table 8 MP Attribute IFD Tag Support Level (for Extended MP Files)

Tag Name	Field Name	Tag ID		Level				
		Dec	Hex	Large Thumbnail	Panorama	Disparity	Multi-Angle	Undefined
Common Tags								
MP Format Version	*MPFVersion*	45056	B000	N	CM[1]	CM[1]	CM[1]	CM[1]
MP Individual Image Number	*MPIndividualNum*	45313	B101	N	CM[2]	CM[2]	CM[2]	CM[2]
Multi-View Image Tags								
Panorama Scanning Orientation	*PanOrientation*	45569	B201	N	R	N	N	N
Panorama Horizontal Overlap	*PanOverlap_H*	45570	B202	N	O	N	N	N
Panorama Vertical Overlap	*PanOverlap_V*	45571	B203	N	O	N	N	N
Base Viewpoint Number	*BaseViewpointNum*	45572	B204	N	N	CM[3]	CM[3]	N
Convergence Angle	*ConvergenceAngle*	45573	B205	N	N	R	N	N
Baseline Length	*BaselineLength*	45574	B206	N	N	R	N	N
Divergence Angle	*VerticalDivergence*	45575	B207	N	N	O	N	N
Horizontal Axis Distance	*AxisDistance_X*	45576	B208	N	N	N	R	N
Vertical Axis Distance	*AxisDistance_Y*	45577	B209	N	N	N	R	N
Collimation Axis Distance	*AxisDistance_Z*	45578	B20A	N	N	N	R	N
Yaw Angle	*YawAngle*	45579	B20B	N	N	N	R	N
Pitch Angle	*PitchAngle*	45580	B20C	N	N	N	R	N
Roll Angle	*RollAngle*	45581	B20D	N	N	N	R	N

Level: specifies the tag support requirements

CM[1]: Conditionally Mandatory (see § 5.2.4.1)

CM[2]: Conditionally Mandatory (see § 6.2.2)

CM[3]: Conditionally Mandatory (see § 5.2.4.5)

R: Recommended

O: Optional

N: Not Specified

6. File Specification

6.1. Baseline MP File

A Baseline MP File comprises a Primary Image (i.e. Baseline MP Primary Image) as the first Individual Image, and a maximum of two Large Thumbnails. The first Individual Image contains MP Extensions. Large Thumbnails follow the first Individual Image. In a Baseline MP File, the maximum number of Individual Images is 3 (including the Baseline MP Primary Image).

The Baseline MP Primary Image shall contain MP Extensions. The MP Extensions includes at least the mandatory set of MP Index IFD tags shown in Table 6, but

the MP Attribute IFD shall be entirely omitted, as shown in Table 7.
A Baseline MP File should have at least one Large Thumbnail; however, Baseline MP Files that do not contain Large Thumbnails are considered valid MP Files as long it contains MP Extensions.

6.1.1. Specification of Baseline MP Primary Image

6.1.1.1. Specification of MP Extensions

In the Baseline MP Primary Image, the Offset to Next IFD field in the MP Index IFD shall be NULL (00000000.H). The MP Attribute IFD shall not be recorded.

6.1.1.2. MP Type

The Baseline MP Primary Image shall have the MP Type Code for Baseline MP Primary Image as listed in Table 4.

6.1.2. Specification of Large Thumbnails

6.1.2.1. Specification of MP Extensions

Large Thumbnails shall not contain the APP2 for MP Extensions.

6.1.2.2. Number of Pixels of Large Thumbnails

For a Class 1 image, the maximum width is 640 pixels and the maximum height is 480 pixels, and either the width or the height shall be the maximum number. For a Class 2 image, the maximum width is 1920 pixels and the maximum height is 1080 pixels, and either the width or the height shall be the maximum number. For either Class 1 or 2, the aspect ratio of the Large Thumbnail shall be equal to the aspect ratio of the Large Thumbnail Source Image. Figure 12 describes the various possible aspect ratios of a Large Thumbnail.

<table>
<tr><td rowspan="2">Large thumbnail source image Aspect Ratio (General Example)</td><td colspan="2">Large Thumbnail Image</td></tr>
<tr><td>Class 1</td><td>Class 2</td></tr>
<tr><td>4 : 3</td><td>640 pixels
480 pixels
Orientation = 1</td><td>1440 pixels
1080 pixels
Orientation = 1</td></tr>
<tr><td>16 : 9</td><td>640 pixels
360 pixels
Orientation = 1</td><td>1920 pixels
1080 pixels
Orientation = 1</td></tr>
<tr><td rowspan="2">4 : 3
Rotated Shot</td><td>The orientation shall be the same as large thumbnail source image.
The value of the orientation may be specified 1 or 6.</td><td>Same as on the left</td></tr>
<tr><td>Orientation = 1
360 pixels
480 pixels
Orientation = 6
640 pixels</td><td>Orientation = 1
810 pixels
1080 pixels
Orientation = 6
1440 pixels
1080 pixels</td></tr>
</table>

Figure 12 Large thumbnail orientation

6.1.2.3. Padding

Padding may be added as specified in "§4.8.1 Stipulations on Compressed Image Size" of the Exif specification only for the case in which the pixel count of the Large Thumbnail is not a multiple of the MCU of a JPEG compressed image specified in the Exif standard.

6.1.2.4. Relationship between Large Thumbnails and Baseline MP Primary Images

6.1.2.4.1. Dependency Relationship

Large Thumbnails shall be a Dependent Image of a Baseline MP Primary Image. A Baseline MP Primary Image may have at most one Class1 and one Class2 images

(total of two Large Thumbnails). Furthermore, if two Large Thumbnails exist then both may be specified as Dependent Images of a Baseline MP Primary Image.

6.1.2.4.2. Sameness

Large Thumbnails shall have the same angle of view, signal level, aspect ratio, orientation, and color space attributes as the Baseline MP Primary Image.

6.1.2.5. Exif Thumbnails

The Thumbnail in APP1 specified in Exif, may be omitted from a Large Thumbnail image.

6.1.3. Specification of File Extension

The file extension of a Baseline MP File shall be “JPG”.

6.2. Extended MP Files

An Extended MP File contains multiple Primary Images that have one of the MP types described in Table 4. Large Thumbnails may also be added to each Primary Image. Several Primary Images may also be combined or stitched into one image and added as one or plural separate Individual Images.

The First Individual Image of an Extended MP File shall have the MP Extensions. The MP Extensions shall at least contain the mandatory MP Index IFD tags as specified in Table 6 and the appropriate MP Attribute IFD tags specified in Table 8.

An Extended MP File may contain only one Primary Image. There is no requirement for the order in which the Individual Images are contained in the MP File.

6.2.1. Restrictions for Extended MP Files

6.2.1.1. MP Type

Except for Large Thumbnails, Individual Images with different MP Types shall not co-exist in a single MP File. An Individual Image that has been created by stitching plural Individual Images shall inherit the same MP Type as the

Individual Images before stitching.

6.2.1.2. Multiplexing

The MP Index IFD shall exist only in the First Individual Image, and not in any of the other Individual Images.

6.2.1.3. Dependency Relationship

Dependent Images shall not be nested. In other words, any Individual Image shall not set both its Dependent Child Image Flag and its Dependent Parent Image Flag to 1.

