NISO DRAFT STANDARD

Data Dictionary
— Technical Metadata for Digital Still Images —

Working Draft, 1.0
July 5, 2000

This document is a Working Draft for review by a NISO Standards Committee. As a draft document, it may be updated at any time during the review process. Its purpose is to facilitate the development of applications to validate, manage, migrate, and otherwise process digital still images of enduring value. Such applications are viewed to be essential components of large-scale digital repositories.

Foreword

Cultural institutions and commercial organizations are increasingly engaged in creating libraries of digital still images. A major challenge in making these collections persist is to build systems, defined broadly as "digital repositories," that maintain functionality and quality intrinsic to images. One management strategy, migration, proposes to preserve image data by copying files to new formats at designated intervals.

The premise that underlies migration is the same that informs new concepts of preservation: digital technologies offer the unprecedented opportunity to preserve content without any loss of information from generation to generation. Whether this is possible, and under what conditions, are two of the questions that led NISO, CLIR, and RLG to sponsor an "Image Metadata Workshop" in April 1999. The workshop goal was to launch a collaborative effort to define a set of metadata elements to document technical attributes of digital still images.

The workshop organizers observed that cultural institutions had been focusing primarily on defining descriptive metadata for the purpose of discovery and identification, and that comparatively little work had been done to codify technical attributes of digital images and their production. Workshop participants agreed that technical metadata is necessary to support two fundamental goals: to document image provenance and history (production metadata); and to ensure that image data will be rendered accurately on output (to screen, print, or film). Several participants also observed that ongoing management, or "preservation," of these core functions will require the development of applications to validate, process, refresh, and migrate image data against criteria encoded as technical metadata.

Two overarching goals led NISO to develop this data dictionary. The first is to identify the data elements that would be used by applications to control transformations of images against stated metrics (or "anchors") for meaningful quality attributes such as detail, tone, color, and size. The second is to propose elements that would be used by digital repository managers, curators, or imaging specialists to assess the current value (aesthetic or functional) of a given image or collection of images.

Production Notes

This document was created electronically using Microsoft Word 97. Styles ("Headings 1-4") were used to format tags and to generate the Contents automatically.

Contents

1. **Introduction**

1.1. Audience

This data dictionary has been prepared for cultural institutions and other organizations interested in preserving collections of digital still images. Many of these organizations are also engaged in digitizing visual materials from historic collections. Therefore, the metadata blocks presented in this document are structured to accommodate practices associated with digital copy photography, such as the use of technical targets, as well as the techniques related to direct digital photography of original scenes.

The purpose of this [draft standard] is to facilitate the development of applications to validate, manage, migrate, and otherwise process images of enduring value. Such applications are viewed to be essential components of large-scale digital repositories.

[authors' note: we defer to the NISO Standards Committee for other high-level statements of purpose and audience]

1.2. Scope

This data dictionary presents a comprehensive list of technical data elements relevant to the management of digital still images. In this context, "management" refers to the tasks and operations needed to support image quality assessment and image data processing throughout the image life cycle. "Quality assessment" is defined broadly, as it refers both to machine operations and curatorial evaluations. Technical metadata have been identified to "anchor" meaningful attributes of image quality that can be measured objectively, such as detail, tone, color, and size. In addition, data elements have been proposed to support subjective assessments of "current value" by digital repository managers, curators, or imaging specialists seeking to determine whether intrinsic image quality (aesthetic or functional) sufficiently justifies associated maintenance or processing costs.

Metadata Out of Scope

Except for documentation of the systems that were used to create an image, metadata to document provenance, authenticity, or other aspects of image integrity are beyond the scope of this dictionary. Similarly, Intellectual Property and Rights (IPR) metadata, including ownership responsibility, is not covered. Although such metadata may be integral to digital repository development, emerging draft standards classify these types of "preservation metadata" at a higher level than "metadata for digital still images." (See, for example, Cedars.) As stated above, data elements in this dictionary focus upon the object class of digital still images.

1.3. Design Principles

The authors of this dictionary are indebted to three working groups that have developed technical metadata specifications for digital still images:

- Digital Imaging Group (DIG), DIG35 Working Group, *Metadata for Digital Images, Working Draft 2.0 Beta — June 18, 2000*
- ISO Technical Committee 42 — Photography, *ISO/DIS 12234-2, Photography — Electronic still picture imaging — Removable memory — Part 2: Image data format — TIFF/EP*, WG18/Item 189.2, June 21, 2000
- Adobe Developers Association, *TIFF, Revision 6.0, Final — June 3, 1992*

Although TIFF and TIFF/EP are file format specifications, the TIFF data elements and values (presented as fields with associated file header tags) present a comprehensive overview of metadata associated with managing and rendering image data.

The DIG35 specification distinguishes itself from file format specifications with its stated purpose to facilitate metadata *sharing*. Thus, the design goals and principles articulated by DIG35 are restated here in their entirety to give the NISO Standards Committee a high-level direction to the development of the draft standard, Technical Metadata for Digital Still Images:

Design Goals (DIG35 1.3.1)

The design goals of this NISO initiative are to define a metadata set that meets the following goals for DIG35 metadata:

- INTERCHANGEABLE: DIG35 is based on a sound conceptual model that is both generally applicable to many applications and assured to be consistent over time. DIG35 will create a better environment for locating and (re)using specific images.
- EXTENSIBLE AND SCALEABLE: DIG35 enables application developers and hardware manufacturers to add additional metadata fields. This allows future needs for metadata to be fulfilled with limited disruption of current solutions.
- IMAGE FILE FORMAT INDEPENDENT: DIG35 does not rely on any specific file format and can therefore be supported by many current and future file formats and compression mechanisms.
- CONSISTENT: DIG35 can work well with existing standards today allowing the metadata standard to be widely acceptable and usable in a variety of application domains and user situations.
- INTERNET-READY: DIG35 provides seamless integration with the Internet by utilizing XML (the recommended implementation method). **[authors' note: since this dictionary makes no recommendation regarding metadata encoding — see Implementation Guidelines below — the decision to accept or reject DIG35's adoption of XML is forwarded to the NISO Standards Committee]**

Design Principles (DIG35 1.3.2)

- use existing standards and output of other organizations as much as possible while creating a future-looking metadata standard.
- focus on mid and long-term perspectives, not only on what current digital imaging technology may be able to offer today.
- be simple for developers to utilize but sophisticated enough to cover a wide spectrum of features.
- support *information* preservation, not *data* preservation
  Many devices, such as digital cameras, may store metadata in a format that end users are not familiar with which will discourage use. Thus, applications may need to apply appropriate conversions to transform these values into user-understandable formats.
  note: See, DIG35 1.2 Scope, "This specification does not concern itself with vendor specific/ proprietary *private metadata* or a particular application domain." (TIFF tags numbered 32768 or higher, for example, are reserved for private values.)
- allow metadata redundancy
  While values exist that can be calculated from other fields, at the definition level, redundant metadata do exist and need to be managed appropriately. (See Section 1.4.2 below.)

1.4. Implementation Guidelines

1.4.1. Metadata Encoding

Although recommendations for metadata encoding were deemed beyond the scope of the data dictionary, logical structures have been proposed for several metadata blocks to serve the development of a data model (see Sections 2.1.5, 4.1, 4.3, 5.1, and 5.2).

The dictionary authors recommend adopting TIFF/EP's guideline prohibiting default values: "...[for every field] do not allow default values. All values shall be explicitly stated. This is done to improve interoperability ..." (TIFF/EP, p4, emphasis added).

[authors' note: the development of a data model and the specification for metadata encoding are forwarded to the NISO Standards Committee]

1.4.2. Metadata Production

The dictionary assumes that metadata mappings will be essential to automate the collection of technical metadata. Since the design model presumes that NISO-compliant metadata will be stored *outside* the image, applications will need to be developed (or identified) that "harvest" file header data programmatically (see 1.4.3 Redundant Metadata). The dictionary implicitly presents the mappings between TIFF's required "Baseline Fields" and selected NISO data elements. (See, TIFF, p. 21-24 and 28-41.) When the data model is finalized for the NISO standard, the TIFF-to-NISO mappings could be presented explicitly as an Appendix.

Recommendation: The NISO Standards Committee is encouraged to consider adding Appendixes to the draft Standard that map elements from the TIFF 6.0 specification as well as other standards and file format specifications (such as DIG35, TIFF/EP, and JPEG2000). These Appendixes would be useful as developer's guides to create applications to collect, mark up, and validate technical image metadata.

