Standard of Camera & Imaging Products Association

CIPA DCG-004- Translation-2009

Guidelines for Handling Exif/DCF

This translation has been made based on the original Guideline (CIPA DCG- x004- 2009). In the event of any doubts arising as the contents, the original Guideline is to be the final authority.

Established on January 26, 2009

Prepared by:
Standardization Committee

Published by:
Camera & Imaging Products Association

Overview

This document is a guideline prescribed in order to enhance compatibility and interoperability when using both "Exchangeable image file format for digital still cameras Exif Version 2.21 (JEITA CP-3451 + CP-3451-1)" (hereinafter called "the Exif standard") and "Design rule for Camera File system DCF Version 2.0 (JEITA CP-3461)" (hereinafter called "the DCF standard") defined by JEITA.

This guideline does not add new definitions or modify the existing Exif/DCF standard, but it provides examples of recommended implementation methods and handling policies.

Contents

1. Background / Purpose

1.1 Background

Image input devices including digital still cameras (hereinafter called "DSC") have rapidly increased in popularity due to higher-resolution images, improved photographic functions and lower prices. The Exif/DCF standard is the global standard for the image-recording format of the DSC.

Due to the spread of DSC, images compliant with Exif/DCF are dealt with not only by image input devices, but also by recording and playback devices such as those for storage and display, including TVs and digital photo frames. In addition, files compliant with Exif/DCF are widely used in application fields from general consumers to business use such as commercial printing and mass media.

Moreover, Exif/DCF files are used in various ways. For example, Exif images can be retouched and edited, and Exif tag information can be changed and added by using image-editing applications on PCs. In some cases, additional information such as the ICC profile is provided for managing color space undefined in the Exif standard.

Because of the increasing utilization of Exif/DCF, it is becoming more important to improve the compatibility and interoperability of images compliant with Exif/DCF.

Furthermore, various trade groups and standardization committees are demanding that the Exif/DCF standard be expanded and clarified.

After examining the problems related to the current Exif/DCF standard in consideration of the above situation, it was determined that both clarification and establishment of operation policies of the standard are required as follows:

First, it is necessary to clarify any parts of the Exif/DCF standard where interpretation is ambiguous.

Next, it is necessary to establish appropriate policies for dealing with Exif/DCF files in consideration of workflow.

Moreover, it is necessary to revise the method for handling the file format and file system at the same time as drawing up this guideline.

1.2 Purpose

As stated in the previous section, the purpose of this guideline is to provide clarification and operational policies for the standard in order to solve current problems and meet user demands. Specifically, its purpose is to present examples related to the recommended implementation of devices dealing with Exif/DCF and to explain the mechanism for maintaining consistency among devices or applications.

In other words, implementation in accordance with this guideline is aimed at maintaining compatibility and enhancing interoperability among devices or applications from different companies.

In addition, responding to the progress of DSC and the infrastructure environment, this guideline aims at enhancing further usability and availability and expanding the opportunities to use digital image data.

This guideline presents the following concrete policies in response to the problems stated in the background section.

Regarding the first point, that is, ambiguous interpretation in the standard, this guideline firstly clarifies how to deal with APP marker segments undefined in the Exif standard. This will lead to enhanced consistency with the existing metadata specified by CIPA and other organizations and manufacturers and metadata undefined in the Exif standard. This guideline also clarifies how to handle files for recording multiple images.

Regarding the next point, that is, policies in consideration of workflow, this guideline provides the following:

• Rules for enhancing stability, compatibility and interoperability of images and metadata when they are edited using PC applications and then exported to DSC again,

• Handling policies on the side of playback devices, and

• Precautions regarding the method of assigning file names and directory names at the time of exporting.

Moreover, regarding the revision of file format and file system, this guideline presents policies related to handling a new file format and new file system in consideration of the current progress in larger-capacity memory media.

As this guideline presents policies and recommended examples in order to enhance compatibility and interoperability among devices and application software dealing with Exif/DCF, implementation in accordance with this guideline is recommended and expected from this point on.

However, since it would be difficult to examine all problems mentioned above in the short term, this guideline will be revised as necessary in the future by examining the problems step by step in consideration of their priority and importance. Furthermore, new problems not mentioned here will be dealt with as well.

2.   Scope

This guideline covers devices, memory media and application software dealing with Exif/DCF files.

As devices mentioned above, the applicable objects are devices with functions such as capturing, recording, displaying, playing, editing, and printing images.
Specifically, examples of capture/recording devices include DSC, DVC and camera phones, etc.
Examples of display/playback devices include image display devices such as DTV, digital photo frames and car navigation systems. In addition, image storage devices include image storers and home servers. Image printing devices include printers.
As application software mentioned above, the applicable objects are application software providing functions for editing, displaying, printing and recording metadata as well as importing and editing images.
Specifically considered is application software that edits Exif/DCF tags and then saves them again or application software that adds metadata information undefined in the Exif standard in Exif/DCF files and then saves it again.