6.2.2. Specification of MP Individual Image Number

6.2.2.1. Panorama Images

MP Individual Image Number tags shall be specified for Panorama Images. MP Individual Image Number identifies the position and sequence of the image with respect to the overall layout of the panorama. The value for the MP Individual Image Number tag starts with 1. The layout of the Individual Images are shown in §5.2.4.3. A value of FFFFFFFF.H shall be specified for the MP Individual Image Number if the position of an image with respect to the overall layout is unknown.
A value of 00000000.H shall be specified for the MP Individual Image Number if the image is a stitched composite of the entire panorama sequence or if the image is a thumbnail index of all of the Individual Images that makes up the panorama.

6.2.2.2. Disparity Images

MP Individual Image Number tags shall be specified for Disparity Images. MP Individual Image Number is the image's Viewpoint Number which identifies the position and sequence of the camera (viewpoint) during shooting. The value for the MP Individual Image Number tag starts with 1. A value of FFFFFFFF.H shall be specified for the MP Individual Image Number if the position of an image is unknown. For Disparity Images, the MP Individual Image Number shall be numbered from leftmost viewpoint (relative to the line of site to the target subject) to the rightmost viewpoint. This rule applies even if the viewpoints are not

situated on a fully planar surface. There are no requirements for vertical position or sequence (see Figure 13).
A value of 00000000.H shall be specified for the MP Individual Image Number if the image is a composite of multiple Individual Images.

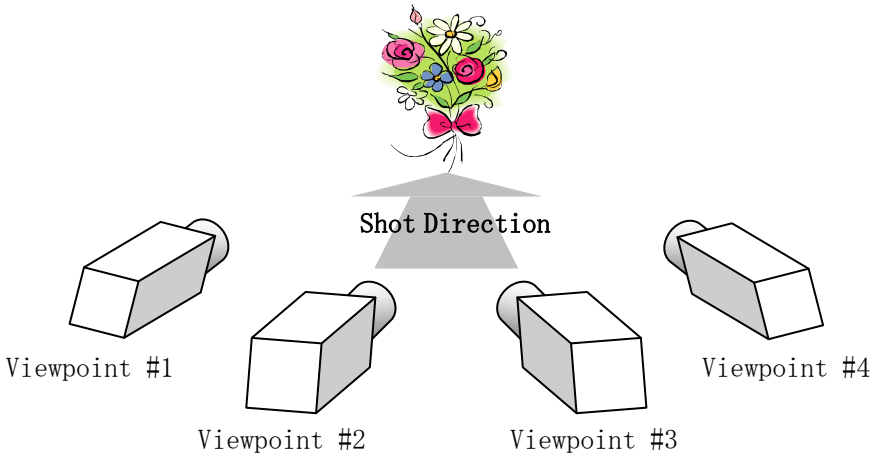


Figure 13 Example of Enumerating Viewpoints

6.2.2.3. Multi-Angle Images

MP Individual Image Number tags shall be specified for Multi-Angle Images. MP Individual Image Number is the image's Viewpoint Number which identifies the position of the viewpoint. The value for the MP Individual Image Number tag starts with 1. A value of FFFFFFFF.H shall be specified for the MP Individual Image Number if the position of an image is unknown.
A value of 00000000.H shall be specified for the MP Individual Image Number if the image is a composite of multiple Individual Images.

6.2.2.4. Specification of MP Individual Image Numbers of Undefined Image Type

MP Individual Image Numbers shall be specified when the Total Number of Captured Frames is specified in the MP file with Individual Images of Undefined Image Type. A value of 00000000.H shall be specified for the MP Individual Image Number if the image is not counted in the Total Number of Captured Frames. There are no requirements for MP Individual Image Number tags with respect to

Undefined Image Types.

6.2.2.5. Duplicate MP Individual Image Numbers

Except for Images with MP Individual Image Numbers of 00000000.H or FFFFFFFF.H, images with the same MP Individual Image Numbers shall not co-exist in a single MP File.

6.2.3. Specification of Large Thumbnails

The specification of Large Thumbnails in Extended MP Files follows the same rules for Baseline MP Files specified in §6.1.2, replacing all reference to "Baseline MP Primary Image" with "Large Thumbnail Source Image".

6.2.4. Specification of MP Extensions

For the First Individual Image in an Extended MP File, the MP Attribute IFD shall be omitted if there are no MP Attribute Fields to be specified.

6.2.5. File Extension Specification

The file extension of an Extended MP Files shall be "MPO"[1].

7. Exif Tag Support Requirements

This section describes the support level requirements for the tags specified by Exif and/or DCF in the APP1 marker segment. They are called Exif tags collectively in this section for the sake of brevity since there are just a few tags specified only by DCF.

For Large Thumbnails, specifying the same tags as the Large Thumbnail Source Image is prohibited. If there are no unique tag values to be specified, the APP1 marker as a whole shall be omitted.

For Individual Images other than Large Thumbnails, the tag support level requirements as specified in the Exif and/or DCF should be followed. Table 9 through Table 13 describes each of the Exif tag support levels in detail. These respective tables illustratively show the Exif tags at the time of Exif 2.32 [CIPA DC-008-2019], DCF 2.0 (Edition 2010) [CIPA DC-009-2010].

[1] MPO stands for Multi Picture Object.

Table 9 Exif Tag Support Levels (1) - 0th IFD TIFF Tag -

Tag Name	Field Name	Tag ID		Baseline MP File	Extended MP File	
		Dec	Hex	Large Thumbnail Image	Other	Large Thumbnail Image
Image width	ImageWidth	256	100	N	Same as Exif (Same as DCF if it has a spec in DCF)	N
Image height	ImageLength	257	101	N		N
Number of bits per component	BitsPerSample	258	102	N		N
Compression scheme	Compression	259	103	N		N
Pixel composition	PhotometricInterpretation	262	106	N		N
Image title	ImageDescription	270	10E	N		N
Manufacturer of image input equipment	Make	271	10F	N		N
Model of image input equipment	Model	272	110	N		N
Image data location	StripOffsets	273	111	N		N
Orientation of image	Orientation	274	112	N		N
Number of components	SamplesPerPixel	277	115	N		N
Number of rows per strip	RowsPerStrip	278	116	N		N
Bytes per compressed strip	StripByteCounts	279	117	N		N
Image resolution in width direction	XResolution	282	11A	CM[1]		CM[1]
Image resolution in height direction	YResolution	283	11B	CM[1]		CM[1]
Image data arrangement	PlanarConfiguration	284	11C	N		N
Unit of X and Y resolution	ResolutionUnit	296	128	CM[1]		CM[1]
Transfer function	TransferFunction	301	12D	N		N
Software used	Software	305	131	N		N
File change date and time	DateTime	306	132	N		N
Person who created the image	Artist	315	13B	N		N
White point chromaticity	WhitePoint	318	13E	N		N
Chromaticities of primaries	PrimaryChromaticities	319	13F	N		N
Offset to JPEG SOI	JPEGInterchangeFormat	513	201	N		N
Bytes of JPEG data	JPEGInterchangeFormatLength	514	202	N		N
Color space transformation matrix coefficients	YCbCrCoefficients	529	211	N		N
Subsampling ratio of Y to C	YCbCrSubSampling	530	212	N		N
Y and C positioning	YCbCrPositioning	531	213	N		N
Pair of black and white reference values	ReferenceBlackWhite	532	214	N		N
Copyright holder	Copyright	33432	8298	N		N
Exif tag	Exif IFD Pointer	34665	8769	CM[2]		CM[2]
GPS tag	GPSInfo IFD Pointer	34853	8825	N		N

Notation

N : Shall not be recorded

CM[1] : Shall be recorded if the value to be stored is different from the source image. Should not be recorded if the value to be stored is the same.

