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Photography — Electronic still picture imaging — Picture transfer protocol (PTP) for digital still photography devices

Photographie — Imagerie des prises de vue électroniques — Protocole de transfert d'images (PTP) pour les appareils photographiques électroniques numériques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15740 was prepared by Technical Committee ISO/TC 42, *Photography*.

Introduction

For the purposes of this International Standard, digital still photography devices (DSPDs) are defined as devices with persistent storage that capture a digital two-dimensional image at a discrete point in time. Most DSPDs include interfaces that can be used to connect to a host computer or other imaging device, such as a printer. A number of high speed interface transports has been developed, including USB, TCP/IP and IEEE 1394 (Firewire). This International Standard is designed to provide requirements for communicating with DSPDs. This includes communications with any type of device, including host computers, direct printers and other DSPDs over a suitable transport. The requirements include standard image referencing behaviour, operations, responses, events, device properties, datasets, and data formats to ensure interoperability. This International Standard also provides optional operations and formats, as well as extension mechanisms.

This International Standard specifies the following:

— behaviour requirements for DSPDs; this includes the baseline features a device needs to support in order to provide interoperability over conforming transports;

— functional requirements needed by a transport to enable the creation of a transport-dependent implementation specification that conforms to this International Standard;

— a high-level protocol for communicating with and between DSPDs consisting of operation, data and response phases;

— sets of suggested data codes and their usages including:

  — OperationCodes

  — ResponseCodes

  — ObjectFormatCodes

  — DevicePropCodes

  — EventCodes

  — required datasets and their usages

  — a means of describing data object associations and filesystems

  — mechanisms for implementing extensibility.

This International Standard does not attempt to define any of the following:

— any sort of device discovery, enumeration or transport aggregation methods; implementation of this functionality is left to the transports and the platforms upon which support for this International Standard is implemented;

— an application programming interface; this is left to the platforms upon which support for this International Standard is implemented.

This International Standard has been designed to appropriately support popular image formats used in digital still cameras, including the Exif and TIFF/EP formats defined in ISO 12234-1 and ISO 12234-2, as well as the Design Rule for Camera Filesystem (DCF) and the Digital Print Order Format (DPOF).

The technical content of this International Standard is closely related to PIMA 15740:2000. The main difference is that PIMA 15740:2000 includes an informative annex describing a USB implementation of ISO 15740. This information is not included in ISO 15740, which instead references the USB still device class document developed by the Device Working Group of the USB Implementers Forum.

Photography — Electronic still picture imaging — Picture transfer protocol (PTP) for digital still photography devices

1 Scope

This International Standard provides a common communication protocol for exchanging images with and between digital still photography devices (DSPDs). This includes communication between DSPDs and host computers, printers, other digital still devices, telecommunications kiosks and image storage and display devices.

This protocol is transport- and platform-independent.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8601:2004, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO 12234-1:2001, *Electronic still-picture imaging — Removable memory — Part 1: Basic removable-memory module*

ISO 12234-2:2001, *Electronic still-picture imaging — Removable memory — Part 2: TIFF/EP image data format*

ISO/IEC 10646-1:1993, *Information technology — Universal Multiple-Octet Coded Character Set (UCS) — Part 1: Architecture and Basic Multilingual Plane*

ISO/IEC 10918-1:1994, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines*

IEC 61966-2-1:1999, *Multimedia systems and equipment — Colour measurement and management — Part 2-1: Colour management — Default RGB colour space — sRGB*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
album
end-user created object used to logically group data objects according to some user-defined criteria

NOTE An album may or may not be a physical folder in a filesystem. In this International Standard, an album is a type of association.

3.2
Application Programming Interface
API
high-level functional description of a software interface

NOTE An API is typically language-dependent.

3.3
association
logical construct used to expose a relationship between discrete objects

NOTE Associations are used to indicate that separate data objects are related. Associations are represented like folders, and may be nested using a standard branched hierarchical tree structure.

EXAMPLE A time sequence, or user-defined groupings by content or capture session.

3.4
connection
transport-provided mechanism for establishing paths for transferring data between devices

3.5
datacode
16-bit unsigned integer whose Most Significant Nibble (4 bits) is used to indicate the category of code and whether the code value is standard or vendor-extended

3.6
data object
image or other type of data that typically exists in persistent storage of a DSPD or other device

3.7
dataset
transport-independent collection of one or more individual data items with known interpretations

NOTE Data sets are not necessarily opaque nor atomic to transport implementations.