3.   Definition of terms

3.1   Verbal forms for the expression of provisions

The keywords in this document are to be interpreted as described in ISO/IEC Directives 2.

(See Directives2 Annex H "Verbal forms for the expression of provisions".)

Requirement

Verbal forms	Equivalent expressions
shall	is mandatory
shall not	

Recommendation

Verbal forms	Equivalent expressions
should	it is recommended that is recommended
should not	

Permission

Verbal forms	Equivalent expressions
may	is optional
need not	

Possibility and capability

Verbal forms	Equivalent expressions
can	it is possible to
cannot	

3.2 Terminology

DSC	Digital Still Camera
DVC	Digital Video Camera
DTV	Digital Television
Primary image	"Recording image as the main data" described in 2 Definition of Terms of the Exif Standard
DCF media	"Removable memory recorded in compliance with the DCF" described in 3.1 Definition of Terms of the DCF Standard
Exif writer	"A digital still camera (DSC) or other device or application software that can output an Exif file" described as a writer in 2 Definition of Terms of the Exif Standard
Exif editor	A device or application to edit existing Exif files (add, change or delete part of a file) (Major examples are image editing applications. It includes certain types of DTV, digital photo frames or DSC.)
Exif reader	"A device, such as a printer with memory card slot, capable of directly reading an Exif file and printing or performing other output processing, as well as application software that uses Exif tags to perform image processing for output" described as a reader in 2 Definition of Terms of the Exif Standard
DCF Reader	"Playback function in conformity with the DCF Reader 1 and Reader 2 specifications" described in 3.1 Definition of Terms of the DCF Standard
DCF Writer	"A recording function compliant with the DCF Writer specification" described in 3.1 Definition of Terms of the DCF Standard

4. Handling Exif/DCF files in consideration of workflow

This chapter presents the workflow dealt with in this guideline. The guideline is described in consideration of this workflow for handling Exif/DCF files from the next chapter.

4.1 Workflow for editing an image with application software

Figure 4-1 shows the workflow when an Exif/DCF file is edited using an application. DSCs in this figure are examples of image capture/playback devices. Consideration is also given to the use of other devices such as a TV or printer.
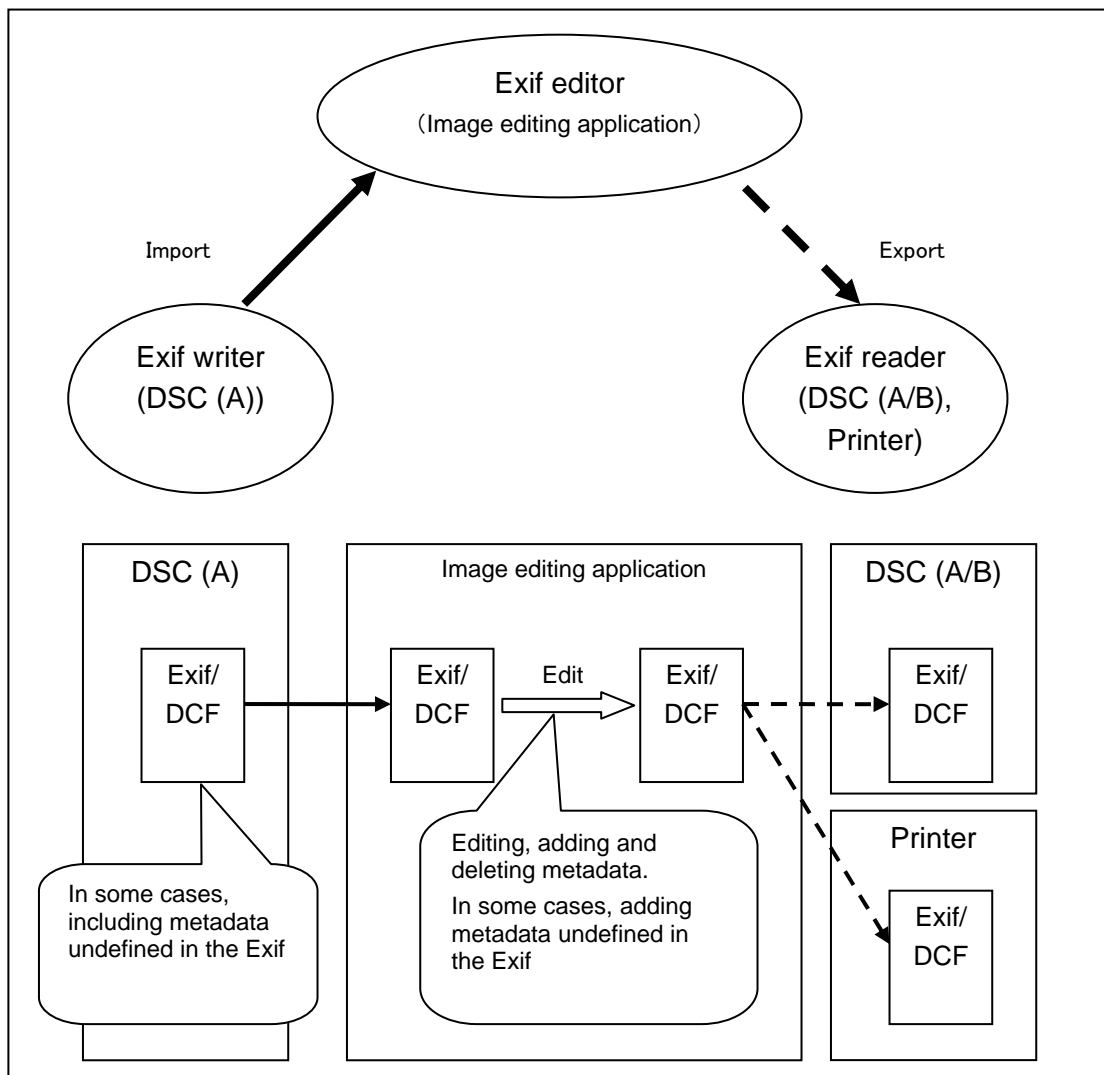
Figure 4-1 Editing images with application software