CM[2] : Shall be recorded if recording Exif Private Tags

: Tags that may be recorded in the Large Thumbnail

Table 10 Exif Tag Support Levels (2) - 0th IFD Exif Private Tag -

Tag Name	Field Name	Tag ID		Baseline MP File	Extended MP File	
		Dec	Hex	Large Thumbnail Image	Other	Large Thumbnail Image
Exposure time	ExposureTime	33434	829A	N		N
F number	FNumber	33437	829D	N		N
Exposure program	ExposureProgram	34850	8822	N		N
Spectral sensitivity	SpectralSensitivity	34852	8824	N		N
Photographic Sensitivity	Photographic Sensitivity	34855	8827	N		N
Optoelectric coefficient	OECF	34856	8828	N		N
Sensitivity Type	SensitivityType	34864	8830	N		N
Standard Output Sensitivity	StandardOutputSensitivity	34865	8831	N		N
Recommended Exposure Index	RecommendedExposureIndex	34866	8832	N		N
ISOSpeed	ISOSpeed	34867	8833	N		N
ISOSpeed Latitude yyy	ISOSpeedLatitudeyyy	34868	8834	N		N
ISOSpeed Latitude zzz	ISOSpeedLatitudezzz	34869	8835	N		N
Exif Version	ExifVersion	36864	9000	N		N
Date and time original image was generated	DateTimeOriginal	36867	9003	N		N
Date and time image was made digital data	DateTImeDigitized	36868	9004	N		N
Offset data of DateTime	OffsetTime	36880	9010	N		N
Offset data of DateTimeOriginal	OffsetTimeOriginal	36881	9011	N		N
Offset data of DateTimeDigitized	OffsetTimeDigitized	36882	9012	N		N
Meaning of each component	ComponentsConfiguration	37121	9101	N	Same as Exif (Same as DCF if it has a spec in DCF)	N
Image compression mode	CompressedBitsPerPixel	37122	9102	N		N
Shutter speed	ShutterSpeedValue	37377	9201	N		N
Aperture	ApertureValue	37378	9202	N		N
Brightness	BrightnessValue	37379	9203	N		N
Exposure bias	ExposureBiasValue	37380	9204	N		N
Maximum lens aperture	MaxApertureValue	37381	9205	N		N
Subject distance	SubjectDistance	37382	9206	N		N
Metering mode	MeteringMode	37383	9207	N		N
Light source	LightSource	37384	9208	N		N
Flash	Flash	37385	9209	N		N
Lens focal length	FocalLength	37386	920A	N		N
Subject area	SubjectArea	37396	9214	N		N
Manufacturer notes	MakerNote	37500	927C	O		O
User comments	UserComment	37510	9286	N		N
DateTime subseconds	SubSec	37520	9290	N		N
DateTimeOriginal subseconds	SubSecTimeOriginal	37521	9291	N		N
DateTimeDigitized subseconds	SubsecTimeDigitized	37522	9292	N		N
Temperature	Temperature	37888	9400	N		N
Humidity	Humidity	37889	9401	N		N
Pressure	Pressure	37890	9402	N		N
WaterDepth	WaterDepth	37891	9403	N		N
Acceleration	Acceleration	37892	9404	N		N
Camera elevation angle	CameraElevationAngle	37893	9405	N		N

Valid image width	PixelXDimension	40962	A002	CM[1]		CM[1]
Valid image height	PixelYDimension	40963	A003	CM[1]		CM[1]
Related audio file	RelatedSoundFile	40964	A004	N		N
Interoperability IFD Pointer	Interoperability IFD Pointer	40965	A005	N		N
Flash energy	Flash Energy	41483	A20B	N		N
Spatial frequency response	SpatialFrequencyResponse	41484	A20C	N		N
Focal plane X resolution	FocalPlaneXResolution	41486	A20E	N		N
Focal plane Y resolution	FocalPlaneYResolution	41487	A20F	N		N
Focal plane resolution unit	FocalPlaneResolutionUnit	41488	A210	N		N
Subject location	SubjectLocation	41492	A214	N		N
Exposure index	ExposureIndex	41493	A215	N		N
Sensing method	SensingMethod	41495	A217	N		N
File source	FileSource	41728	A300	N		N
Scene type	SceneType	41729	A301	N		N
CFA pattern	CFAPattern	41730	A302	N		N
Custom image processing	CustomRendered	41985	A401	N	Same as Exif (Same as DCF if it has a spec in DCF)	N
Exposure mode	ExposureMode	41986	A402	N		N
White balance	WhiteBalance	41987	A403	N		N
Digital zoom ratio	DigitalZoomRatio	41988	A404	N		N
Focal length in 35 mm film	FocalLengthIn35mmFilm	41989	A405	N		N
Scene capture type	SceneCaptureType	41990	A406	N		N
Gain control	GainControl	41991	A407	N		N
Contrast	Contrast	41992	A408	N		N
Saturation	Saturation	41993	A409	N		N
Sharpness	Sharpness	41994	A40A	N		N
Device settings description	DeviceSettingDescription	41995	A40B	N		N
Subject distance range	SubjectDistanceRange	41996	A40C	N		N
Unique image ID	ImageUniqueID	42016	A420	O		O
Camera Owner Name	CameraOwnerName	42032	A430	N		N
BodySerial Number	BodySerialNumber	42033	A431	N		N
Lens Specification	LensSpecification	42034	A432	N		N
Lens Make	LensMake	42035	A433	N		N
Lens Model	LensModel	42036	A434	N		N
Lens Serial Number	LensSerialNumber	42037	A435	N		N
Composite image	CompositeImage	42080	A460	N		N
Source image number of composite image	SourceImageNumberOfCompositeImage	42081	A461	N		N
Source exposure times of composite image	SourceExposureTimesOfCompositeImage	42082	A462	N		N
Gamma	Gamma	42240	A500	N		N

Notation

O : Optional

N : Shall not be recorded.

CM[1] : Shall be recorded if the value to be stored is different from the source image.
Should not be recorded if the value to be stored is the same.

: Tags that may be recorded in the Large Thumbnail

(Translation Note : the note here does not concern with this translation document because it hits only about Japanese expression in the documents.)

Note: Each of Interoperability IFD Pointer tag and Gamma tag has different name in Exif and DCF. But DCF's name is used since DCF's spec has priority in this standard.