3.8
Design Rule for Camera Filesystem
DCF
standard convention for camera filesystems which specifies the file format, foldering and naming conventions in order to promote file interoperability between conforming digital photography devices

3.9
device discovery
act of determining the set of all devices present on a particular transport or platform that are physically or logically accessible

3.10
Digital Still Photography Device
DSPD
device with persistent storage that captures a two-dimensional digital still image

3.11
Digital Print Order Format
DPOF
standardized ASCII file stored on removable media along with the image files that indicates how many copies of which images should be printed

NOTE DPOF also allows index prints, cropping, and text overlays to be specified.

3.12
enumeration
act of creating an ordered increasing numerical list that contains one representative element for each member of a set

3.13
Exif/JPEG
compressed file format for digital cameras in which the images are compressed using the baseline JPEG standard described in ISO 12234-2

NOTE In Exif, metadata and thumbnail, images are stored using TIFF tags within an application segment at the beginning of the JPEG file.

3.14
folder
optional sub-structure in a hierarchical storage area that can contain data objects

3.15
FlashPix
image file format, defined in *FlashPix Format Specification*, using a structured storage file containing metadata and a tiled, hierarchical image representation

NOTE The tiles in a FlashPix image are normally baseline JPEG images, and individual image tiles of a particular resolution can be easily accessed for rapid display and editing.

3.16
ICC profile
data file that characterizes the colour characteristics of an image capture or image output device

3.17
IEEE 1394
high-speed serial bus standardized by the IEEE (Institute of Electrical and Electronics Engineers) currently having clock rates of 100, 200 and 400 Mbits/sec

NOTE IEEE 1394 is often referred to as FireWire.

3.18
image aspect ratio
ratio of the image width to the image height

3.19
image capture device
device for converting a scene or a fixed image such as a print, film or transparency, to digital image data

3.20
image output device
device that can render a digital image to hardcopy or softcopy media

3.21
in-band event
event transmitted on the same logical connection as operations and responses

NOTE Events are only asynchronous to the degree of data precision for which the transport implementation allows event interleaving.

3.22
initiator
device that initiates a conversation by opening a session, and issues all formal operations to the responder

NOTE The initiator is analogous to the client in the client/server paradigm.

3.23
International Imaging Industry Association
I3A
organization that serves to represent the common interests among manufacturers of imaging technology products

NOTE See http://www.i3a.org.

3.24
Infrared Data Association
IrDA
infrared wireless communication system that currently supports wireless communication at data rates between 9 600bps and 4Mbps.

3.25
Joint Photographic Experts Group
JPEG
specific image compression method defined in ISO/IEC 10918-1

3.26
LogicalStorageID
least significant sixteen bits of a StorageID

NOTE This value uniquely identifies one logical storage area within the physical store indicated in the PhysicalStorageID.

3.27
Most Significant Nibble
MSN
most-significant four bits of the most-significant byte

3.28
object aggregation
act of taking one or more location-specific lists of objects that exist on a particular device and grouping them together in one set

3.29
ObjectHandle
device-unique 32-bit unsigned integer assigned by a device to each data object in local persistent storage which is provided to external devices

NOTE External recipients of an ObjectHandle must use it to reference that piece of data in subsequent transactions. ObjectHandles are guaranteed to be persistent over at least a session.

3.30
out-of-band event
event transmitted on a different logical connection as operations and responses

NOTE Out-of-band events are asynchronous from operation transactions.

3.31
Personal Computer
PC
any personal computing device, which may employ various hardware architectures and operating systems

3.32
PhysicalStorageID
most significant sixteen bits of a StorageID

NOTE This value uniquely identifies one physical storage area on a device, although there may be more than one logical store per physical store.

3.33
Portable Network Graphics
PNG
extensible file format for lossless, portable, compressed storage of raster images

NOTE PNG supports indexed-colour, greyscale, truecolour and an optional alpha channel.

3.34
protocol
defined mechanisms for exchanging data between devices

3.35
pull model
use paradigm for DSPDs where the object receiver initiates the operation requests to transfer data objects from the sender

3.36
push model
use paradigm for DSPDs where the object sender initiates the operation requests to transfer data objects to the receiver

3.37
QuickDraw picture
file format consisting of sequences of saved drawing commands

NOTE QuickDraw files are commonly referred to as PICT files.