1.4.3. Redundant Metadata

This dictionary adopts the following assumptions articulated in the DIG35 specification:

- general-purpose metadata standards must be "applicable to the broadest possible class of file formats" (3.2.1)

- to facilitate the management (processing) of the widest range of file formats, an image management metadata standard should "…assume the existence of a file format that contains no header information." (3.2.1, emphasis added) In other words, data that exists in file headers to comply with specifications for a given image format will need to be replicated.

- there should never be any conflicts between the metadata specified in this standard and file header metadata; technical metadata specified in this standard "… should be considered informational and not be used to decode the image data stored in the associated file" (3.2.1, emphasis added)

- metadata conflicts: in Section 3.2.1, DIG35 states, "... if there is a conflict ... the file header should always take precedence;" however, Section 5.2.2 includes the following NOTE: "The decision on whether to recognize the metadata or the image data as the correct data when there is redundancy is still under investigation. DIG35 welcomes comments in this area."

  [authors' note: metadata redundancy and precedence are DIG35 Discussion Items to be resolved by August 2000 (see, DIG35, Section VI); we defer to the NISO Standards Committee to monitor the resolution of these issues in DIG35 and subsequently to determine the appropriate rules for the NISO Draft Standard]

1.5. Terminology

The dictionary adopts the following concepts and terminology:

- *tag* refers only to the i.d. number of each data element; *field* refers to the entire data element
- *image* or *image data* refers to a two-dimensional array of *pixels*
- *processed image* refers to an image that has had one or more image processing steps applied after scanning (see *Section 5.1 Image Processing*)
- image data is stored using either strips or tiles, which are collectively termed *segments*
- each pixel consists of one or more color *components*, e.g.:
  - bilevel and grayscale data have one color component per pixel
  - RGB color data has three components per pixel

- *component* and *sample* are synonymous (and are preferred to *channel*)
- *sampling frequency* (not "dpi") is used to refer to the number and placement of pixels in the image (see *Section 4.1 Spatial Metrics*)

1.6. Field Reference Guide

1.6.1. Documentation

Each field contains the following documentation:

[**Field Number, "tag"**]

Definition	definition in italics
Type	specification allowable data type(s) (see Section 1.6.2)
Required	M = mandatory MA = mandatory if applicable R = Recommended O = optional
Repeatable	Y = yes N = no
Values (Examples)	When data type = "enumerated type," values listed are actual values. When data type = "string," examples are provided
Notes or **Usage Notes**	A comments field, including pointers to related documentation. "Usage Notes" recommend syntax for values and/or provide additional information about examples.
Use	System Manager (curator, repository manager, imaging expert) User (end user)
References	Specify cross-references to specifications and guidelines consulted in writing the data dictionary (see Section 6). The convention "implied" is used when values in the cross-referenced data element do not map to the NISO-specified values. note: TIFF references include parenthetical notations to the "Baseline" fields, required or optional, that must be present for parsing by baseline TIFF readers (see Section 1.4.3 Redundant Metadata)

1.6.2. Data Types

The following data types are used in this dictionary:

Data Type	Definitions
ComplexType	multiple data types presented in an XML schema definition (DIG35)
DateTime	date or datetime conforms **either** to conventions specified by TIFF: YYYY:MM:DD HH:MM:SS, with hours 0-24, a space character between the date and time, and a null termination byte YYYY:MM:DD YYYY:MM YYYY **or** to W3C Note-datetime formats (see Section 6 "References")
Enumerated type	a string that may only contain one of a number of specified values
Non-negative real	a real where $r \geq 0$
Positive integer	an integer where $i > 0$
Reference	a single pointer to another object
String	one or more characters

1.7. Status of this Document

This document represents a **work in progress** that has been prepared for review by a NISO Standards Committee. The data dictionary, delivered to NISO on July 5, 2000, constitutes a working draft of a standard for digital still image metadata. This draft standard may either be updated or replaced by other documents at any time.

The NISO Standards Committee intends to release a NISO Draft Standard for Trial Use by June 30, 2001.

2. **Basic Image Parameters**

The items in this section are fundamental to the reconstruction of the digital file as a viewable image on electronically interfaced displays. It makes no presumption about the rendered or spatial accuracy of the displayed image, only that a reasonably appearing image can be reconstructed using these elements. Elements for efficient and convenient image display management are provided under *Segments 2.1.5.*

2.1. Format

2.1.1. MIMEType

Definition	*Designation of the Multipurpose Internet Mail Extensions (MIME) type associated with the image data.*
Type	enumerated type
Required	M
Repeatable	N
Values (Examples)	image/gif = GIF image/jpeg = JPEG image/tiff = TIFF image/x-pcd = PCD application/pdf = PDF
Usage Notes	The values listed above represent MIME types for digital still image formats commonly used in library and museum digital reformatting initiatives. The x- convention is used to construct an unofficial type for any image format lacking a formally registered MIME type.
Use	System
References	NISO Group 1, LC #51, MOA (Type of Image), Harvard

2.1.2. Format

Definition	*Name of image format.*
Type	string
Required	M
Repeatable	N
Values (Examples)	GIF = GIF JPG = JFIF/JPEG JP2 = JPEG 2000 PCD = Image Pac multi-resolution format used by Kodak Photo CD TIF = TIFF
Usage Notes	Recommended syntax: record value as a three-character name that corresponds to the standard file extension associated with the image format. Alternative syntax for file formats that encode revision numbers in the file header:

	[file format] [revision number] *example*: TIFF/EP 1.0.0.0 (see TIFF/EP) For a list of common image file formats and their associated extensions, as well as information about applications and conversion filters that support each format, see the Center for Innovative Computer Applications "Image File Formats List," http://www.cica.indiana.edu/graphics/image.formats.html.
Use	System
References	TIFF/EP 37398 (5.2.1), DIG35 A.3.1.1, NISO Group 1, LC #42 (File Extension), MOA (File Format), NLA 5.1.1

2.1.3. Compression

Definition	*Designates the compression scheme used to store the image data.*
Type	enumerated type
Required	M
Repeatable	N
Values	1 = Uncompressed 2 = CCITT 1D 3 = CCITT Group 3 4 = CCITT Group 4 5 = LZW 6 = JPEG 32773 = PackBits (simple byte-oriented run-length scheme)
Notes	Values above drawn from TIFF 6.0 specification (p117).
Use	System
References	DIG35 A.3.1.4, TIFF 259 (*Baseline Required*, p21-24, 117), NISO Group 1, RLG #11, LC #24, MOA (Lossless Compression Format), CDL, Harvard #2, NLA 5.1.10

2.1.4. PhotometricInterpretation

Definition	*Designates the color space of the decompressed image data.*
Type	enumerated type
Required	M
Repeatable	N
Values	0 = WhiteIsZero. For bilevel and grayscale images: 0 is imaged as white. 2**BitsPerSample-1 is imaged as black. This is the normal value for Compression=2. 1 = BlackIsZero. For bilevel and grayscale images: 0 is imaged as black. 2**BitsPerSample-1 is imaged as white. If this value is specified for Compression=2, the image should display and print reversed. 2 = RGB. In the RGB model, a color is described as a combination of the three primary colors of light (red, green, and blue) in particular concentrations. For each of the three components, 0 represents minimum intensity, and 2****BitsPerSample** - 1 represents maximum intensity. Thus an RGB value of (0,0,0) represents black, and (255,255,255) represents white, assuming 8-bit components. For **PlanarConfiguration** = 1, the components are stored in the indicated order: first Red, then Green, then Blue. For

	PlanarConfiguration = 2, the **StripOffsets** for the component planes are stored in the indicated order: first the Red component plane **StripOffsets**, then the Green plane **StripOffsets**, then the Blue plane **StripOffsets**. 3 = Palette color. In this model, a color is described with a single component. The value of the component is used as an index into the red, green and blue curves in the **ColorMap** field to retrieve an RGB triplet that defines the color. When **PhotometricInterpretation**=3 is used, **ColorMap** must be present and **SamplesPerPixel** must be 1. 4 = Transparency Mask. This means that the image is used to define an irregularly shaped region of another image in the same TIFF file. **SamplesPerPixel** and **BitsPerSample** must be 1. PackBits compression is recommended. The 1-bits define the interior of the region; the 0-bits define the exterior of the region. 5 = CMYK 6 = YC_bC_r 8 = CIELab
Notes	DIG35 does not include photometric interpretation in its data dictionary. For colorspace (A.3.3.1), DIG35 specifies "an ICC profile" with a value expressed either as a profile name or a URL. note: when **PhotometricInterpretation** = 6, TIFF/EP requires use of the following four tags (which are not covered in this specification): 530 **YCbCrSubSampling**, 531 YCbCr **Positioning**, 529, **YcbCrCoefficients**, 532 **ReferenceBlackWhite** See also, TIFF Section 21 YCbCr Images for additional information regarding TIFF YcbCr (*Class Y*) images.
Use	System (*tone, color*) Manager, one of the quantitative metrics to evaluate image quality
References	DIG35 H.2.3 (p75), TIFF 262 (*Baseline Required*, p22-24, 37, and 90), TIFF/EP 262 (5.2.13), NISO Group 1, LC #46 (implied), MOA ("Color Space"), CDL ("Color Space"), Harvard #3, NLA 5.1.6 ("Image Colour Space")

2.1.5. Segments

Image data is stored using either strips or tiles, which are collectively termed segments (TIFF/EP, 10). TIFF specifies that strip-oriented and tile-oriented fields must not be used in the same file (TIFF, 67).