4.1.1 Actions

In this workflow, the following cases are considered:

1. Recording an image using an Exif writer (in some cases, recording metadata undefined in the Exif)
2. Importing the image into an Exif editor and editing it (in some cases, adding metadata undefined in the Exif at this time)
3. Exporting the edited image to an Exif reader. At this time, there are cases in which the Exif reader is a DCF Reader, but in other cases, that is not so.
4. Viewing the image with an Exif reader

5. Issues related to the Exif standard

This chapter explains how to deal with the primary image data defined in the Exif standard as follows.

5.1 JPEG compressed data

This section provides guidelines related to the basic structure of JPEG compressed data.

5.1.1 Application marker segments

The basic structure of JPEG compressed data in Exif adopts a configuration based on marker segments compliant with the "Baseline DCT format of JPEG."

In the JPEG standard on which the Exif standard is based, the use of the APPn (Reserved for application segments) and COM (Comment) marker is not restricted. In the Exif standard (4.5.4 Basic Structure of JPEG Compressed Data), it is written, "APPn other than APP1 and APP2 or COM segments are not used". However, there is no mention of prohibited use of undefined APPn markers. Therefore, undefined APPn markers can be optionally used for recording by vendors or trade groups. In this case, compliance with the following rules is recommended in order to maintain reproduction compatibility with the Exif devices.

In this guideline, marker segments of JPEG compressed data should be recorded in accordance with the order shown in **Table 5-1** and should be interpreted as described in the table.

That is, it is possible to optionally record multiple APPn (n is a value from zero to 15) markers immediately after APP1 and APP2 defined in the Exif standard.

The bracketed marker segment names show optional marker segments in the Exif standard. In addition, this guideline clarifies the No. 4 marker segment, which has a mesh background.

Table 5-1 Marker segments of JPEG compressed data in Exif

No	Name of marker	Specification in the Exif standard	Clarified part in this guideline
1.	SOI	Recording this marker is mandatory. It shall be recorded in this position at the beginning of all markers.	
2.	APP1	Exif Attribute Information Recording this marker is mandatory. It shall be recorded in this position immediately after SOI.	
3.	(APP2)	Flashpix Extension data Recording this marker is optional. Multiple APP2 markers can be optionally recorded in any order. It shall be recorded in this position, if necessary.	

4.	(APPn)	Data undefined in Exif (including APP1, APP2)	Recording this marker is optional. Multiple markers can be recorded, as necessary.
5.	DQT, DHT, (DRI), SOF	Other marker groups defined in Exif Only the DRI marker is optional. Recording the rest of the markers is mandatory. Their recording order may be changeable.	
6.	SOS (compressed data)	If the DRI marker is recorded, the RSTm marker shall be inserted as well.	
7.	EOI	Recording this marker is mandatory. It shall be recorded in this position.	

In accordance with **Table 5-1**, the structure of JPEG compressed data in the current Exif standard is shown.

Mesh background indicates mandatory segments in the Exif standard.

SOI	Start of Image
APP1	Application marker segment 1 (for Exif Attribute Information)
(APP2)	Application marker segment 2 (for Flashpix Extension data)
DQT	Quantization Table
DHT	Huffman Table
(DRI)	(Restart Interval)
SOF	Frame Header
SOS	Scan Header
	Compressed Data
EOI	End of Image

Figure 5-2 Structure of JPEG compressed data in the current Exif standard

The following figure shows an example structure of JPEG compressed data when undefined data in the Exif standard is added.