3.38
responder
device that responds to operations from the initiator

NOTE The responder is analogous to a server in the client/server paradigm.

3.39
session
logical connection between two devices defining a period of time during which obtained state information, such as handle persistence, may be relied upon

3.40
square pixel sampling
image having equal sample spacing in the two orthogonal sampling directions

3.41
StorageID
device-specific four byte unsigned integer (UINT32) that represents a unique storage area that may contain data objects

NOTE The most significant sixteen bits of a StorageID represent the PhysicalStorageID, whilst the least significant sixteen bits of a StorageID represent the LogicalStorageID.

3.42
transport aggregation
act of taking one or more transport-specific lists of conforming devices that are logically or physically accessible in a system and grouping them in one set that spans all transports across the particular system

3.43
transport
means of attaching the digital capture device to some other digital device including a physical wire or a wireless connection

3.44
Universal Serial Bus
USB
digital interface for connecting up to 127 devices in a tiered-star topology

NOTE See http://www.usb.org.

4 Digital Still Photography Device Model

4.1 Overview

Digital Still Photography Devices (DSPDs) are used to acquire digitally encoded still images. These devices include persistent storage capability so that any digital images and other data acquired by the device are preserved across power cycle operations unless they are specifically deleted.

A DSPD might support many different features. This International Standard supports devices with a wide range of potential features. However, a small number of features is required for conformance with this International Standard, while many others are optional. Subclause 4.2 describes the required features and functionality. Annex A describes features that are not required for conformance, but should be implementable using this International Standard and its extension mechanisms.

Standard data formats for datatypes and datasets are described in Clause 5.

Clause 6 describes required and optional support for particular image and non-image formats and metadata. This clause also describes methods for associating data objects.

A particular feature set places requirements on the transports used to connect the DSPD to other devices. Clause 7 describes these requirements.

All DSPDs must store images in some form of storage area. Clause 8 describes the usage of these stores, as well as the methods for referencing them.

Clause 9 describes the roles of devices, sessions and transactions that transports are required to use in order to communicate with and/or between DSPDs. Clause 10 lists the standard operations, their corresponding optional operation codes and their usages. Standard responses to operations are defined in Clause 11. The use of events is mandatory in order to ensure synchronization between devices. Clause 12 describes events and their usages.

In order to expose device controls and manipulate properties in a common way, a standard set of device properties and their usages have been defined in Clause 13.

Clause 14, serves as a summary of the individual operations and events that are required to be supported by particular devices, as well as a checklist that can be used by implementers.

4.2 Baseline requirements

4.2.1 General

The requirements listed in 4.2.2 to 4.2.5 shall be met in order for a DSPD to conform to this International Standard.

4.2.2 Implementation of a suitable transport

The DSPD shall provide appropriate hardware and software support for at least one transport that meets the requirements specified in Clause 7.

4.2.3 Thumbnail support

The DSPS shall provide support for thumbnails as described in 6.2.

4.2.4 Standard Image and Data Reference Behaviour

In order to ensure interoperability, it is necessary to define a standard mechanism for describing image and data objects present on a device. The DSPD shall meet the requirements described in Clause 6.

4.2.5 Asynchronous Event Support

The DSPD shall be capable of generating and reacting to asynchronous events. Clause 12 describes events and their usages.

5 Data Format Specification

5.1 General format

5.1.1 Multibyte data

For the purposes of interpretability, all data fields showing internal content representations shall be read from left to right, in order of decreasing byte significance, commonly referred to as big-endian notation. Therefore, the left-most byte shall represent the Most Significant Byte (MSB), and the right-most byte shall represent the Least Significant Byte (LSB). The most significant four bits of the MSB are referred to as the Most Significant Nibble (MSN), while the least significant four bits of the LSB are referred to as the Least Significant Nibble (LSN). The actual multibyte format used on the wire is transport-specific, while the actual multibyte format used at the application interface is platform-specific.

5.1.2 Bit format

Bit fields presented in this International Standard are numbered so that the least significant bit is at the zero position, holding the right-most position in the field; e.g. the most significant bit of a UINT32 would be referred to as bit 31, while the least significant bit would be referred to as bit 0.

5.1.3 Hexadecimal notation

This International Standard uses hexadecimal notation as a means of concisely describing multibyte fields. All hexadecimal bytefields are represented with the prefix “0x”. Following this prefix are pairs of characters, where each pair represents one byte, with the most significant byte appearing first, and the least significant byte appearing last.

