Automatic Exposure:
Capturing Technical Metadata for Digital Still Images

Automatic Exposure – Capturing Technical Metadata for Digital Still Images is an RLG Initiative, supported by the Consortium for Interchange of Museum Information (CIMI), the Digital Library Federation (DLF), and the Museum Computer Network (MCN).

First published in November 2003 as a white paper for the RLG & NISO-sponsored Automatic Exposure Meeting (Las Vegas, NV). This version has been revised and updated to include input from community experts.

Research Libraries Group, Inc.
Mountain View, California 94043 USA
www.rlg.org

Executive Summary

The RLG initiative *Automatic Exposure – Capturing Technical Metadata for Digital Still Images* seeks to minimize the cost of technical metadata acquisition and maximize the cultural heritage community's capability of ensuring long-term access to digital assets. The goal of the initiative is to lower the barrier for institutions to capture the data elements proposed by NISO Z39.87: Technical Metadata for Digital Still Images [Draft Standard for Trial Use].[1] NISO Z39.87 defines a standard, comprehensive set of data elements key to an institution's ability to manage and preserve its digital images.
To that end, the project pursues three main thrusts:

- To engage manufacturers of high-end scanners and digital cameras in a dialog about what technical metadata their products currently capture, and what technical metadata is required for digital archiving.
- To examine how existing industry efforts can be leveraged to satisfy the data set proposed by NISO Z39.87: Technical Metadata for Digital Still Images
- To identify and evaluate the existing or emerging tools for harvesting technical metadata developed at individual institutions or by vendors, and explore how those tools can scale to serve the entire community.

Problems, solutions, opportunities

The rise of the Internet in the mid 1990s afforded museums, libraries and archives the opportunity to provide unparalleled access to their collections through the new online medium. The case in favor of digitizing unique and rare cultural objects is compelling: 24/7 availability of collections which could only be accessed through travel, or not accessed at all by the general public. The vast majority of museum collections, for example, are not found on gallery walls, but in museum basements and storage facilities, hidden from the public's eye. Funding from private and federal sources has since created an astonishing amount of digital images, served up on museum, library and archive websites, or integrated into union resources such as RLG Cultural Materials.[2]

While digitization provides a radically new way for cultural heritage institutions to fulfill their core mission of providing access to the cultural memory of humankind, it also throws into relief a familiar problem in a new guise. The cultural heritage community has ample experience in preserving physical artifacts, and has taken on the preservation of digital materials with a similar level of commitment. The high cost of the digitization process and the stress it puts on sensitive materials has given rise to the sense that only access in perpetuity can justify the cost of digitizing collections. Cultural heritage institutions have adopted the approach of capturing one image at very high resolution for a multitude of uses over time. The digital images museums, libraries and archives create are digital assets, or in other words, investments they need to manage and preserve, just

[1] For more information on NISO Z39.87, please see http://www.niso.org/standards/standard_detail.cfm?std_id=731
[2] For more information on RLG Cultural Materials, please see http://www.rlg.org/culturalres/

as they need to manage and preserve their physical collections. Since concerns of longevity and preservation are deeply engrained in the cultural heritage community, the new digital challenge propelled museums, libraries and archives into the forefront of research into digital preservation.

A recent development illustrates the scope of the current investigation: in January 2003, the US legislation appropriated $100 million for a program tasking the Library of Congress with building a national information infrastructure for digital preservation.[3] The appropriation allows the Library of Congress to fund partner institutions, identified through a competitive grant application process, who are working on pieces of the digital preservation puzzle. Digital preservation has become a national priority, and cultural heritage and government institutions are taking the lead. The outcome of the groundbreaking work in those communities will have a profound impact on any industry with a long-term investment in digital data, including companies from fields such as health care, entertainment and finance.