The following diagram illustrates the logical structure of the Segments metadata.

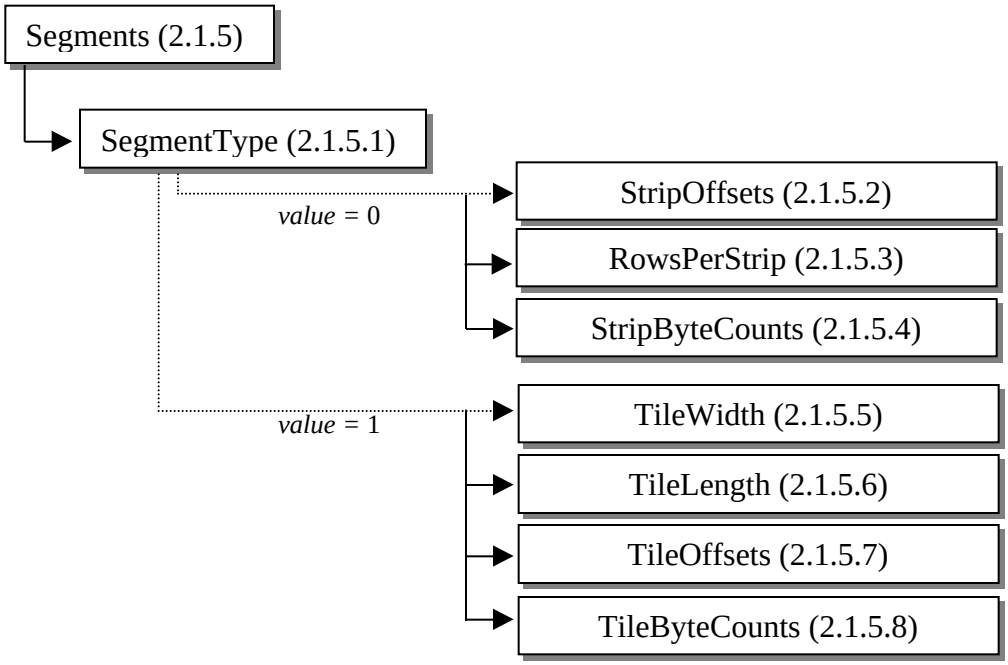

Figure 1 - Logical Structure of *Segments* Metadata

2.1.5.1. SegmentType

Definition	*Specifies whether image data is stored in strips or tiles.*
Type	enumerated type
Required	M
Repeatable	N
Values	0 = strips 1 = tiles
Usage Note	When value = 0, fields 2.1.5.5-2.1.5.8 are irrelevant. When value = 1, fields 2.1.5.2-2.1.5.4 are irrelevant.
Use	Manager
References	

2.1.5.2. StripOffsets

Definition	*For each strip, the byte offset of that strip.*
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	
Notes	"The **StripOffsets** field stores the offsets from the start of the image file to the start of each image data strip." (TIFF/EP)
Use	System ("This required field is the only way for a reader to find the image data, unless TileOffsets is used," TIFF p40)

References	TIFF 273 (*Baseline Required*, p21-24, 40), TIFF/EP 273 (5.2.21)

2.1.5.3. RowsPerStrip

Definition	*The number of rows per strip*.
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	
Notes	"RowsPerStrip and ImageLength together tell us the number of strips in the entire image. The equation is:…" (TIFF, p39)
Use	System
References	TIFF 278 (*Baseline Required*, p21-24, 39), TIFF/EP 278 (5.2.22)

2.1.5.4. StripByteCounts

Definition	*The number of image data bytes stored within each strip after compression.*
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	
Notes	TIFF/EP recommends that the image data, prior to compression, not exceed 64 Kbytes per strip.
Use	System
References	TIFF 279 (*Baseline Required*, p21-24, 40), TIFF/EP 279 (5.2.23)

2.1.5.5. TileWidth

Definition	*The tile width in pixels. This is the number of columns in each tile.*
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	
Notes	
Use	System
References	TIFF 322 (p67), TIFF/EP 322 (5.2.24)

2.1.5.6. TileLength

Definition	*The tile length (height) in pixels. This is the number of rows in each tile.*
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	

Notes	
Use	System
References	TIFF 323 (p67-68), TIFF/EP 323 (5.2.25)

2.1.5.7. TileOffsets

Definition	*For each tile, the byte offset of that tile, as compressed and stored on disk.*
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	
Notes	
Use	System
References	TIFF 324 (p68), TIFF/EP 324 (5.2.26)

2.1.5.8. TileByteCounts

Definition	*For each tile, the byte offset of that tile, as compressed and stored on disk.*
Type	positive integer
Required	R (when applicable; see usage note in 2.1.5.1)
Repeatable	N
Values	N = **TilesPerImage** for **PlanarConfiguration** = 1 = **SamplesPerPixel** * **TilesPerImage** for **PlanarConfiguration** = 2
Notes	TIFF/EP recommends that the image data, prior to compression, not exceed 64 Kbytes per tile. For each tile, the number of (compressed) bytes in that tile. See **TileOffsets** for a description of how the byte counts are ordered. No default. See also **TileWidth**, **TileLength**, **TileOffsets**. (TIFF, p68)
Use	System
References	TIFF 325 (p68), TIFF/EP 325 (5.2.27)

2.1.6. PlanarConfiguration

Definition	*Designates how the components of each pixel are stored.*
Type	enumerated type
Required	MA (when **SamplesPerPixel** > 1)
Repeatable	N
Values	1 = chunky format 2 = planar format
Notes	"If **SamplesPerPixel** is 1, **PlanarConfiguration** is irrelevant." (TIFF, p38) See, TIFF/EP 5.2.14 for an alternative definition of Planar Configuration that incorporates CFAPattern values.
Use	System
References	TIFF 279 (*Baseline optional*, p38), TIFF/EP 284 (5.2.14)

2.2. File

2.2.1. ImageIdentifier

Definition	*A unique identifier*.
Type	string
Required	M
Repeatable	N
Values	
Notes	"Persistent identifer required at prime object level, optional at all levels." (LC)
Use	Manager, System
References	DIG35 A.3.1.2, NISO Group 1 (Class ID/Genotype), LC #44 (handle), CDL (AdminMD), Harvard (ID)

2.2.2. FileSize

Definition	*Extent of image in bytes.*
Type	positive integer
Required	M
Repeatable	N
Values	
Notes	
Use	System
References	NISO Group 1, LC #69, Harvard, NLA #1

2.2.3. Checksum

Definition	*Checksum (or equivalent).*
Type	enumerated type
Required	R
Repeatable	N
Values	MD5
Usage Note	Local repository policies regarding file integrity metadata should govern implementation of this field. The enumerated type values should be defined locally, as should the rule regarding when the checksum is generated: prior to deposit, at the time of deposit, or both.
Use	System Manager (to monitor file integrity)
References	NISO Group 3, LC #22

2.2.4. Orientation

Definition	*Designates the orientation of the image, with respect to the placement of its rows* (**ImageWidth**) *and columns* (**ImageLength**)*, as it was saved to disk.*
Type	enumerated type
Required	R
Repeatable	N
Values	1 = normal* 3 = normal rotated 180° 6 = normal rotated cw 90° 8 = normal rotated ccw 90° 9 = unknown
Usage Notes	* "normal" is defined as follows: when opened, the top (0^{th}) row of pixels corresponds to the visual top of the image, and the first (0^{th}) column of pixels on left corresponds to the visual left-hand side of the image. Consult TIFF for additional values referring to mirrored images. (Note that TIFF/EP supports only five values, which are proposed above as the finite list of enumerated type values.) This field is to be used to record only the orientation of the image, not the orientation of the device (e.g., camera) used to capture the image (see, DIG35 C.3.2.5 "Camera Capture Settings") and TIFF/EP 5.2.12, which defines orientation as "...the orientation of the camera relative to the scene, when the image was captured."
Use	System
References	TIFF 274 (p36), NISO Group 1, LC #47, Harvard #9, NLA 5.1.9