Table 11 Exif Tag Support Levels (3) - 0th IFD GPS Tag -

Tag Name	Field Name	Tag ID		Baseline MP File	Extended MP File	
		Dec	Hex	Large Thumbnail Image	Other	Large Thumbnail Image
GPS tag version	GPSVersionID	0	0	N	Same as Exif	N
North or South Latitude	GPSLatitudeRef	1	1	N		N
Latitude	GPSLatitude	2	2	N		N
East or West Longitude	GPSLongitudeRef	3	3	N		N
Longitude	GPSLongitude	4	4	N		N
Altitude reference	GPSAltitudeRef	5	5	N		N
Altitude	GPSAltitude	6	6	N		N
GPS time (atomic clock)	GPSTimeStamp	7	7	N		N
GPS satellites used for measurement	GPSSatellites	8	8	N		N
GPS receiver status	GPSStatus	9	9	N		N
GPS measurement mode	GPSMeasureMode	10	A	N		N
Measurement precision	GPSDOP	11	B	N		N
Speed unit	GPSSpeedRef	12	C	N		N
Speed of GPS receiver	GPSSpeed	13	D	N		N
Reference for direction of movement	GPSTrackRef	14	E	N		N
Direction of movement	GPSTrack	15	F	N		N
Reference for direction of image	GPSImgDirectionRef	16	10	N		N
Direction of image	GPSImgDirection	17	11	N		N
Geodetic survey data used	GPSMapDatum	18	12	N		N
Reference for latitude of destination	GPSDestLatitudeRef	19	13	N		N
Latitude of destination	GPSDestLatitude	20	14	N		N
Reference for longitude of destination	GPSDestLongitudeRef	21	15	N		N
Longitude of destination	GPSDestLongitude	22	16	N		N
Reference for bearing of destination	GPSDestBearingRef	23	17	N		N
Bearing of destination	GPSDestBearing	24	18	N		N
Reference for distance to destination	GPSDestDistanceRef	25	19	N		N
Distance to destination	GPSDestDistance	26	1A	N		N
Name of GPS processing method	GPSProcessingMethod	27	1B	N		N
Name of GPS area	GPSAreaInformation	28	1C	N		N
GPS date	GPSDateStamp	29	1D	N		N
GPS differential correction	GPSDifferential	30	1E	N		N

Notation

N : Shall not be recorded

Table 12 Exif Tag Support Levels (4) - 0th IFD Interoperability Tag -

Tag Name	Field Name	Tag ID		Baseline MP File	Extended MP File	
		Dec	Hex	Large Thumbnail Image	Other	Large Thumbnail Image
Interoperability Index	InteroperabilityIndex	1	1	N	Same as DCF	N
Interoperability Version	InteroperabilityVersion	2	2	N		N
Related Image File Format	RelatedImageFileFormat	4096	1000	N		N
Related Image Width	RelatedImageWidth	4097	1001	N		N
RelatedImageLength	RelatedImageLength	4098	1002	N		N

Notation

N：Shall not be recorded

Note: Interoperability Index tag is called interoperability Identification in Exif and Interoperability Index in DCF, that is inconsistensy for the name. In this standard DCF's name is used since DCF's spec has priority.

Table 13 Exif Tag Support Levels (5) - 1st IFD TIFF Tag -

Tag Name	Field Name	Tag ID		Baseline MP File	Extended MP File	
		Dec	Hex	Large Thumbnail Image	Other	Large Thumbnail Image
Image width	ImageWidth	256	100	N	Same as Exif	N
Image height	ImageLength	257	101	N		N
Number of bits per component	BitsPerSample	258	102	N		N
Compression scheme	Compression	259	103	N		N
Pixel composition	PhotometricInterpretation	262	106	N		N
Image title	ImageDescription	270	10E	N		N
Manufacturer of image input equipment	Make	271	10F	N		N
Model of image input equipment	Model	272	110	N		N
Image data location	StripOffsets	273	111	N		N
Orientation of image	Orientation	274	112	N		N
Number of components	SamplesPerPixel	277	115	N		N
Number of rows per strip	RowsPerStrip	278	116	N		N
Bytes per compressed strip	StripByteCounts	279	117	N		N
Image resolution in width direction	XResolution	282	11A	N		N
Image resolution in height direction	YResolution	283	11B	N		N
Image data arrangement	PlanarConfiguration	284	11C	N		N
Unit of X and Y resolution	ResolutionUnit	296	128	N		N
Transfer function	TransferFunction	301	12D	N		N
Software used	Software	305	131	N		N
File change date and time	DateTime	306	132	N		N
Person who created the image	Artist	315	13B	N		N
White point chromaticity	WhitePoint	318	13E	N		N
Chromaticities of primaries	PrimaryChromaticities	319	13F	N		N
Offset to JPEG SOI	JPEGInterchangeFormat	513	201	O		O
Bytes of JPEG data	JPEGInterchangeFormatLength	514	202	O		O
Color space transformation matrix coefficients	YCbCrCoefficients	529	211	N		N
Subsampling ratio of Y to C	YCbCrSubSampling	530	212	N		N
Y and C positioning	YCbCrPositioning	531	213	N		N
Pair of black and white reference values	ReferenceBlackWhite	532	214	N		N
Copyright holder	Copyright	33432	8298	N		N
Exif tag	Exif IFD Pointer	34665	8769	O		O
GPS tag	GPSInfo IFD Pointer	34853	8825	N		N

Notation

O : Optional

N : Shall not be recorded

: Tags that may be recorded in the Large Thumbnail

A.Annex

A.1.MP Data Structure and File Specification (Informative)

The MP Format specification defines a general data structure for containing multiple images into a single file, along with two specific file types, Baseline MP File and Extended MP File, which utilizes this structure. These file types specify a minimum set of mandatory tags that are required to manage the multiple images contained in the file.

A Baseline MP File contains one Baseline MP Primary Image along with an associated Large Thumbnail, and its file extension is “JPG”.

An Extended MP File can contain multiple Primary Images, and its file extension is “MPO”.

Figure 14 visually describes the above relationship between the specification of these file types.

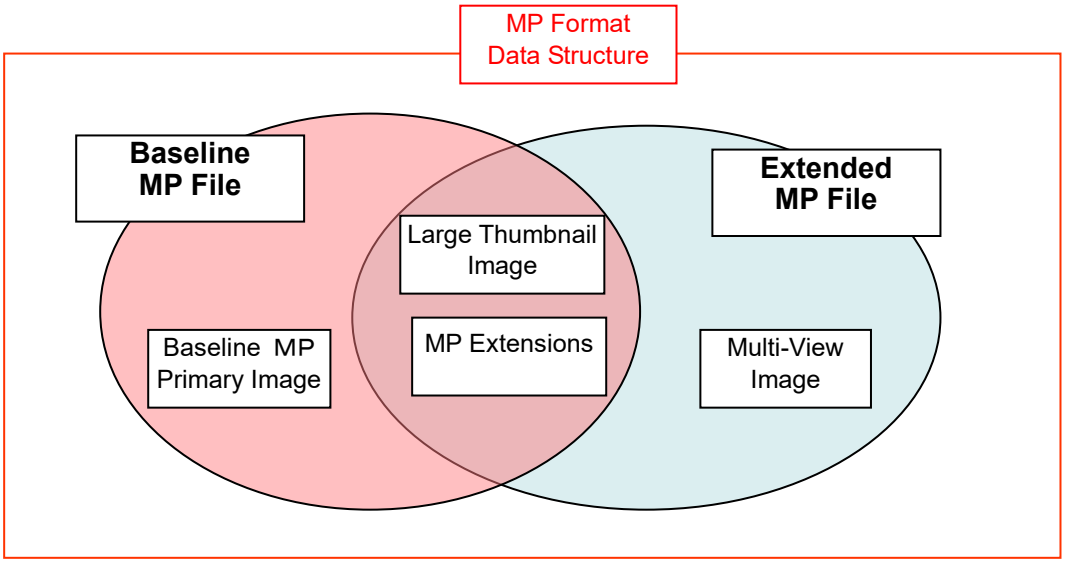


Figure 14 Relationship between the MPF Data and File Structures

A.2.Interoperability Guidelines (Normative)

This section describes a set of guidelines concerning the behavior of devices and software that utilize this specification.