Obviously, the focus on sustaining digital assets creates a market where products supporting digital preservation will have a clear advantage over products which ignore this pivotal issue. In the realm of digital imaging, manufacturers of capture devices can position themselves advantageously by creating devices that will address digital preservation at the outset – at the point of image and file creation. During digitization, the capture device, its host computer and the software driving the process are cognizant of all the technical properties of the digital file created. Writing those properties to a format suitable for ingest into preservation systems or digital asset management databases is an important step to ensure the long-term viability of a digital file, whether the image represents an 18th century French painting, the x-ray of a fractured bone, a picture from a sporting event or the image of a cashed check.

Technical metadata is a key component of a comprehensive body of metadata necessary for digital preservation. While technical metadata is a subset of preservation metadata deemed necessary to achieve the long-term viability of a digital asset, it has often been called the first line of defense against losing access to a digital file. Technical metadata assures that the information content of a digital file can be resurrected even if traditional viewing applications associated with the file have vanished. Furthermore, it provides metrics which allow machines as well as humans to evaluate the accuracy of output from a digital file. In its entirety, the data set supports the management and preservation of digital images throughout the different stages of their lifecycle. At this point, capturing technical metadata tends to be a manual, time-consuming process. Most cultural heritage institutions subscribe to the value of recording technical metadata, yet few have the ability to capture the technical properties of files even at the most basic level. The conundrum is obvious: cultural heritage institutions do not have the staff to hand-capture metadata vital for preservation, but they also do not have the staff to recreate the files if they lose access. Furthermore, they can not justify the risk of damaging artwork and fragile materials through repeated handling and exposure to light. Securing long-term

[3] For more information on NDIIPP, please see http://www.digitalpreservation.gov/

access to digital images becomes the linchpin in the community's ability to continue on the path of providing broad access to collections online.

The cultural heritage community has made great strides in developing and adapting standards on the cutting edge of digital preservation. A target data set of technical metadata for digital images has already been defined in the draft standard NISO Z39.87. *Automatic Exposure* examines strategies for economically implementing the data dictionary proposed by the NISO standard. Looking at the bigger picture, NISO Z39.87 plays its part in the larger family of preservation standards. Translated into XML schema by the Library of Congress,[4] it supports the implementation of Metadata Encoding and Transmission Standard (METS)[5] as an extension schema. METS provides a data structure for displaying, exchanging, and archiving digital objects. This digital object standard, in turn, becomes an Information Package as stipulated in the Open Archival Information System (OAIS),[6] a reference model specifying the responsibilities and data flow surrounding a digital archive at a conceptual level.[7]

While the OAIS was initially developed by the space data community, the library community provided crucial input to the development of this International Organization for Standardization (ISO) standard ISO 14721:2003. The joint OCLC-RLG Working Group on Preservation Metadata has published documents on applying the abstract framework to a cultural heritage setting since 2001.[8] In its current incarnation as the Preservation Metadata: Implementation Strategies (PREMIS) Working Group,[9] the group is focused on creating a comprehensive data dictionary for preservation metadata independent of file formats. Since technical metadata is highly file format specific, NISO Z39.87 will complement the all-encompassing PREMIS effort for data sets comprised of digital still images.

Or, in other words (and using less acronyms): the cultural heritage community has established a framework for digital preservation, and the parts fit together to form a mature strategy. However, the techniques to economically populate the framework and its elements with the appropriate values remain to be identified. Technical metadata in particular lends itself to automatic capture of, and the majority of data elements stipulated by NISO Z39.87 could be effortlessly recorded during image capture. For the small subset of elements remaining (such as elements pertaining to lighting during a shoot),[10] profiles could help capture metadata at the batch-level. The camera operator would

---

[4] For more information on NISO Metadata for Images in XML Schema (MIX), please see http://www.loc.gov/standards/mix/

[5] For more information on METS, please see http://www.loc.gov/standards/mets/

[6] For more information on OAIS and its application in the cultural heritage community, please see http://www.rlg.org/longterm/oais.html

[7] For more information on the interplay of NISO Z39.87, METS and OAIS, please see http://www.rlg.org/preserv/diginews/diginews7-3.html#feature2

[8] For more information, see *Preservation Metadata and the OAIS Information Model, A Metadata Framework to Support the Preservation of Digital Objects*, http://www.oclc.org/research/projects/pmwg/pm_framework.pdf

[9] For more information on PREMIS, see http://www.oclc.org/research/projects/pmwg/

[10] Please consult Appendix 2 for details on which elements can be automatically captured, and which elements have to be supplied manually or through profiles.

specify the parameters of a particular set-up once, and then apply it to the entire batch of files generated during a session.