2.2.5. DisplayOrientation

Definition	*Designates the orientation in which the image should be presented to a conventional monitor with a 3:2 aspect ratio.*
Type	enumerated type
Required	O
Repeatable	N
Values	0 = portrait 1 = landscape
Notes	This value is important to record when the preferred orientation of the image sent to a 3:2 aspect ratio computer monitor is different from **Orientation**. While **Orientation** refers to the placement of pixels in the digital image file, **DisplayOrientation** refers to the preferred orientation in which to display the content (text, picture, table, etc.) *within* the file. This field will likely become obsolete when "standard" delivery applications,

	such as web browsers, incorporate an image rotation tool,.
Use	System
References	Harvard #10

2.3. PreferredPresentation

Definition	*Designation of the device, application, medium, viewing environment (or any combination thereof) to render the image data.*
Type	string
Required	O
Repeatable	N
Values	
Usage Notes	For image data that can be defined to have a "best representation," use this free-text field to recommend the "target" device, application, medium, viewing environment (or combination thereof) presumed or proven to be meaningful to image quality. The Library of Congress's presentation_profile specifies "the program (or equivalent) used to manage the presentation of this primary or intermediate object for users." (LC #54) Standard: *ISO/DIS 3664 Viewing conditions for graphic technology and photography*. note: this field differs from DIG35 A.3.2 (Preferred Presentation Parameters), which specifies output size in meters.
Use	Manager, User
References	LC #54

3. **Image Creation**

This section can best be described as *descriptive* technical metadata. While it provides no quantitative information, per se, it can provide critical information with respect to the logistics and administrative conditions surrounding digital image data capture. Frequently, simple interrogation of these fields offers valuable diagnostics about the image creation step as well as those of subsequent image generations.

3.1. Image Creation

This metadata block documents selected, irreversible attributes of the analog-to-digital conversion process that may be used for future quality assessment of the image data. By definition, image creation occurs only once.

See, *5.1 Image Processing* for fields to record digital-to-digital conversion processes.

3.1.1. SourceType

Definition	*This field specifies the medium of the analog source material scanned to create a digital still image.*
Type	string
Required	R
Repeatable	N
Values (Examples)	daguerreotype reflection print silver gelatin print Acme Bronze 100 chromagenic film 35mm color negative Kodak Royal Gold 100 Emul. 3712011
Notes	"General or specific physical nature of original item (i.e., still pictorial image)." (LC) DIG35 proposes documenting a number of attributes of film: brand, category, film size, roll ID, frame ID, and film speed.
Usage Notes	Do not record dimensions of source material in this field. See, **Source_Xdimension** (4.1.7) and **Source_Ydimension** (4.1.8). When the source of the image data is another digital still image (e.g., a parent high-resolution image used to create a reduced-resolution image), see **ImageProcessing** (5.1).
Use	Manager, User
References	DIG35 B.3.4.1, B.3.4.2 (CapturedItem, Reflection Print; CapturedItem, Film), RLG #12, LC #52, MOA (Source Type, Source Characteristics), Harvard #16

3.1.2. ScanningAgency

Definition	*Identifies the organization-level producer(s) of the image.*
Type	string
Required	O
Repeatable	Y
Values	Luna Imaging, Inc. JJT, Inc. University of Michigan Digital Library Production Services Harvard College Library Digital Imaging Group
Notes (Usage Note)	"Identifies the organization-level producer of the 'file/bitstream,' i.e., the scanned image, transcribed text, audio file, etc." (LC #18) TIFF 315, Artist, (*Baseline optional*) refers to the "person who created the image;" TIFF/EP 315 Artist refers to "the name of the camera owner or image creator." Mapping data from these TIFF fields to **ScanningAgency** should only be done when there is no higher-level organization associated with the image creation. Otherwise, descriptive and/or IPR metadata standards should take precedence for rules regarding encoding of "artist" metadata.
Use	Manager
References	DIG35 B.3.1 (General Creation Information, Operator Organization), RLG #3, LC (#18), Harvard #18

3.1.3. HostComputer

Definition	*Computer and/or operating system in use at the time of image creation.*
Type	string
Required	R
Repeatable	N
Values	
Notes	The definition for this single data element can be interpreted narrowly, as in TIFF (see above), or broadly as in Cedars, which states: "This element contains information about the operating environment of the **original digital object at the time of ingest**, including information on relevant hardware and operating systems, together with the software products that would have been required in order to use it."
Use	Manager
References	TIFF 316 (p34), Cedars 1.1.3.1.4 (Original Technical Environments)

3.1.4. DeviceSource

Definition	*Classification of device used to create the image data.*
Type	string
Required	R

Repeatable	N
Values	transmission scanner reflection print scanner digital still camera still from video
Usage Notes	Recommended syntax: use enumerated values specified above and expand list to accommodate new technologies When image processing software is used to generate the image data from a digital source, see **ImageProcessing** (5.1).
Use	Manager
References	DIG35 B.3.1 (General Creation Information, Image Source)

3.1.5. ScanningSystem

Definition	*The scanner manufacturer and model name or number, and the name and version of the capture software used to create the image.*
Type	string
Required	R
Repeatable	N
Values (Example)	string; string; string Scitex; Leaf Volare; Leaf Colorshop 4.0
Usage Note	Recommended syntax: record values in following order: manufacturer; model name or number followed by serial number of device if desired; software name and version number. Separate values with semicolon and space.
Use	Manager
References	concatenation of TIFF 271 "Make" (*Baseline optional*, p35), TIFF 272 "Model" (*Baseline optional*, p35), and TIFF 305 "Software" (*Baseline optional*, p39); TIFF/EP 271, 272, 305; RLG #4, LC #16, Harvard #17

3.1.6. Camera Capture Settings

Definition	*This section describes the camera capture settings used when the digital image was captured.*
Type	complextype
Required	O
Repeatable	N
Values	XML, see schema definition in DIG35 B.3.2.5
Usage Note	This element maps to DIG35 B.3.2.5 Camera Capture Settings.
Use	System Manager
References	DIG35 B.3.2.5

3.1.7. Sensor

Definition	*Designates the type of image sensor used in the camera or image capture device.*
Type	enumerated type
Required	R
Repeatable	N
Values	0 = undefined 1 = MonochromeArea 2 = OneChipColorArea 3 = TwoChipColorArea 4 = ThreeChipColorArea 5 = ColorSequentialArea 6 = MonochromeLinear 7 = ColorTriLinear 8 = ColorSequentialLinear
Notes	enumerated values drawn from TIFF/EP 37399 (p25-26)
Use	Manager
References	DIG35 B.3.2.4 (Sensor Technology), TIFF/EP 37399 "SensingMethod" (5.2.16), RLG #5, NISO Group 1 (Lamp / Sensor) and Group 2 (CCD)

3.1.8. DateTimeCreated

Definition	*Date or DateTime image was created*.
Type	DateTime
Required	MA (for an image scanned from an analog source)
Repeatable	N
Values	
Usage Notes	The recommended use is to adopt the DIG35 specification: "This field should be stored when the capture process started. (e.g. it may be an 8 minute exposure.) This field should never be changed after it is written in the image capture device" (DIG35 B.3.1, emphasis added). TIFF/EP expresses the same rule: "This tag should never be changed after it is written in the camera or image capture device." See, **DateTimeProcessed** (5.1.1) for images created by processing image data (i.e., digital-to-digital conversion).
Use	Manager
References	DIG35 B.3.1 (Capture Time), TIFF 306 (p31), TIFF/EP 36867 DateTimeOriginal (5.2.46), RLG #1, LC #23, Harvard (createdate), NLA #2

3.2. Methodology

Definition	*Designates the methodology and rationale to digitize an object or collection.*
Type	string, reference
Required	O
Repeatable	N
Values	free text filename
Notes	For an example, see "Scanning the Collection" notes associated with the American Memory collections, Library of Congress, National Digital Library Program, http://lcweb2.loc.gov/ammem/ammemhome.html
Use	Manager, User
References	NISO Group 2, LC #60 (reformatting guidelines), LC #61 (reformatting method), Harvard #23

4. **Imaging Performance Assessment**

The operative principle in this section is to *maintain* the attributes of the image inherent to its quality. The title *Performance Assessment* has both a present and future context: these elements serve as metrics to assess the accuracy of output (today's use), and to assess the accuracy of preservation techniques, particularly migration (future use).