A.2.1.Creating an MP File

A.2.1.1.Creating a Baseline MP File

A Primary Image that has a large number of pixels should contain a Large Thumbnail.

A.2.1.2.Creating an Extended MP File

A.2.1.2.1. Image Unique ID

A value for the Exif ImageUniqueID tag [42016 (A420.H)] should be specified in the Exif header of each Individual Image of an Extended MP File. The ImageUniqueID values for all of the Individual Images are listed in the ImageUIDList tag in the MP Index IFD of the First Individual Image. This will allow each Individual Image to be split up into independent image files, while maintaining the linkage across all of the images by cross referencing with the ImageUIDList in the First Individual Image.

A.2.1.2.2. Order of Individual Images

For Disparity Images, it is recommended that all Multi-View Images be contained in the MP File in the order of their MP Individual Image Number values.

A.2.1.2.3. Specifying the Representative Image

When creating Disparity Images the center most image should be specified as the Representative Image.

If there are an even number of viewpoints, the Representative Image should be the image with the Viewpoint Number equal to (number of viewpoints)/2 or (number of viewpoints/2)+1. If there are an odd number of viewpoints, the Representative Image should be the image with the Viewpoint Number equal to (number of viewpoints/2)+0.5

A.2.2.MP File Playback

A.2.2.1.Playback of Baseline MP Files

A hardware and software product that supports playback of Baseline MP Files shall recognize the presence of a Large Thumbnail and shall be capable of reproducing either of the Large Thumbnail, the Baseline MP Primary Image, or the Exif Thumbnail image. Requirements for how the Large Thumbnail is recognized and how an image is reproduced, including support for DCF optional

color space, are beyond the scope of this specification.

A.2.2.2.Playback of Extended MP Files

A hardware or software product that supports playback of Extended MP Files shall be capable of either reproducing the Individual Images appropriate for their MP Type, or simply reproducing each Individual Image separately. However, the reproducing capability may be restricted by the large file size as described in §A.5. The reproduction of an Individual Image may be substituted by the reproduction of its Exif Thumbnail or the Large Thumbnail dependent on the Individual Image. Furthermore, a hardware or software product that supports the playback of Multi-View Images shall reproduce the Individual Images even in the case when the order of MP Entries does not match the order of the MP Individual Image Numbers, or in the case when the order of MP Entries does not match the order of the Individual Images, or in the case when the MP Individual Image Numbers are not continuous.

A.2.2.3.Playback in accordance with the MP Endian

A hardware or software product that supports playback of MP Files should confirm the MP endian to properly read and process the MP Extensions. It is cautioned that reproducing the MP Extensions without complying with the MP endian might lead to mis-interpretation of the MP Extensions if the Exif endian does not coincide with the MP endian.

A.2.2.4.Handling of other JPEG Marker Segments

In an MP Format, the MP Extensions may co-exist with other APP2 (such as Flashpix). A hardware or software product that supports MP File can properly reproduce the MP file by skipping over the other APPn and COM markers except the APP1 and APP2 specified in this specification.

A.2.3.Editing and Overwriting MP Files

A.2.3.1.Updating Tag Information

A hardware or software product shall properly update the tags such as the data offset of Individual Images when overwriting the MP file after editing, re-encoding or deleting a particular images in the MP file or after editing the tags or inserting

APPn in the MP file.

A.2.3.2.Handling of Large Thumbnails during Edit Operations

When editing a Large Thumbnail Source Image, the Large Thumbnail should also be edited appropriately to match the source image in order to comply with the specification in §6.1.2.4.2.

A.2.3.3.Handling of Total Number of Captured Frames during Editing

When an MP file is overwritten after revising the number of Individual Images by editing, etc. the total number of captured frames shall not be changed. To create a new file with the number of Individual Images revised, the total number of captured frames at the time of creating should be specified in the new file.

A.3.Precautions on the Representation of Functions (Informative)

The representation of functions of a hardware or software product compliant with this standard should note the range of compatible MP file types.

Regarding representations such as Multi-Picture Format Compatibility without a clear corresponding MP file, users may misunderstand that the hardware or software product is compatible with all types of MP files. A hardware or software product compatible with only some types should not be represented in this way.

A.3.1.Representation Example

A representation example is shown below. (Representation examples are not limited to this.)

For a hardware or software product which records, plays, or edits a Baseline MP file and overwrites the MP file, it may, for example, be represented as “compatible with MPF (HD thumbnail)” or “compatible with MPF (VGA thumbnail)”.

A hardware or software product which records the some type of the Extended MP file, plays the Extended MP file appropriate to the MP type, or edits and overwrites the Extended MP file may, for example, be represented as “compatible with MPF (Panorama)”.

A hardware or software product which plays each of the Individual Images of an Extended MP file may, for example, be represented as “compatible with MPF (individual play)”.

A.4.Reference to the DCF Specification (Informative)

By complying with the DCF specification, a Baseline MP File may be handled as a DCF basic file or a DCF optional file.

An Extended MP File may be handled as a DCF extended image file.

A.4.1.Individual Image Data Format

A Baseline MP File may be handled as a DCF basic file or a DCF optional file by making the data format of the Baseline MP Primary Image comply with the image data format specified by DCF standard. Furthermore, the handling of the images will be more convenient by making the chrominance sampling and Huffman table the same between the Large Thumbnail and the Baseline MP Primary Image.

The handling of the Extended MP file will be more convenient by making the chrominance sampling and Huffman table the same among the Individual Images.

A.4.2.DCF Object Structure

A DCF object structure may be formed by creating a separate DCF basic or optional file of the Representative Image in an Extended MP File. Until Readers supporting Extended MP Files become popular, Extended MP Files should be created with a DCF object structure, so that the DCF-compliant Readers may reproduce the Representative Image.

A.4.3.Handling of DCF Objects during Editing Operations

When the Representative Image in the MP file is edited for a DCF object structure as specified in §A.4.2, applying the same modification to the DCF basic file or the DCF optional file with the modification to the Representative Image can ensure the consistency between the Representative Image in the MP file and the DCF basic file or the DCF optional file.

A.5.Restrictions for Extended MP File Playback (Informative)

Some products may not be able to properly handle large Extended MP Files due to limitations in file size. In the cases like this, it is recommended that the product issue some kind of warning to the user, whether via documentation or on-screen message, stating that it may not be able to read some Extended MP Files that are

larger than the product's maximum supported file size.

Furthermore, if some or all of the Individual Images are unreadable due to the design of the product (whether it be the Large Thumbnail, Exif Thumbnail, or any other Individual Image), the user may be notified via some form of user interface.

A.6.Example of Creating a Large Thumbnail (Informative)

MP Attribute IFD in the First Individual Image and the APP2 in the Large Thumbnail shall not be recorded as specified in §6.1.1.1 and §6.1.2.1 when the Baseline MP file contains the Large Thumbnail. Furthermore, Exif Thumbnail in the Large Thumbnail may be omitted as specified in §6.1.2.5 (see Figure 15).