Automatic Exposure proposes to solve the key issue of economic metadata acquisition for technical metadata. By making the capture of technical metadata cheaper, recording this type of preservation metadata turns from an unfulfilled imperative into a choice without a sticker shock. In this way, *Automatic Exposure* will help institutions across the board to manage their digital assets in keeping with identified preservation strategies. Manufacturers whose capture devices implement the recommendations from this initiative will find that their products have a competitive edge not only in the cultural heritage community, but also in other markets where digital files represent valuable long-term assets.

An introduction to NISO Z39.87

The target data element set is the data dictionary defined as *NISO Z39.87 Technical Metadata for Digital Still Images*.[11] (Currently holding the status Draft Standard for Trial Use, the standard is due to be revised and balloted at the beginning of 2004.)

The standard is an outgrowth of an April 1999 workshop sponsored by NISO, the Council on Library and Information Resources (CLIR), and RLG. Attended by representatives from libraries, universities, museums, archives, the government, and the digital imaging vendor community, the workshop was in response to the major challenge that cultural heritage institutions faced in making their digital collections persist. Though most cultural heritage institutions had begun to digitize their collections at a rapid pace, few were consistently collecting metadata that would enable them to maintain the functionality and quality intrinsic to the images despite whatever preservation strategies might be applied over the long-term.

Technical metadata was necessary to support two fundamental functions: documentation of image provenance and history (production metadata); and assurance that image data would be rendered accurately on output (to screen, print, or film). Ongoing management, or "preservation," of these core functions would require the development of applications to validate, process, refresh, and migrate image data against criteria encoded as technical metadata. At the time no such metadata set had been identified, therefore workshop attendees began this task.

Following the workshop, NISO commissioned Don Williams (Kodak) and Stephen Chapman (Harvard University) to draft a data dictionary of technical metadata. Two overarching goals drove the development of the data dictionary. The first was 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 was to propose elements that would be used by digital

[11] The complete NISO Z39.87 [Draft Standard for Trial Use] can be found at http://www.niso.org/standards/resources/Z39_87_trial_use.pdf

repository managers, curators, or imaging specialists to assess the current value (aesthetic or functional) of a given image or collection of images.

The resulting draft data dictionary encompasses technical metadata available in TIFF Rev. 6.0, TIFF/EP, and EXIF file formats, as well as some metadata elements embodied within the just-emerging Digital Imaging Group's[12] DIG35 metadata element set. Although TIFF Rev 6.0, TIFF/EP, and EXIF are file format specifications, these particular formats were chosen for two specific reasons. First, the associated data elements and values (presented as fields with associated file header tags) represent a comprehensive list of metadata used to render and manage image data.[13] Second, cultural heritage institutions had long before selected TIFF as the default digital master (master image) file format.[14] Few unique metadata elements offered by DIG35 were included within the NISO draft dictionary because the DIG35 elements appeared closely tied to consumer photographer needs rather than those of cultural heritage institutions with commitments to long-term image persistence and access. What was embraced from the DIG35 draft specification was its set of overarching design goals – interchangeability, extensibility, scalability, and consistency. Consequently, these same goals underpin the NISO draft standard.

In June 2002, NISO Z39.87-2002 (AIIM 20-2002) was released as a Draft Standard for Trial Use to allow eighteen months of use and comment by the cultural heritage community. To support one implementation of the data dictionary, the Library of Congress created a schema for the data elements within the standard -- *Metadata for Images in XML (MIX)*, enabling its use within the XML environment. Many cultural heritage institutions have begun to implement NISO Z39.87 and/or MIX and the resulting comments are informing the NISO technical committee of changes required for Z39.87 at the end of the trial use period. One important change to be made is the inclusion of JPEG 2000 with MimeType, Compression and other related elements. Other considerations will be given to implementation options and allowing easier XML options for some data elements.