Sub-sections *4.1 Spatial Metrics* and *4.2 Energetics* are meant as high-level quantitative measures of imaging performance. Sub-section *4.3 Targets* is meant to complement the former by providing low-level benchmarking quantification of the absolute imaging performance of the digital capture process. This information in this latter section should be closely tied to sanctioned imaging performance standards when available. In the absence of such standards, *de-facto* standards are appropriate.

To help in the understanding of this section, Figures 1 and 2 are provided as examples of typical imaging chains. Frequently, confusion exists around image state generations, and at which generation the metadata is meant to apply. Often, knowledge at all levels is required. In such cases, repeatable fields for a given element are offered.

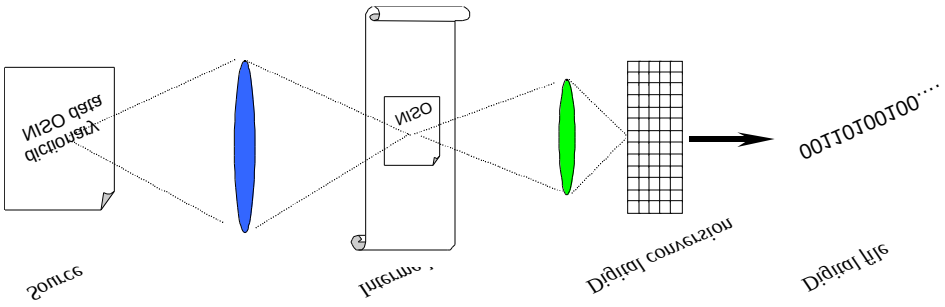

Figure 2 - Digital conversion of Intermediate; Indirect conversion of Source

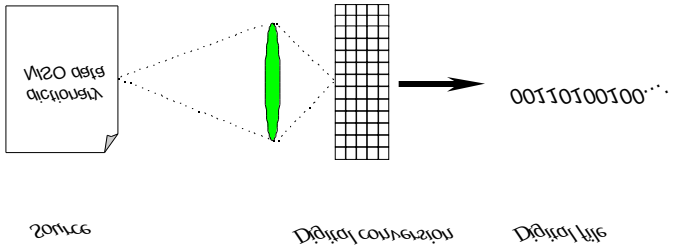

Figure 3 - Direct digital conversion of Source

To a large extent, the image of any source can be linked backed to that source with appropriate capture documentation and benchmarking targets. While the original source characteristics are not unequivocally recoverable, suitably accurate reconstructions of the source can, in principle, occur. The high level metrics of sub-sections 4.1 and 4.2 can provide nominal recovery of the original source characteristics. Detailed imaging performance information in Section 4.3, if properly documented, is a reliable thread to more accurate source characteristics.

4.1. Spatial Metrics

While it is recognized that digital images can describe three-dimensional objects, this section deals only with the classic 2-dimensional projection of such objects as seen by the imaging device at any given instant in time. The digital image assumes the form of a uniformly sampled rectangular grid of pixels (picture elements) in the "x" (ImageWidth) and "y" (ImageLength) dimensions. The global photometrics associated with each of these pixels is covered in sub-section 4.2.

Though range or depth data (i.e. "z" dimension) can be digitized with specialized 3-D imaging devices, these are currently outside the mainstream of most imaging practices. More experience with this type of data is needed before any viable suggestions on metadata documentation are made. The format of this document does not exclude their future adoption.

4.1.1. ImageWidth

Definition	*This specifies the width of the digital image, i.e. horizontal or X dimension, in pixels.*
Type	positive integer
Required	M
Repeatable	N
Values	
Notes	The image width may be the shorter or longer dimension of the image, depending upon the orientation of the camera or scanner during image capture. For multiple-resolution image file formats, value shall specify the highest resolution. This value may be used to calculate **XSamplingFrequency** when **Source_Xdimension** is given in inches and **SamplingFrequencyUnit** = 2. Formula to calculate X_Sampling Frequency: **XSamplingFrequency** = **ImageWidth/Source_Xdimension**
Use	System, required field for image viewers (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	DIG35 A.3.1.3 (“Image Size”), TIFF 256 (*Baseline Required*, p21-24, 34), TIFF/EP 256 (5.2.2), LC #48, Harvard #7

4.1.2. ImageLength

Definition	*This specifies the length of the digital image, i.e. vertical or Y dimension, in pixels.*
Type	positive integer
Required	M
Repeatable	N
Values	
Notes	The image length may be the shorter or longer dimension of the image, depending upon the orientation of the camera or scanner during image capture. For multiple-resolution image file formats, value shall specify the highest resolution. This field may be used to calculate **YSamplingFrequency** when **Source_Ydimension** is given in inches and **SamplingFrequencyUnit** = 2 Formula to calculate YSamplingFrequency: **YSamplingFrequency** = **ImageLength**/**Source_Ydimension**
Use	System, required field for image viewers (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	DIG35 A.3.1.3 ("Image Size"), TIFF 257 (*Baseline Required*, p21-24, 34), TIFF/EP 257 (5.2.3), LC #49, Harvard #8

4.1.3. XSamplingFrequency

Definition	*This field specifies the number of pixels per* **SamplingFrequencyUnit** *in the image width.*
Type	positive integer
Required	MA (when **SamplingFrequencyUnit** = 2 or 3)
Repeatable	N
Values	
Notes	With fields **YSamplingFrequency** (4.1.4) and **SamplingFrequencyUnit** (4.1.5), **XSamplingFrequency** specifies the dimensions (scale) of the printed image. When **SamplingFrequencyUnit**=1, this value for this field shall be null.
Use	System, accurate output of file to print/film (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	TIFF 282 (*Baseline Required*, p21-24, 41), TIFF/EP 282 (5.2.6), NISO Group 1 ("Resolution Issues"), Harvard #4

4.1.4. YSamplingFrequency

Definition	*This field specifies the number of pixels per* **SamplingFrequencyUnit** *in the image length.*
Type	positive integer
Required	MA (when **SamplingFrequencyUnit**=2 or 3)

Repeatable	N
Values	
Notes	With fields **YSamplingFrequency** (4.1.4) and **SamplingFrequencyUnit** (4.1.5), **YSamplingFrequency** specifies the dimensions (scale) of the printed image.
Use	System, accurate output of file to print/film (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	TIFF 283 (*Baseline Required*, p21-24, 41), TIFF/EP 283 (5.2.7), NISO Group 1 ("Resolution Issues"), Harvard #5

4.1.5. SamplingFrequencyUnit

Definition	*The unit of measurement for* **XSamplingFrequency** *and* **YSamplingFrequency**.
Type	enumerated type
Required	M
Repeatable	N
Values	1 = no absolute unit of measurement. 2 = inch 3 = centimeter
Notes	Value "1" used for images that may have a non-square aspect ratio, but no meaningful absolute dimensions. In copy work, should also be used when source measurements are unknown (e.g., when a photo-intermediate such as 35mm negative film is the source). When **SamplingFrequencyUnit** = 2 and **Source_Xdimension** is given in inches, the **XSamplingFrequency** may be calculated as follows: **XSamplingFrequency** = **ImageLength**/**Source_Xdimension** When **SamplingFrequencyUnit** = 2 and **Source_Ydimension** is given in inches, the **YSamplingFrequency** may be calculated as follows: **YSamplingFrequency** = **ImageWidth**/**Source_Ydimension** The same formulas may be used when **SamplingFrequencyUnit** = 3 and source dimensions are given in centimeters.
Use	System, accurate output of file to print/film (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	TIFF 296 (*Baseline Required*, p21-24, 38), TIFF/EP 296 (5.2.8), NISO Group 1 ("Resolution Issues"), Harvard #6