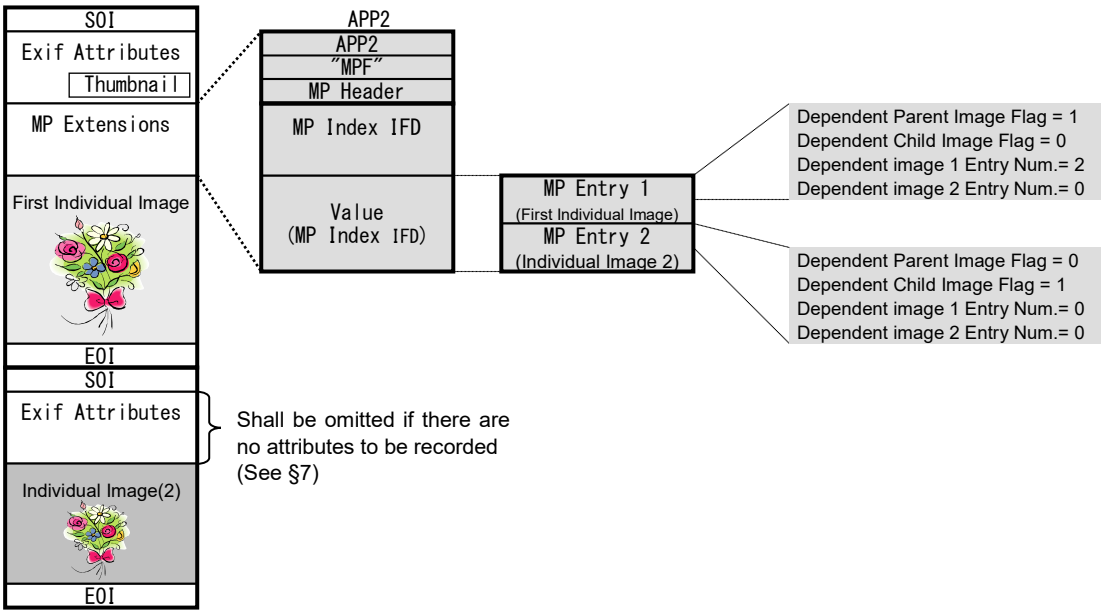


Figure 15 Example method for storing Dependent Images

A.7.Updating the MP Entry during the Deletion of an Individual Image (Informative)

Figure 16 shows an example of updating operation of the MP Entry in accordance with the specification in §5.2.3.3 when deleting an Individual Image from the MP File.

MP Index IFD

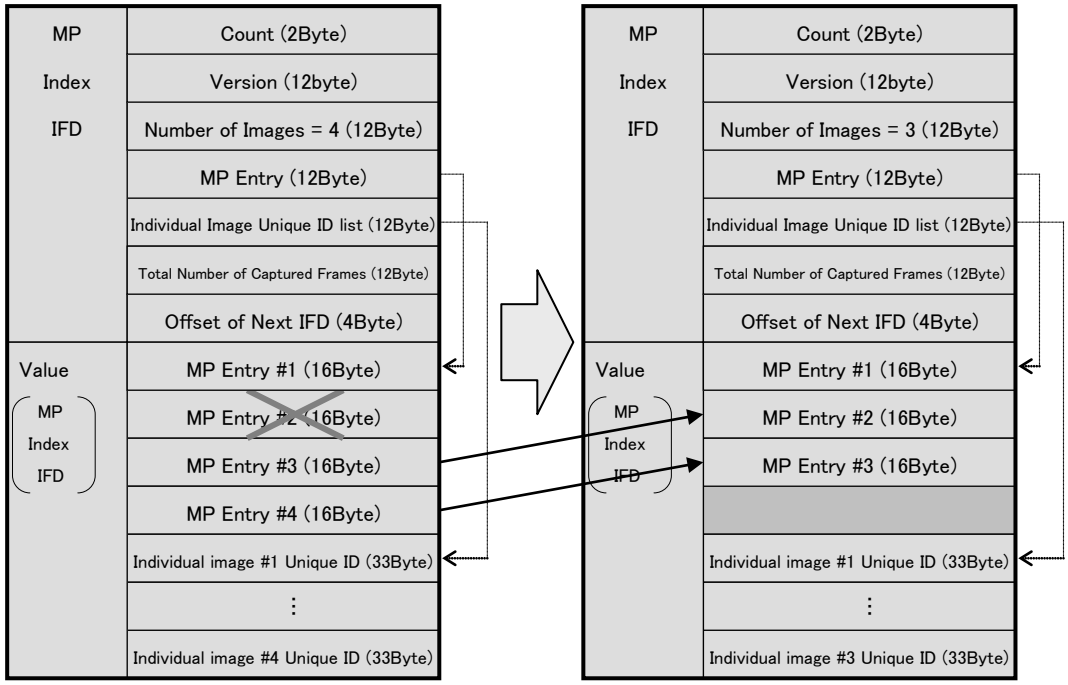
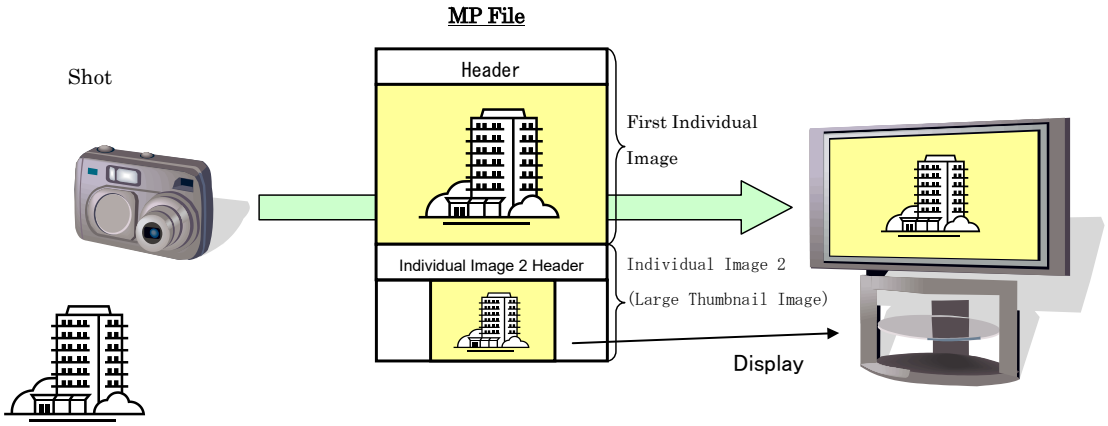