Where we are now: A look at the state of the state

In order to accurately discover the "state of the state," we actually have to look at the state of the communities involved: the manufacturer community and the cultural heritage community. What metadata is being recorded by devices on the market today? Are cultural heritage institutions able to harvest this information? And if so, how is this being accomplished? The answers to those questions provide us with a state of the state, which in turn will allow us to move forward with solutions to the problems enumerated earlier.

---

[12] The Digital Imaging Group (DIG) merged with the Photographic and Imaging Manufacturers Association (PIMA) to form the International Imaging Industry Association (I3A) in July 2001.
[13] See mapping document in Appendix 2 for more information.
[14] The JPEG (JFIF) file format is not accepted as an archival format by the cultural heritage community though it is widely used as the file format of choice for access versions of the digital images.

What technical metadata is recorded by capture devices?
Most of the information available about metadata recording is related to digital cameras and comes from product reviews or recent surveys conducted by Kodak.[15] From these observations and reviews, it is clear that the full range of metadata from any of the related standards is underutilized. At best, most cameras – consumer and professional levels – capture some core TIFF elements, very few of the available EXIF "camera capture" elements, and a few additional elements categorized as "GPS tags" and "Thumbnail tags." Surprisingly, the cameras labeled as "consumer cameras" were more likely to record more information than the "professional cameras" offered by the same company.

At this point, compliance with DIG35 is also difficult to rely upon. After a thorough search for documentation, it became clear that adoption of DIG35 as a data element set is not widespread among device manufacturers. JPEG 2000-compliant cameras have also been slow to emerge. Should companies move to embrace JPEG 2000, the required technical metadata would be available for harvesting via the DIG35 metadata schema that is a component of JPEG 2000 files. In the interim, a few companies have created supporting software to expose, exploit, and transfer the metadata found within image files (Kodak's Picture Metadata Toolkit, Canto's DIG35 Asset Store for the Canto Cumulus, and Adobe's XMP are a few examples), though the usefulness of these programs is hampered by the generally inadequate amount of metadata that most cameras and scanners currently capture.

Harvesting the technical metadata
According to the results of the *Automatic Exposure* survey, the practices of cultural heritage institutions are far from uniform when it comes to exposing and obtaining technical metadata from image files. Some institutions are extracting the metadata from image file headers through a fairly manual process. Still others utilize a variety of available software packages to extract some file header information in combination with the manual logging of other information. Finally, some institutions have developed fairly sophisticated methods and mechanisms to harvest the technical metadata currently recorded during the capture process.

Though these are positive responses to a difficult problem, access to more sophisticated solutions is not uniformly available. Not all institutions will have the infrastructure in place to allow for local development of such mechanisms or even the modification of another institution's "solution." As well, these varied approaches lack uniformity in the kinds of data being harvested, since each protocol is likely to be built for a specific institution or instance. What is needed is a suite of tools that can be made available and applicable to all types of institutions, affording *all* cultural heritage institutions the ability to preserve their digital images.

In the interim, several promising harvesting tools have been developed by cultural heritage institutions. The following tools were discovered during the *Automatic Exposure*

[15] See Appendix 3: Kodak's *Professional Camera Metadata Survey* (2002), Appendix 4: Kodak's *2002 Consumer Digital Camera Metadata Survey*, and Appendix 5: Kodak's *2003 Consumer Digital Camera Metadata Survey*.

survey and survey follow-up. They may be able to play a role in whatever solutions emerge=.

a. **JHOVE: The JSTOR-Harvard Object Validation Environment**
http://hul.harvard.edu/jhove/jhove.html
JSTOR[16] and the Harvard University Library are collaborating on a project to develop an extensible framework for format validation: JHOVE (pronounced "jove"), the JSTOR/Harvard Object Validation Environment.