4.1.6. SamplingFrequencyPlane

Definition	*The reference plane location for which* **XSamplingFrequenc**y *and* **YsamplingFrequency** *are designated.*
Type	enumerated type
Required	M
Repeatable	N
Values	1 = camera/scanner focal plane 2 = object plane 3 = source object plane
Notes	*This element is meant to remove the ambiguity with respect to* **XSamplingFrequency** *and* **YSamplingFrequency** *for the scanning of film intermediates. It can be used to deduce* **Source_Xdimension** *or* **Source_Ydimension** *in conjunction with* **ImageWidth** *or* **ImageLength.** Value = **1** is consistent with DIG35 (B.3.2.4) and TIFF/EP 5.2.9-5.2.10 and is an indication of the physical sensor sampling frequency. It is of limited use without knowledge of the optical magnification between sensor and imaged object Value = **2** would be most common for direct scanning of source objects. If "object plane" is the same as "source object plane," (Fig. 3) this value is used. Value = **3** commonly used for film intermediates such as microfilm where **XSampling Frequency** and **YSamplingFrequency** are often referred to at the source object plane rather than the object film plane (Fig. 2).
Use	System, accurate output of file to print/film (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	TIFF/EP 5.2.9-5.2.10 (implied)

4.1.7. Source_Xdimension

Definition	*Specifies the width of the scanned object.*
Type	[non-negative real] [unit of measure]
Required	O
Repeatable	N
Values (Examples)	7.63 inches 32 mm
Notes	Note that DIG35 B.3.4.1 and B.3.4.2 proposes expressing the value of this field in meters. For copy work of relatively small items, this is not always practical. Thus, values may be expressed in the unit of measure that is consistent with institutional practices and conventions. The Library of Congress, for example, suggests populating this field with data "modeled on (…[or] copied from) the MARC field 300 or its equivalent in non-MARC data." (LC #28) If unknown or impractical to record, the value of **Source_Xdimension** may be deduced. See, **SamplingFrequencyPlane** (4.1.6).

Use	System, accurate output of file to print/film (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	DIG35 B.3.4.1-2 (in meters), LC #28, MOA ("Source Physical Dimensions"), Harvard #16 (implied)

4.1.8. Source_Ydimension

Definition	*Specifies the length of the scanned object.*
Type	[non-negative real] [unit of measure]
Required	O
Repeatable	N
Values (Examples)	5.29 inches 28 mm
Notes	Note that DIG35 B.3.4.1 and B.3.4.2 proposes expressing the value of this field in meters. For copywork of relatively small items, this is not always practical. Thus, values may be expressed in the unit of measure that is consistent with institutional practices and conventions. The Library of Congress, for example, suggests populating this field with data "modeled on (…[or] copied from) the MARC field 300 or its equivalent in non-MARC data." (LC #28) If unknown or impractical to record, the value of **Source_Ydimension** may be deduced. See, **SamplingFrequencyPlane** (4.1.6).
Use	System, accurate output of file to print/film (*size*) Manager, one of the quantitative metrics to evaluate image quality
References	DIG35 B.3.4.1-2 (in meters), LC #28, MOA ("Source Physical Dimensions"), Harvard #16 (implied)

4.2. Energetics

This section is meant to provide nominal accuracy and precision data on the global energetic response and archiving space of the imaging device and subsequent digital file. The data herein presumes to apply to all pixels in the digital image, except as noted. This section is purposely titled *Energetics* to not mislead the user with respect to the visual interpretation of the data contained in the digital image. While interpretative values are provided for each data element these are considered nominal and not absolute. Only with careful populating of *Sub-section 4.3 Targets* elements can improved data interpretation be realized.

4.2.1. BitsPerSample

Definition	*The number of bits per component for each pixel. This field provides N values depending upon* **SamplesPerPixel** *present.*
Type	enumerated type
Required	M
Repeatable	N
Values	1 = 1-bit (bitonal) 4 = 4-bit grayscale 8 = 8-bit grayscale or palletizedcolor 8,8,8 = RGB 16,16,16 = TIFF, HDR (high dynamic range) 8,8,8,8 = CMYK
Notes	"Note that this field allows a different number of bits per component for each component corresponding to a pixel. For example, RGB color data could use a different number of bits per component for each of the three color panes. Most RGB files will have the same number of **BitsPerSample** for each component. Even in this case, the writer must write all three values." (TIFF, p29, emphasis added)
Use	System (*tone, color*) Manager, one of the quantitative metrics to evaluate image quality
References	TIFF 258 (*Baseline Required*, p22-24, 29), TIFF/EP 258 (5.2.20), RLG #13, NISO Group 1 (tonal resolution), LC #45 (implied), MOA (implied), Harvard #1, NLA 5.1.4 (implied)

4.2.2. SamplesPerPixel

Definition	*Designates the number of color components per pixel.*
Type	enumerated type
Required	M
Repeatable	N
Values	1 = when **PhotometricInterpretation** = 0 or 1 3 = when **PhotometricInterpretation** = 2 (RGB), 6 (YcbCr) 4 = when **PhotometricInterpretation** = 5 (CMYK)
Notes	Values drawn from TIFF (p39, 69) and TIFF/EP (5.2.19). See also **BitsPerSample**, **PhotometricInterpretation**, **ExtraSamples**.
Use	System (*tone, color*) Manager, one of the quantitative metrics to evaluate image quality
References	TIFF 277 (*Baseline Required*, p24, 39), TIFF/EP 277 (5.2.19), RLG #13 (implied), NISO Group 1 ("Channels and Layers"), LC #45 (implied), MOA (implied), NLA 5.1.4 (implied)

4.2.3. Extrasamples

Definition	*Specifies that each pixel has* M *extra components whose interpretation is defined by one of the values listed below*.
Type	enumerated type
Required	MA
Repeatable	N
Values	0 = unspecified data 1 = associated alpha data (with pre-multiplied color) 2 = unassociated alpha data 3 = range or depth data
Notes	This field must be present if there are extra samples in the image data. When this field is used, **SamplesPerPixel** (3.2.2) has a value greater than **PhotometricInterpretation** (2.1.4) suggests.
Use	System
References	TIFF 338 (*Baseline mandatory if applicable*, p31), NISO Group 1 (channels and layers)

4.2.4. Colormap

Definition	*This field defines a Red-Green-Blue color map (often called a lookup table) for palette-color images.*
Type	enumerated type (see structure in Values below) or reference
Required	MA (for palettized color images, **PhotometricInterpretation** = 3)
Repeatable	N
Values (Examples)	[n bit code value] [red value] [green value] [blue value] 0 0 4 5 1 1 5 8 2 3 7 10 .. … … … 255 129 250 150 (The reference data type accommodates the practice of generating a colormap at the beginning of each session.)
Notes	As noted in the TIFF definition, **Colormap** is synonymous with color lookup table (CLUT). When **PhotometricInterpretation** = 2, there is no **Colormap**; in other words, there is no **Colormap** in RGB images (TIFF, p24).
Use	System (*tone, color*)
References	TIFF 320 (*Baseline mandatory if applicable*, p23, 29-30), MOA ("CLUT"), NLA 5.1.8 (note: the MOA and NLA definitions for CLUT do not correspond to TIFF's)

4.2.5. GrayResponseCurve

Definition	*For grayscale data, the optical density of each possible pixel value.*
Type	enumerated type or reference
Required	R
Repeatable	N
Values	N = 2**__BitsPerSample__
Usage Note	Must be accompanied by **GrayResponseUnit** (4.2.6) (The reference data type accommodates the practice of generating a response curve at the beginning of each session.)
Use	System (objective assessment of optical density)
References	TIFF 291 (*Baseline optional*, p33)

4.2.6. GrayResponseUnit

Definition	*The precision of the information contained in the GrayResponseCurve.*
Type	enumerated type
Required	R
Repeatable	N
Values	1 = Number represents tenths of a unit. 2 = Number represents hundredths of a unit. 3 = Number represents thousandths of a unit. 4 = Number represents ten-thousandths of a unit. 5 = Number represents hundred-thousandths of a unit.
Usage Note	Modifies **GrayResponseCurve** (4.2.5)
Use	System (objective assessment of optical density)
References	TIFF 290 (*Baseline optional*, p33)

4.2.7. WhitePoint

Definition	*The white point chromaticity of the effective illumination source of the capture process.*
Type	enumerated type
Required	O
Repeatable	Y
Values	3127/10000, 3290/10000, 1 = [source-to-intermediate capture] 3127/10000, 3290/10000, 2 = [source-to-digital capture]
Usage Note	These values specify the 1931 CIE xy chromaticities of the effective illumination (i.e., filter/light source combination) at capture. The ordering is white [x], white [y], **1** [source-to-film capture] or **2** [source-to-digital capture] comment: "The chromaticities of the primaries of the image are encoded using the redColorantTag, greenColorTag, and blueColorantTag values within the ***InterColorProfile*** tag value. The chromaticity of the white point of the image

	is encoded using the mediaWhitePointTag values within the ***InterColorProfile*** tag value." (TIFF/EP 4.5 Camera Color Space Information)
Use	System (objective assessment of colorimetry)
References	TIFF 318 (*RGB Image Colorimetry, pg 83*), TIFF/EP 34675 InterColorProfile, NISO Group 1 (White-point / Black-point)