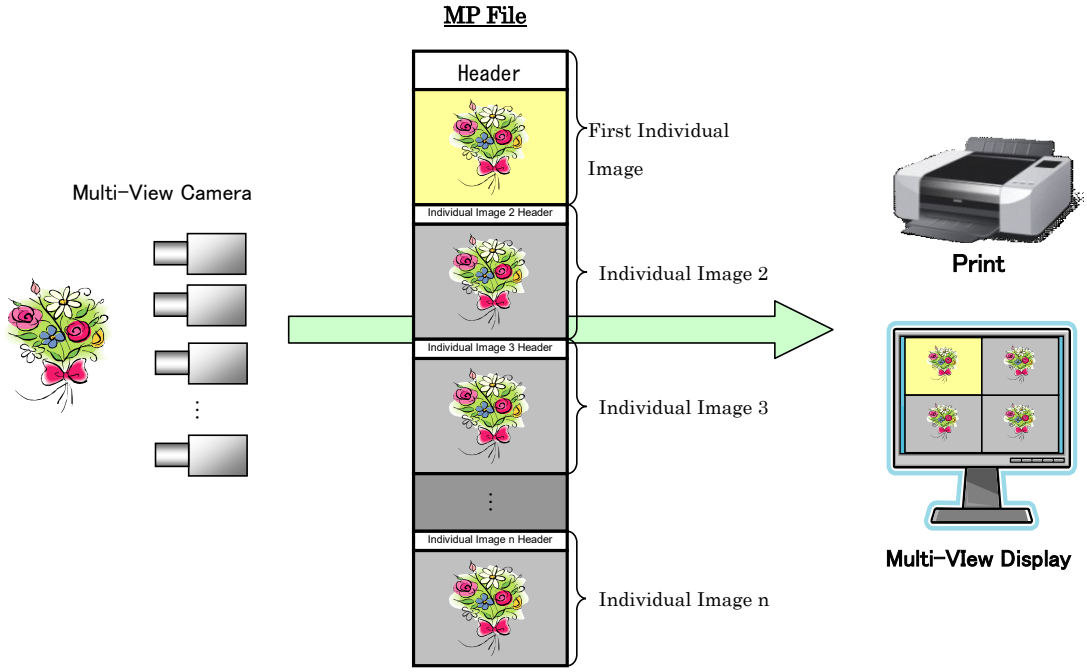
Figure 16 Example of Updating the MP Entry after Delete

A.8.Use Cases

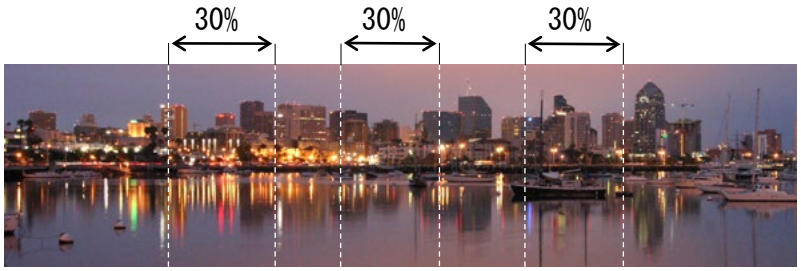
A.8.1.Large Thumbnails for Displays (e.g. TV)



A.8.2.Multi View Images



A.9.Panorama Image Examples
A.9.1.Horizontal Only Shots



[Image 1]

PanOrientation	00040001.H
MPIndividualNum	00000001.H
PanOverlap_H	00000000.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

[Image 2]

PanOrientation	00040001.H
MPIndividualNum	00000002.H
PanOverlap_H	000001E0.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

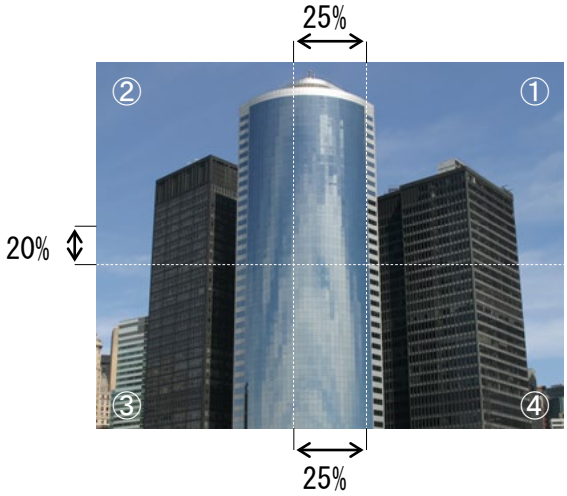
[Image 3]

PanOrientation	00040001.H
MPIndividualNum	00000003.H
PanOverlap_H	000001E0.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

[Image 4]

PanOrientation	00040001.H
MPIndividualNum	00000004.H
PanOverlap_H	000001E0.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

A.9.2.Horizontal and Vertical Shots



[Image 1]

PanOrientation	02020120.H
MPIndividualNum	00000001.H
PanOverlap_H	00000000.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

[Image 2]

PanOrientation	02020120.H
MPIndividualNum	00000002.H
PanOverlap_H	00000190.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

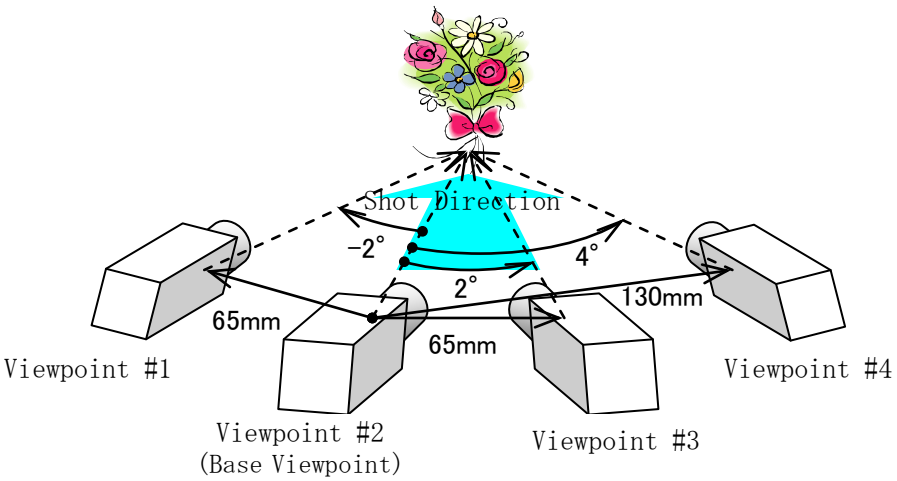
[Image 3]

PanOrientation	02020120.H
MPIndividualNum	00000003.H
PanOverlap_H	00000000.H/00000640.H
PanOverlap_V	000000F0.H/000004B0.H

[Image 4]

PanOrientation	02020120.H
MPIndividualNum	00000004.H
PanOverlap_H	00000190.H/00000640.H
PanOverlap_V	00000000.H/000004B0.H

A.10.Disparity Image Examples



[Image 1]

MPIndividualNum	00000001.H
BaseViewpointNum	00000002.H
ConvergenceAngle	FFFFFFFE.H/00000001.H
BaselineLength	00000041.H/000003E8.H

[Image 2]

MPIndividualNum	00000002.H
BaseViewpointNum	00000002.H
ConvergenceAngle	00000000.H/00000001.H
BaselineLength	00000000.H/000003E8.H