JHOVE provides functions to identify, validate, and characterize digital objects. JHOVE has three main operational modes:

- Format *identification* is the process of determining the format to which a digital object conforms; in other words, it answers the question: "I have a digital object; what format is it?"
- Format *validation* is the process of determining the level of compliance of a digital object to the specification for its purported format, e.g.: "I have an object purportedly of format *F*; is it?"
- Format *characterization* is the process of retrieving the significant properties of an object of format X.

The third mode (characterization) is relevant to the *Automatic Exposure* initiative. Essentially, this is the process of extracting pertinent technical characteristics from the digital object itself. In the case of raster image formats —TIFF in particular — a significant subset of the NISO Z39.87 metadata may be made available in this manner.

In its initial implementation, the project is creating two plug-in modules for JHOVE, one each for PDF and TIFF. The TIFF module will recognize the various public profiles of TIFF: version 3.0 through 6.0; Baseline 6.0 bi-level, grayscale, palette, RGB, and CMYK; TIFF/IT, TIFF/EP, EXIF, GeoTiff, etc. Options for output include a simple text display (label: value), a "standard" XML schema applicable to all formats, using an RDF-like syntax to display complex nested property structures; and for still image formats, MIX-compliant XML. (This latter is not yet implemented.) In short, if cameras and/or scanning devices can properly embed preservation metadata within the TIFF file, JHOVE can automatically extract it.

b. National Library of New Zealand
The National Library of New Zealand has developed a Metadata Extract tool. Currently, it consists of 5 adapters (individual file types) and has been built in both GUI and command-line versions. The tool extracts data from within the header and surrounding directory structure as necessary, then maps that data into the Library's preservation metadata data model format ready for ingest into the

[16] JSTOR is a non-profit organization providing access to an archive of important scholarly journal literature. For more information on JSTOR, please see http://www.jstor.org/

Library's metadata repository (as yet unbuilt). It is envisaged that this repository will in time be a component of the Library's core business systems.

There is also interest in making this open-source tool available to the greater community.

c. **National Library of Australia**
The National Library of Australia has developed software to manage the process of digitization and storage of images, which has automated as much as possible of the capture of metadata. This followed a tendering process which showed there was no software which would meet their needs. They have also developed delivery systems for each format. All delivery systems are standards-based and generic.

d. **BSCAN**
Developed by Image Access Incorporated, BSCAN is a commercial software tool which "automates and streamlines custom capture workflow solutions." According to the web site (http://imageaccess.com/html/b5.htm), BSCAN "provides a complete set of even the most advanced capture functionality, including full-function scanner control, automated forms processing, image clean-up, barcode, handwriting and text recognition, rapid key-entry, unlimited scalability, remote capture, portable scanning, and more."
Our survey indicates that this software is used by Stanford and the University of Southampton.

Where we would like to go: A review of options for metadata capture and transfer

As a first phase of *Automatic Exposure*, RLG circulated a short informal survey to identify stakeholders in the cultural heritage community and equipment used. We also solicited feedback about current procedures for technical metadata capture and hopes for the future. Despite limited circulation of this survey, we received well over 100 responses, confirming our belief that technical metadata capture is a key issue in the cultural heritage community at the present time.

In our survey, we asked whether it would be more suitable to write technical metadata internal to the digital image file or external as a separate structured text file. The responses remained fairly evenly divided. Some argued that keeping the image and the metadata together prevents the separation of the two and makes the entire package more portable, while others countered that in the end, the management of the metadata in a preservation system remains the key objective, and only technical metadata external to the digital image guarantees easy ingest. A number of respondents also expressed concern that metadata internal to the image would eventually be much harder to migrate to emerging file formats. If you have to save an image from the eclipsing file format A to the emerging file format B as a preservation strategy, what are our assurances that this process will also successfully migrate the metadata contained within the file in format A into the file in format B? This concern strengthened the belief that in the end, the only appropriate place for technical metadata to be managed in the long run is external to the file in a database designed for digital preservation. In keeping with the evenly divided response among those who chose one approach over the other (28% of those surveyed favored metadata internal to the image file; 25% favored metadata external to the image file), a large number of those surveyed wanted to see both mechanisms implemented (28%).[17]