4.2.8. PrimaryChromaticities

Definition	*The chromaticities of the primary colors of the imaging process*
Type	enumerated type
Required	O
Repeatable	Y
Values (Examples)	640/1000, 330/1000, 300/1000, 600/1000, 150/1000, 60/1000, 1 = [source-to-intermediate capture] 640/1000, 330/1000, 300/1000, 600/1000, 150/1000, 60/1000, 2 = [source-to-digital capture]
Usage Note	These values specify the 1931 CIE xy chromaticities of the capture primaries The ordering is red [x], red [y], green[x], green[y],blue[x],blue[y], **1** [source-to-film capture] or **2** [source-to-digital capture] comment: "The chromaticities of the primaries of the image are encoded using the redColorantTag, greenColorTag, and blueColorantTag values within the ***InterColorProfile*** tag value. The chromaticity of the white point of the image is encoded using the mediaWhitePointTag values within the ***InterColorProfile*** tag value." (TIFF/EP 4.5 Camera Color Space Information)
Use	System (objective assessment of colorimetry)
References	TIFF 319 (*RGB Image Colorimetry, pg 83*), TIFF/EP 34675 InterColorProfile

4.3. TargetData

Targets are used as concise physical benchmarks for absolute energetic and spatial information about the item of interest at time of capture. They are, in essence, Rosetta stones for the source. As such, their utility is undisputed whenever corrections or faithful reconstructions of the source document are required. To aid in their use and management, this section was created.

Depending on workflows and philosophy, targets can be considered as either external or internal to a digital image. Internal targets are part of a digital image by being within the field of view at time of capture. External targets are typically captured session-to-session and usually give temporally sparse information between image captures. For stable capture environments their utility can be equivalent to internal targets. Since they are not part of the digital image itself, their location must be managed in order to maintain a thread to the source.

The following diagram illustrates the logical structure of the TargetData.

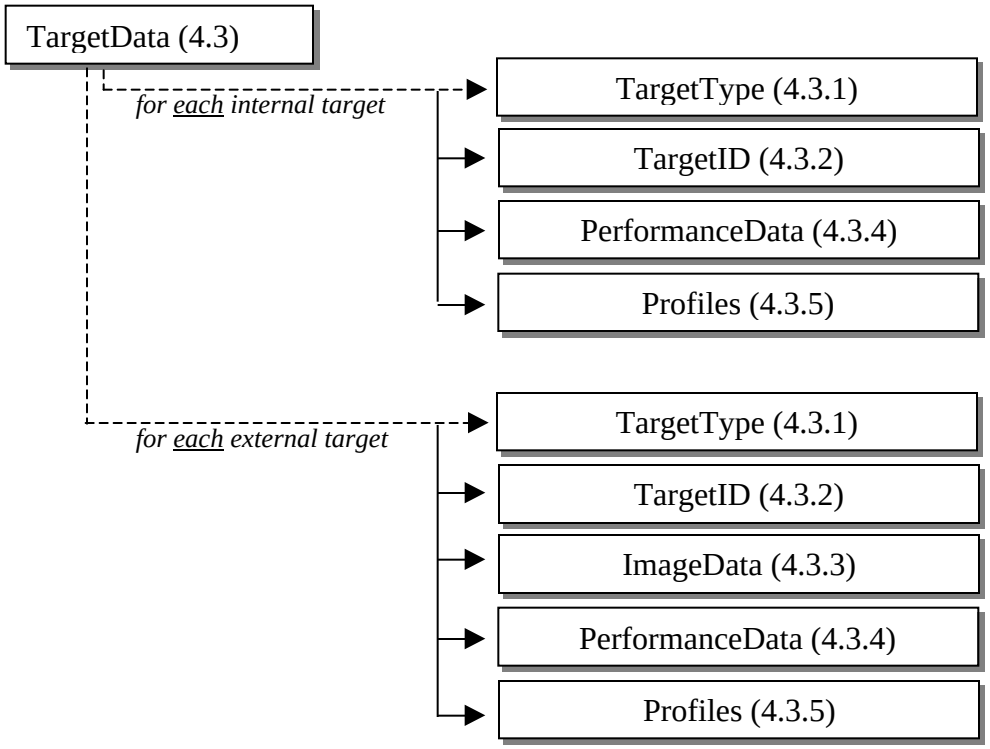

Figure 4 – Logical Structure of TargetData

4.3.1. TargetType

Definition	*This element identifies the targets as either internal or external*
Type	enumerated type
Required	R
Repeatable	Y
Values	0 = external 1 = internal
Usage Notes	The Count for this field = 1. Each target shall be represented by its own logical metadata block. See diagram of proposed **TargetData** structure (4.3). When value = 1, the **ImageData** field shall not be used. See **ImageData** 4.3.3.
Use	Manager
References	

4.3.2. TargetID

Definition	*Identifies the target name, manufacturer or organization, and version number or media.*
Type	string
Required	R
Repeatable	Y

Values (Examples)	string, string, string ColorChecker, Gretag-Macbeth, Item #XXX Q60, Eastman Kodak, Ektachrome Transparency ISO 16067, Applied Image Inc., Version #2
Usage Notes	Recommended syntax: as specified in definition — separate each sub-part of value by a comma and a single space. The Count for this field = 1. Each target shall be represented by its own logical metadata block. See diagram of proposed **TargetData** structure (4.3).
Use	Manager (objective measure of system quality)
References	RLG #15, Harvard #13, 22.1

4.3.3. ImageData

Definition	*Identifies the path where the digital image of the reference target identified in* 4.3.2 **TargetID** *is located.*
Type	reference
Required	R (applicable only if 4.3.1 **TargetType** = 0)
Repeatable	Y
Values	filename URN
Usage Notes	The Count for this field = 1. Each target shall be represented by its own logical metadata block. See diagram of proposed **TargetData** structure (4.3).
Use	System (to create **PerformanceData** and/or **Profiles**)
References	Harvard #22.2

4.3.4. PerformanceData

Definition	*Identifies the path of the file that contains the image performance data relative to the target identified in* 4.3.2 **TargetID**.
Type	reference
Required	O
Repeatable	Y
Values	filename URN
Usage Notes	The Count for this field = 1. Each target shall be represented by its own logical metadata block. See diagram of proposed **TargetData** structure (4.3). **PerformanceData** refer to standards-based characterizations of system performance according to measurements of spatial resolution, OECF, noise, and other attributes important to image quality. Standards: Electronic imaging standards through the Photographic Imaging Manufacturers Association (PIMA) (http://www.pima.net/standards/it10/IT10_POW.htm)

	provide example uses and reporting formats for proposed ISO performance data characterization. These include, for example, GrayResponseCurve (ISO 14524) and Spatial Resolution Measurement (ISO 16067).
Use	Systems (Manager (objective measure of quality of **ScanningSystem**)
References	Harvard #22.4

4.3.5. Profiles

Definition	*Identifies the path of the file that contains the ICC color profile or other image management profiles.*
Type	reference or positive integer
Required	O
Repeatable	Y
Values	filename URL or URN *for string,* value = N (actual size of the embedded ICC profile in bytes), see TIFF/EP 34675
Usage Notes	The Count for this field = 1. Each target shall be represented by its own logical metadata block. See diagram of proposed **TargetData** structure (4.3).
Use	System (tone/color)
References	TIFF/EP 34675 InterColorProfile (5.2.66), Harvard #22.3

5. **Change History**

Change History metadata serves the function of documenting processes applied to image data over the life cycle of an image. As defined below, "processes" result either in *editing* or in *transforming* the image.

The Image Creation metadata block (Section 3.1) is used to document the source, scanning system, and capture settings used to create an image from an analog source. The metadata blocks in Change History are used to document the source, systems, and settings used in any subsequent digital-to-digital operations related to image creation.

The Change History metadata contains:

- a summary of image editing operations applied to an image
- previous versions of the technical metadata

Notes:

- the Change History metadata is not designed to be used to reverse image editing operations
- the Change History metadata is not designed to be used to authenticate an image*

[*authors' note: the NISO Standards Committee is encouraged to monitor the DIG35 specification (to be finalized in August 2000) and to review other conceptual models of maintaining and migrating metadata, such as canonicalization (Lynch). Consistent with other metadata blocks in this data dictionary, Change History limits its focus to quality assessment and preservation of *image data* and thus may not be sufficient to meet requirements defined for image integrity and authenticity.]