5.2 Data types

5.2.1 Data type summary

The types of data that are defined in this International Standard as having specific interpretations of their data content, are listed in Table 1 — Data type summary.

Table 1 — Data type summary

Name	Size (bytes)	Format
OperationCode	2	Datacode (UINT16)
ResponseCode	2	Datacode (UINT16)
EventCode	2	Datacode (UINT16)
DevicePropCode	2	Datacode (UINT16)
ObjectFormatCode	2	Datacode (UINT16)
StorageID	4	Special (UINT32)
ObjectHandle	4	Handle (UINT32)
DateTime	Variable	String
DeviceInfo	Variable	Dataset
StorageInfo	Variable	Dataset
ObjectInfo	Variable	Dataset
DevicePropDesc	Variable	Dataset
DevicePropDescEnum	Variable	Enumerated form of DevicePropDesc
DevicePropDescRange	Variable	Range form of DevicePropDesc
Object	Variable	Variable

5.2.2 Datacodes

Datacodes are 16-bit unsigned integers (UINT16) with specified interpretations, used for the purposes of enumeration. In order to aid in visual interpretation, potential transport debugging, and to simplify some transport implementations, the primary and vendor-defined datacodes for operations, responses, data formats, events, and properties in this International Standard have mutually exclusive values. The most significant four bits of a datacode (Most Significant Nibble) shall have a particular bit pattern that identifies its code type. Therefore the allocation of these four bits to type specification infers that the minimum value of any enumerated datacode is 0 (xxxx0000-00000000) and the maximum value is 4,095 (xxxx1111-11111111).

It is strongly recommended that transport implementations use these codes directly in their binary representations, but this is not mandatory. Particular transport implementations may be unable to use the specified code systems for one or more code types, due to pre-existing structure formats for data-wrapping, or other constraints. Where it is possible to use the codes, they should be used. If one or more particular datacode types cannot be used, the transport implementation specification should still attempt to accommodate those datacode types that can be used. If the binary form suggested in this International Standard is not used for a particular datacode type, an appropriate corresponding enumerated identifier in an alternate form should be made available where possible for each datatype enumeration specified here, each having the same usage and definition as those specified in this International Standard. This allows for transport-aggregating abstractions in host software to use the codes defined in this International Standard, even though a particular code might not be transmitted across the wire for a particular transport in the binary

form specified. Transports may also need to perform multiple transactions over the wire in order to fulfill one operation defined in this International Standard, and therefore one operation code may not be sufficient.

For example, if a transport does not use the 16-bit OperationCodes, it should still provide an equivalent mechanism for the GetObject operation that supports the same usage defined in this International Standard. Another example would be a transport that uses OperationCodes for some operations but not others, because the transport in question possesses a built-in mechanism for performing the equivalent operation, and provides its own operation identification scheme for that operation.

Table 2 — Datacode formats

Bit 15	Bit 14	Bit 13	Bit 12	Bits 11-0	Code type
0	0	0	0	Any	Undefined (not a conforming code)
0	0	0	1	Any	Standard OperationCode
0	0	1	0	Any	Standard ResponseCode
0	0	1	1	Any	Standard ObjectFormatCode
0	1	0	0	Any	Standard EventCode
0	1	0	1	Any	Standard DevicePropCode
0	1	1	0	Any	Reserved
0	1	1	1	Any	Reserved
1	0	0	0	Any	Undefined
1	0	0	1	Any	Vendor-Defined OperationCode
1	0	1	0	Any	Vendor-Defined ResponseCode
1	0	1	1	Any	Vendor-Defined ObjectFormatCode
1	1	0	0	Any	Vendor-Defined EventCode
1	1	0	1	Any	Vendor-Defined DevicePropCode
1	1	1	0	Any	Reserved
1	1	1	1	Any	Reserved

It is a convention of this International Standard that all datacodes shall set bit 15 to 1 in order to indicate that the code value is vendor-specific, and therefore undefined in this International Standard. Codes indicating that they are vendor-defined should be interpreted according to the VendorExtensionID and VendorExtensionVersion fields of the DeviceInfo dataset as described in 5.5.2.

Individual datacode interpretations and usage are described in the appropriate section of this International Standard for each type of datacode.

5.3 Simple types

5.3.1 Simple type summary

The generic datatypes that may be used in this standard are listed in Table 3 — Datatype codes.