In conclusion, it seems that writing technical metadata directly to the image file itself seemed compelling because it identified a suitable carrier for the information (the file) for the time before ingest of the metadata into preservation systems. Respondents who have access to a harvesting tools such as described above also had less reason to insist on external metadata, since they were confident that they could extract the metadata themselves. Getting the metadata out of the file, or having an external metadata file ready at hand, seemed a more pressing issue to those institutions that already have preservation repositories to host and manage the data, but no appropriate harvesting mechanism.

This survey result gives *Automatic Exposure* the mandate to identify a mechanism which both puts the metadata into the image file itself and makes provisions for its import into a database system, be it through broadly available metadata harvesting mechanisms or simultaneous export to an external structured text file.

In order to achieve this goal *Automatic Exposure* is working to:

- To engage manufacturers of high-end scanners and digital cameras in a dialog about what technical metadata their products currently capture, and what technical metadata is required for digital archiving.
- To examine how existing industry efforts can be leveraged to satisfy the data set proposed by NISO Z39.87: Technical Metadata for Digital Still Images
- To identify and evaluate the existing or emerging tools for harvesting technical metadata developed at individual institutions or by vendors, and explore how those tools can scale to serve the entire community.

In the dialog with manufacturers, the project aims to find common interests in recording metadata and making it available for further processing such as ingest into preservation systems. While the cultural heritage community has defined a standard metadata element set for digital preservation in Z39.87, the industry has launched a number of initiatives which promise to deliver self-describing digital files, or files which carry within their code vital information about their origination, content, access rights, etc. In some instances, these initiatives propose metadata element sets which include tags relevant to digital preservation (such as DIG35[18] or EXIF[19]); in other instances, they propose specific or generic transfer mechanisms for self-describing metadata (such as the XML box in JPEG 2000's JP2 file format or Adobe's Extensible Metadata Platform). The industry at large and the manufacturers of digital capture devices have already made an

[17] The rest (19%) did not answer this particular question on the survey.
[18] For more information on DIG35, please see http://www.i3a.org/i_dig35.html
[19] For more information on EXIF, please see http://www.exif.org/

investment by developing and implementing some of these technologies. While preliminary review of the industry initiatives reveals that none of the specifications delivers the complete metadata set crucial for digital preservation as outlined in NISO Z39.87, all of them cover at least parts of the NISO dataset.[20] We hope that this convergence presents us with the opportunity to expand on existing initiatives to supply a complete NISO Z39.87 technical metadata set.

A key component of the discussions consists in identifying what format the metadata gets captured in, and how it gets packaged for transfer. Among the options for more complete technical metadata capture: manufacturers could package technical metadata as NISO Z39.87 in MIX XML. The XML instances could be transported as a text file external to the actual digital image, or using mechanisms such as the XML box provided in the emerging JPEG 2000[21] file format. For other file formats, options such as Adobe's open source Extensible Metadata Platform (XMP)[22] could transport the data elements stipulated in NISO Z39.87. Apart from strategies powered by XML, file header tags traditionally have carried at least some of the metadata pertinent to preservation. EXIF 2.2 expands on TIFF and JPEG's capacity to include metadata, although its tag set falls short of the NISO Z39.87 element set.[23]

In summary: *Automatic Exposure*'s preference in terms of encoding technical metadata is NISO MIX XML, external and/or internal to the digital file described by the metadata. Our main criteria for evaluating existing industry initiatives specifying an element set is whether they cover the elements proposed by NISO Z39.87 comprehensively. The NISO Z39.87 elements should be automatically captured during file creation whenever possible; for elements outside of the realm of automatic capture, software needs to allow manual data entry or, even better, the application of capture profiles for batch-application of metadata. Our main criteria for evaluating specific transfer mechanisms for technical metadata are ease of access to the metadata, and broad availability and support for the mechanism itself. Our last resort is to employ manipulation tools such as metadata harvesters (in case the metadata is otherwise inaccessible or sits in header tags) or Extensible Stylesheet Language Transformations (XSLT) in order to transform the offered dataset into NISO Z39.87 elements / MIX XML. Obviously, even this last strategy only succeeds if the data present maps conclusively to NISO Z39.87.