[authors' note: regarding conceptual differences between History and Change History (as defined here), the NISO Standards Committee might want to consider *timestamps* when reviewing the issue of metadata encoding. (See, DIG35 F.3.2. See also, DIG35 5.6 Metadata Persistence.) Additionally, Change History may be expanded in the draft standard to incorporate a reference to presumed "repository" metadata, external to technical metadata, that will also be integral to History. See, for example, the LC data element #25 *Date and time image deposited to repository*.]

Structure

The following assumption and definitions govern the proposed logical structure for Change History:

- *image processing* may occur multiple times throughout the life cycle of an image
- the image life cycle may consist of multiple generations of the image
- changes to any of the values in *Section 2.1 Format* create a new *generation* of the image
- image *transformation* refers to any processing that produces a new generation image

· all other processes (i.e., those that do not create new values in Section 2.1) are classified as *image editing*

The following diagram illustrates the logical structure of Change History.

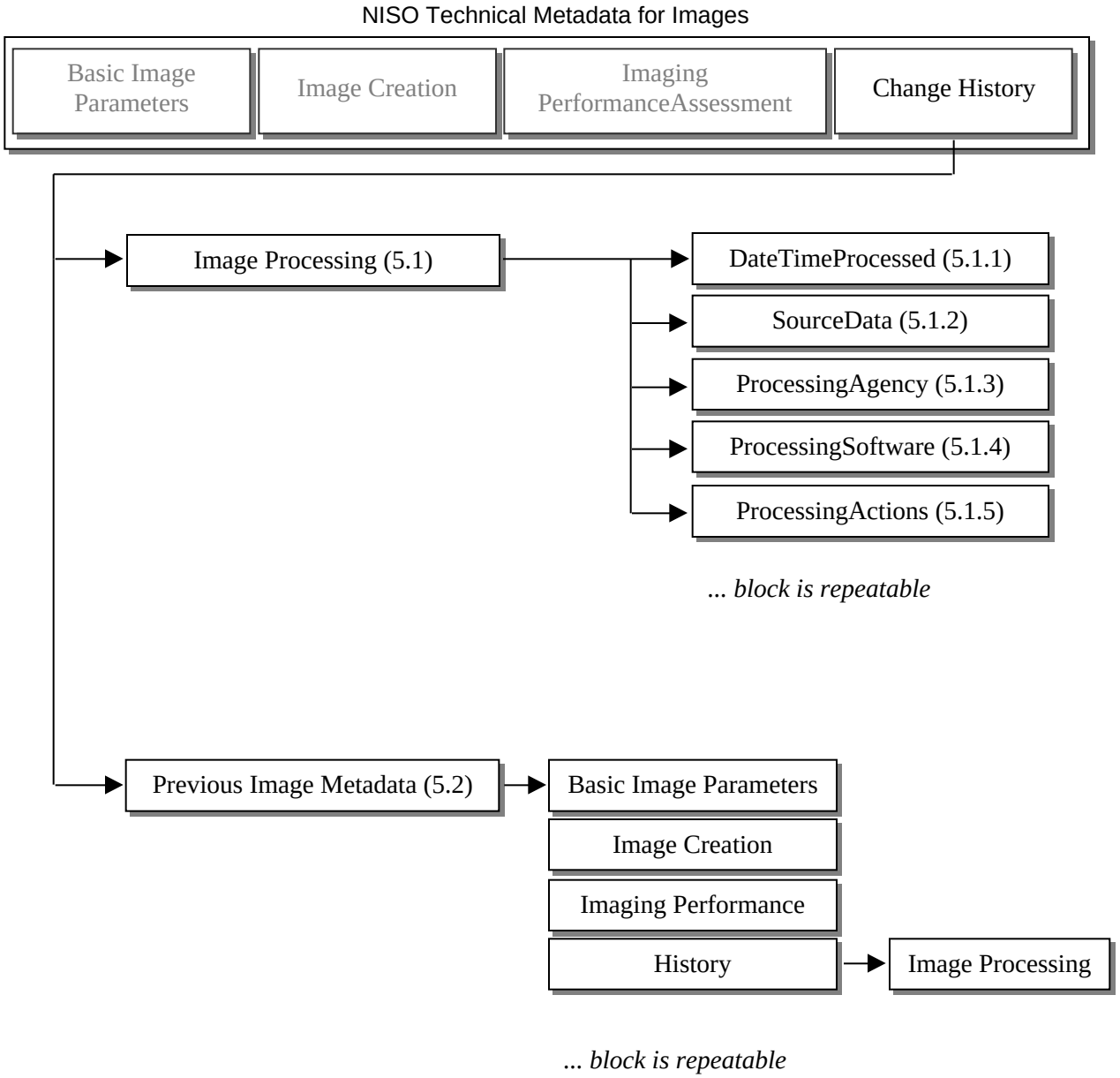

Figure 5 – Logical Structure of Change History

5.1. Image Processing

This metadata block contains a summary of image editing operations (i.e., digital-to-digital conversion processes) that may be used for future quality assessment of the image data.

Note: Fields 5.1.1-5.1.5 define a single metadata block to document a single processing action (image cropped) or a single set of processing actions (subsampling, application of ICC profile, conversion to jpeg in order to create a reduced-resolution delivery image from an archival uncompressed "master" image).

The logical structure of this metadata block presumes that image processing will occur multiple times (Fig. 5). To document a full change history applied to an image, each metadata block should not be overwritten by subsequent processing actions.

5.1.1. DateTimeProcessed

Definition	*Date or DateTime image was processed.*
Type	DateTime
Required	MA
Repeatable	N
Values	
Usage Notes	If multiple processing steps are recorded together in 5.1.5, the DateTime shall refer to the final (i.e., most recent) **ProcessingAction**. The value for this field shall be null for images that receive no processing following image conversion, as documented in *3.1 Image Creation*.
Use	Manager
References	TIFF/EP 306 (5.2.47) *differs from TIFF 306*; LC #66 (revision_date_time), Harvard #11 (modified)

5.1.2. SourceData

Definition	*This field specifies either a reference to the source image data (digital file), or a brief description of the file, to create a processed digital image.*
Type	reference or string
Required	MA
Repeatable	N
Values (Examples)	local filename URL or URN or Name Resolution Service name of file stored in repository Photo CD image (terse descriptions of "production image" that was deleted)
Usage Notes	The value for this field shall be null for images that receive no processing following image conversion, as documented in *3.1 Image Creation*.
Use	Manager
References	

5.1.3. ProcessingAgency

Definition	*Identifies the organization-level producer(s) of the processed image.*
Type	string
Required	R
Repeatable	Y
Values	Luna Imaging, Inc. JJT, Inc. University of Michigan Digital Library Production Services Harvard College Library Digital Imaging Group
Usage Notes	…multiple agencies…
Use	Manager
References	LC #18 (implied)

5.1.4. ProcessingSoftware

Definition	*The name and version number of the image processing software used to edit or transform the image data.*
Type	string
Required	R
Repeatable	Y
Values	
Usage Notes	…multiple programs…
Use	Manager
References	RLG #5-6, Harvard #20

5.1.5. ProcessingActions

Definition	*An ordinal listing or script of the image processing steps performed by way of* **ProcessingSoftware (5.1.4)**
Type	string **or** reference **or** complex
Required	R
Repeatable	Y
Values (Examples)	Rotate 90 CW Photoshop actions script - *photoshop*.ATN
Notes	
Use	Whenever possible script or action files should be supplied for this element.
References	DIG35 D.3.2 Image Processing block, RLG #5-6, Harvard #21, Cedars 1.1.3.1.3 (Change History Before Archiving)

5.2. Previous Image Metadata

Definition	*Documentation of change history and preservation of essential technical metadata to simulate return to original image data.*
Type	complex type*
Required	MA (each time a new generation of the image is created)
Repeatable	
Values	TBD
Notes	[review final version of DIG35 specification] *alternative to single data element model*: TIFF/EP: "This optional tag encodes a record of what has been done to the image. The current information shall not be erased when adding new information to the image history. As changes are made, the additional information about the changes should be concatenated to the previous string. The new information should be separated by one or more ASCII blank spaces, and terminated with a NULL zero byte."
Use	Manager, User
References	DIG35 D.3.3 Previous Image Metadata, TIFF/EP 37395 ImageHistory (5.2.42), RLG #6, Harvard #14

* **assumed to be appropriate data type; decision deferred to NISO Standards Committee**

6. **References**

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