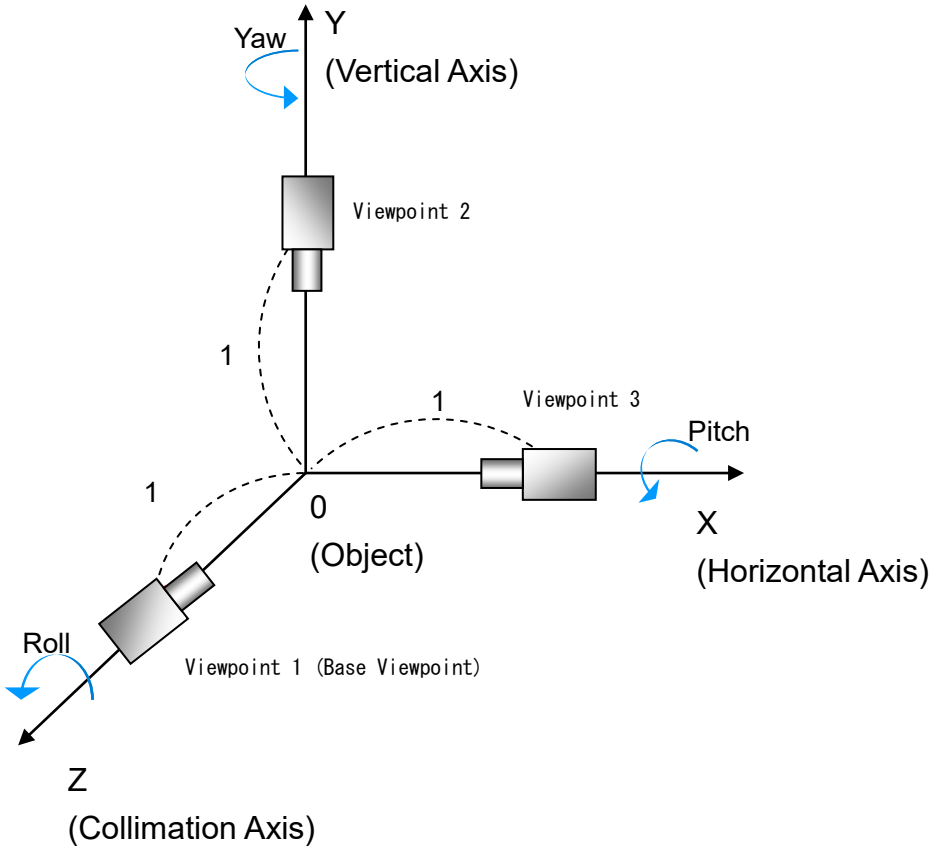
[Image 3]

MPIndividualNum	00000003.H
BaseViewpointNum	00000002.H
ConvergenceAngle	00000002.H/00000001.H
BaselineLength	00000041.H/000003E8.H

[Image 4]

MPIndividualNum	00000004.H
BaseViewpointNum	00000002.H
ConvergenceAngle	00000004.H/00000001.H
BaselineLength	00000082.H/000003E8.H

A.11.Multi-Angle Image Examples



[Image 1]

MPIndividualNum	00000001.H
BaseViewpointNum	00000001.H
AxisDistance_X	00000000.H/00000001.H
AxisDistance_Y	00000000.H/00000001.H
AxisDistance_Z	00000001.H/00000001.H
YawAngle	00000000.H/00000001.H
PitchAngle	00000000.H/00000001.H
RollAngle	00000000.H/00000001.H

[Image 2]

MPIndividualNum	00000002.H
BaseViewpointNum	00000001.H
AxisDistance_X	00000000.H/00000001.H
AxisDistance_Y	00000001.H/00000001.H
AxisDistance_Z	00000000.H/00000001.H
YawAngle	00000000.H/00000001.H
PitchAngle	FFFFFFA6.H/00000001.H
RollAngle	00000000.H/00000001.H

[Image 3]

MPIndividualNum	00000003.H
BaseViewpointNum	00000001.H
AxisDistance_X	00000001.H/00000001.H
AxisDistance_Y	00000000.H/00000001.H
AxisDistance_Z	00000000.H/00000001.H
YawAngle	0000005A.H/00000001.H
PitchAngle	00000000.H/00000001.H
RollAngle	00000000.H/00000001.H

Explanation

1. Purpose of the standard

As the performance and capabilities of digital cameras have increased, there have been calls for summarizing and recording not only Individual Image data, but also multiple image data which are interrelated in order to display image data with specified pixel count on a monitor. One method of linking and recording multiple images is to record the images as Individual Image files, then to record the information linking the files as a separate file. Other methods are to store the linked image files in a single folder, or to record the links based on a file name. These methods offer the benefit of permitting each image to be operated using existing players. However, as users operate or move files between recording media, image files may become scattered and lost, and their links may be broken. To resolve these problems, it was decided to set a format for recording multiple image data as a single file.

2. Course of deliberations

The Multi Page Format (MP) (tentative name) Proposal and Written Draft was submitted to the CIPA, which received it and began technical deliberations in October 2007. As the standard is called Multi Picture Format (MPF) and in line with the purpose of the proposal, the subcommittee was named the Multi-Picture Format Sub-Working Group.

As the data structure for recording multiple images, address information which each image (Individual Image) records and attribute information such as type of Individual Image are recorded in the file header, and each attribute information is recorded in the header of Individual Image. These attributes are recorded in APP2, which is part of APPn defined by JPEG (Application Mark Segment). Attribute information concerning the Individual Images themselves is recorded in APP1 with reference to Exif standards.

Types of Individual Images are defined as: 1) Large Thumbnails (image recorded based on the specified pixel number to play and display on a monitor), 2) Multi View images (defined as images taken from multiple viewpoints, of which there

are two kinds: those for disparity imaging use and multi angles which is an image taken from different directions,), 3) Panorama image (image recorded by dividing the photographed range into multiple shots), and 4) a continuous shooting image (multiple images recorded by a single continuous shot), which were proposed in the draft.

1) Large Thumbnails are defined as two kinds: mainly class 1 (VGA) to be displayed on the monitors of compact devices, and class 2 (equivalent to full HD) to be displayed on a high-definition television.

2) Multi view images are defined as a type with three subdivisions which are combined with 3) Panorama images.

Because usage of this standard is likely to expand later, an "undefined" type was established. This "undefined" type records multiple images which are linked, other than 1), 2), and 3), and information concerning how they are linked is defined separately from this standard. But the image data format conforms to the provisions of this standard and the player can at least play and display each Individual Image separately. If the number of Individual Images in a file increases, thus increasing the file size, it will sometimes be time-consuming to search for Individual Images and it would be better to make it an existing format, so 4) a continuous shooting image was considered to be an "undefined" type of image which is not defined as a type of Individual Image.

Regarding interoperability with existing players, there is concern that Individual Images will be lost during play and return to memory, so the extension of files including multi view images or images of undefined type was set as a proprietary ".MPO" which can be handled by players and application software compatible with this standard. Regarding files consisting only of the primary image and monitor display image, by making the extension ".JPG", the primary image can be played by almost all existing hardware or software product and the monitor display can be restored even after it has been lost, so the extension was set as ".JPG".

Under this standard, multiple types of data are defined, and the playable types of Individual Images vary according to the hardware or software product and application software. To clarify the compatible range, a file consisting only of a main image and monitor display image (extension .JPG) is a Baseline MP file,

while a file including other types (extension .MPO) is an Extended MP file. (Please refer to the Annex for recording and playing a Baseline MP file and an Extended MP file.)

The technical deliberations concerning the Multi Picture Format were completed and Draft version 0.9 was compiled based on the above. The results were received, and deliberations concerning the standardization began in September 2008. The representations in the guideline in the Annex were thus clarified, the representations concerning reference to other standards (Exif, DCF) were revised, and descriptions were added or revised to prevent confusion in the market. As a result, this written standard (CIPA DC-00x-200x) was enacted.

3. Participating members

The bulk of the deliberations over the formulation of the standards described in this document was performed by the Standard Development Working Group.

The members of the Working Group are listed below.

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Vice Chair	SATOH Hitoshi	FUJIFILM Corporation
Vice Chair	IMAFUJI Kazuharu	NIKON CORPORATION
Vice Chair	YOSHIDA Hideaki	OM Digital Solutions Corporation
Vice Chair	FUKUSHIMA Tsumoru	Panasonic Corporation
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