In this case, the added segments are assumed as APPx, APPy and APPz (x, y and z are optional numbers from zero to 15).

SOI	Start of Image
APP1	Application marker segment 1 (for Exif Attribute Information)
(APP2)	Application marker segment 2 (for Flashpix Extension data)
(APPx)	Application marker segment x (data 1 undefined in Exif)
(APPy)	Application marker segment y (data 2 undefined in Exif)
(APPz)	Application marker segment z (data 3 undefined in Exif)
DQT	Quantization Table
DHT	Huffman Table
(DRI)	(Restart Interval)
SOF	Frame Header
SOS	Scan Header
	Compressed Data
EOI	End of Image

Figure 5-3 Structure of JPEG compressed data

with added APPn in Exif (Example)

5.1.2 How to deal with APPn markers undefined in the Exif standard

Exif writers should record only the minimum for vendors when recording APPn markers undefined in the Exif standard. Especially, metadata for which the content is inconsistent with that of metadata written in the Exif standard should not be recorded.

Even if APPn markers are undefined in the Exif standard and incomprehensible, Exif editors should not delete them, in consideration that the necessary information is recorded. Moreover, Exif editors should add only the minimum for vendors when adding APPn markers undefined in the Exif standard. Especially, metadata for which the content is inconsistent with that of metadata written in the Exif standard should not be added.

When adding APPn markers, because the volume becomes quite large, current devices might not be able to handle the file itself. In other cases, the large volume might affect the performance of the device. Such cases should be kept in mind. For example, when an Exif editor uses optional APPn to add unique information to the file created by an Exif writer, the file size increases by the amount of added information. Even if the additional information is small, because the file size increases, some Exif readers might not properly handle the file itself due to the regulation in the specifications of the device. Other Exif readers might be affected in terms of performance. Therefore, it is necessary to take into account such cases.

Exif readers should be implemented to operate without interruption even if APPn markers undefined in the Exif standard have been recorded. It is recommended that Exif readers be designed to skip over unknown APP markers in the Exif standard (4.5.4 Basic Structure of JPEG Compressed Data).

5.1.3 Recording data other than the primary image

The JPEG standard defines data formats such as compressed image data format and it does not mention file formats. Therefore, it is possible to add information other than the primary image by separately defining the structure of an image file.

For example, the file formats for recording multiple images and for information other than images are considered. If there is a standard specification, specific methods for implementation and handling should comply with the standard specification.

In Exif editors, when APP markers compliant with a standard specification are used to manage the start address of an image with offset in files, it should be considered that the start address of the image might be changed by adding the APPn markers.

In Exif writers, when data is recorded using a unique method that does not comply with a standard specification, it should be kept in mind that the data might be changed or deleted when used with other Exif writers or editors.

Moreover, Exif readers should be implemented to operate without interruption even if certain kinds of data have been recorded after EOI of the primary image defined in the Exif standard. Specifically, unknown data after EOI of the primary image should be skipped.

6. Issues related to the DCF standard

This chapter explains how to deal with memory media defined in the DCF standard.

6.1 Large-capacity memory media

The DOS FAT file system specified in the DCF standard has become insufficient due to larger-capacity memory media.

This section provides guidelines related to the file system used in DCF media.

6.1.1 File system

The file system used in DCF media having a capacity of over 2 Gbyte is in fact operated by FAT32.

Interoperability should be enriched by adopting an appropriate file system within the specified range of the DCF standard depending on such conditions as capacity when selecting the file system to be used in DCF media.

7. References

All reference citations in this document use the abbreviations defined in the following table.

DCF	Design rule for Camera File system: DCF Version 2.0 JEITA CP-3461, September 2003. http://www.jeita.or.jp/
Exif	Exchangeable image file format for digital still cameras: Exif Version 2.2 JEITA CP-3451, April 2002. Exchangeable image file format for digital still cameras: Exif Version 2.21 (Amendment Ver2.2) JEITA CP-3451-1, September 2003. http://www.jeita.or.jp/
JPEG	"Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines", ISO/IEC 10918-1:1994. http://www.iso.org/
Directives2	ISO/IEC Directives, Part 2 "Rules for the structure and drafting of International Standards" http://www.iso.org/ http://isotc.iso.org/livelink/livelink/fetch/2000/2122/3146825/4229629/4230450/4230456/ISO_IEC_Directives__Part_2__Rules_for_the_structure_and_drafting_of_International_Standards__2004__5th_edition___pdf_format_.pdf?nodeid=4230517&vernum=0

8.　Participating members

The bulk of the deliberations over the formulation of the standards described in this document was performed by the Exif/DCF Sub-Working Group.

The members of the Working Group are listed below.

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