---

[20] For a mapping between NISO Z39.87 and industry element sets, please see Appendix 2.
[21] For more information on JPEG 2000, please see http://www.jpeg.org/index.html
[22] For more information on Adobe XMP, please see http://www.adobe.com/products/xmp/main.html
[23] Please consult Appendix 2.

Appendix 1:

Industry initiatives for self-describing objects and metadata transfer

The following list presents technical specifications and standards pertinent to the questions posed by *Automatic Exposure*. This list has been compiled with the help of our survey. The information on the individual specifications in some instances comes directly from the websites of the organizations responsible for their upkeep, and will have to be verified on a case-by-case basis. In most cases, there is a descriptive paragraph on each specification, followed by a tentative discussion, to be reviewed and revised during the process of *Automatic Exposure*. The specifications each hold a potential piece to the puzzle of how to translate existing and emerging technologies, file formats, and standards to accommodate the cultural heritage community's specifications for technical metadata.

Specifications pertinent to metadata element sets

a. **NISO Metadata for Images in XML Standard (MIX)**
<http://www.loc.gov/standards/mix/>
NISO Z39.87 Technical Metadata for Digital Still Images consists of a data dictionary outlining the elements deemed crucial for the preservation of digital image files. The Library of Congress created a NISO-authorized XML Schema for encoding technical metadata as specified by the data dictionary. Many institutions have adopted MIX as an extension schema to Metadata Encoding and Transmission Schema (METS). METS wraps digital surrogates with descriptive and administrative metadata (including technical metadata) into one XML document. [Please note: as an XML Schema of the NISO draft standard, this schema will be updated once the draft standard has been revised and balloted.]
Discussion:
NISO Z39.87 is the target element set of Auto Exposure, and its encoding in MIX is the preferred transfer format, either internal or external to the digital file. In a JPEG 2000 implementation, MIX-encoded technical metadata could be stored in the XML box defined in the JP2 file format. If Adobe XMP emerges as a viable transport mechanism for metadata, it could associate NISO Z39.87 (in an RDF implementation) with any file format.

b. **EXIF 2.2** <http://www.exif.org/Exif2-2.PDF>
A specification published by the JEITA (Japan Electronics and Information Technology Industries Association) Technical Standardization Committee, and presently supported by most consumer cameras. EXIF as a file recording format encodes either TIFF or JPEG files; it also defines a metadata elements set, which it captures as additional tags (TIFF) or markers (JPEG).
Discussion:
The EXIF format relies on vendor-supplied mechanisms for viewing and extracting metadata stored in file headers. The *Automatic Exposure* initiative will assess the

viability of this specification by analyzing a mapping from EXIF to NISO Z39.87. If the mapping is satisfactory, the availability of applications for harvesting and/or reformatting the metadata determines EXIF's utility. Prioritized from most to least desirable, the cultural heritage community would need applications which…

- generate NISO MIX from EXIF
- generate only the NISO Z39.87 compliant subset of data (not formatted as MIX)
- generate a superset of data in XML, including all of the required elements specified in the NISO Z39.87 Data Dictionary.

c. **DIG35** <http://www.i3a.org/downloads_dig35.html>
A technical specification published by i3A (International Imaging Industry Association), consisting of an element set and an XML reference implementation aimed at consumer and prosumer cameras. DIG35 is file-format independent, while its most prominent implementation to date is in JPEG 2000 (Part 2) as an extension to the emerging file format. Canto's Digital Asset Management software as well as Eastman Kodak's Metadata Picture Toolkit supports read and write access to DIG35's metadata tags.
Discussion:
The *Automatic Exposure* initiative will assess the viability of this specification by analyzing a mapping from DIG35 to NISO Z39.87. If the mapping is satisfactory, the availability of applications for harvesting and/or reformatting the metadata determines DIG35's utility. Prioritized from most to least desirable, the cultural heritage community would need applications which…

- generate NISO MIX from DIG35
- generate only the NISO Z39.87 compliant subset of data (not formatted as MIX)
- generate a superset of data in XML (in case the DIG35 implementation is not in XML), including all of the required elements specified in the NISO Z39.87 Data Dictionary.

Specifications pertinent to metadata exposure, transfer and manipulation

a. **JPEG 2000** <http://www.jpeg.org/JPEG2000.html>
A file format specification published by the Joint Photographic Experts (JPEG) Group, and an ISO standard since 2001. JPEG 2000 (Part 2; JPX) handles technical metadata as DIG35. JPEG 2000 (Part 1; JP2) includes sophisticated metadata features, such as a potentially unlimited number of extensions in the form of XML boxes.
Discussion:
The *Automatic Exposure* initiative will assess the viability of using the JP2 and JPX formats to capture and exchange metadata for archiving according to the availability of applications that can (prioritized from most to least desirable):

- generate JP2 files with embedded NISO MIX metadata
- parse JPX files to "extract" NISO MIX from the technical metadata embedded as DIG35

b. **Adobe Extensible Metadata Platform (XMP)**
<http://www.adobe.com/products/xmp/main.html>

Adobe XMP is a technology which allows capturing, processing and exchanging metadata by harvesting existing information from fileheaders, and embedding it into the digital file in an XMP packet. The packets consist of XML data governed by Resource Description Framework (RDF)[24] syntax. Adobe hopes that this open source technology will become an industry-wide standard for sharing metadata across applications, file formats and devices. It has been implemented across most of the Adobe product line, including Adobe Photoshop. According to an Adobe press release, XMP has the support of Artesia Technologies, Documentum, Getty Images, IBM, Interwoven, Kodak, KPMG Consulting, Inc., MediaBin, Inc., North Plains Systems, WebWare and Xerox Corporation, and the endorsement of W3C's Eric Miller.

Discussion:

Depending on whether this technology will become a de facto industry standard or just a mechanism supported by a select number of companies, XMP provides an interesting answer to the metadata transfer questions posed by *Automatic Exposure*. XMP makes existing technical metadata accessible, and allows augmentation of the data with values which have not been automatically captured.

c. Eastman Kodak Picture Metadata Toolkit 1.3.2

<http://picturemetadata.sourceforge.net/>

The Eastman Kodak Picture Metadata Toolkit consists of open-source C++ code for accessing and manipulating metadata associated with digital images in a variety of formats. The Toolkit builds on a number of existing open source projects, including OpenTIFF, a toolkit for accessing TIFF image files, and OpenEXIF, a toolkit for accessing EXIF image files. Currently the Picture Metadata Toolkit supports DIG35, EXIF 2.2 and TIFF.

---

[24] For more information on RDF, please see http://www.w3.org/RDF/

Appendix 2: Mapping Z39.87 to DIG35, TIFF 6.0 and EXIF 2.2

Issued as a separate spreadsheet file. DRAFT
Automatic_Exposure_Appendix_2-Mapping.xls

Appendix 3: Kodak's Professional Camera Metadata Survey (2002)

Issued as a separate pdf file. Reprinted with permission from Eastman Kodak Company.
Automatic_Exposure_Appendix_3-Kodak_Survey.pdf

Appendix 4: Kodak's 2002 Consumer Digital Camera Metadata Survey

Issued as a separate pdf file. Reprinted with permission from Eastman Kodak Company.
Automatic_Exposure_Appendix_4-Kodak_Survey.pdf

Appendix 5: Kodak's 2003 Consumer Digital Camera Metadata Survey

Issued as a separate pdf file. Reprinted with permission from Eastman Kodak Company.
Automatic_Exposure_Appendix_5-Kodak_Survey.pdf