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TIFF-PDF/A White Paper

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Project Narrative

For the past several years, information has circulated about Portable Document Format/Archival (PDF/A) as a document format. In the late 1990s when recording jurisdictions began the process of digitizing documents from paper and microfilm, the most accepted standard document storage format was the Tagged Image File Format (TIFF). Land Records Management Systems (LRMS) software for recorders incorporated the receipt and storage of TIFF images to meet the growing demand of their clients. Simultaneously, title plants across the country began digitizing their records, and/or purchasing digitized images from recorders. Software vendors also incorporated TIFF images to accommodate title plant users. Access to images contained in LRMS and title software are important to all stakeholders in the property records industry. Specifically, the stakeholders are identified as:

1. Submitters (title companies, lenders, attorneys, the public)
2. Custodians (recorders)
3. Downstream Users (title plants, public records aggregators, the public)

Billions of TIFF land record images are being stored and used across the United States. While land records continued with TIFF images, the federal court system transitioned to Portable Document Format (PDF) images and later adopted PDF/A images as its desired document format. State court systems are following the federal model. As with any changes to technology patterns, transitions are challenging. It is time for PRIA to focus on document image formats and to gather reliable background information about the benefits and possible pitfalls of continued reliance on TIFF images, as well as PDF/A images.

History

Under any circumstances, preserving real property records in perpetuity is a challenging responsibility. As record collections get larger and more diverse, the ability to track and assess their content and condition becomes more complex and difficult. It is necessary to recognize that, although past practices did not produce flawless results, zero loss has always been the objective for records storage and migration and continues to be the goal. Anything less leads to the possibility of defining acceptable loss.

Paper and microfilm copies have been used successfully considering their creation process and storage conditions. One of the primary reasons for this success is the analog nature of the information and the storage media. Legibility and information from paper and microfilm is relatively easy to determine because it can be accessed using simple technology tools.

These visual cues make human readable media inherently easier to analyze and preserve than its digital counterpart. As electronic storage media displaces traditional analog media, the imperative will be to determine the tools needed to evaluate the health of the digital and digitized data the media holds. In the process of developing these tools and cues, the standard of data legibility and document existence should not fall below historical expectations.

During the 1980s and 1990s, the document transfer technology used in most offices was sending and receiving facsimiles (faxes). Fax machines reproduced a simple “bit map” version of the source document, a “picture” image with no intelligence, which came to be known as a raster image. A raster image is an electronic photograph created by reflected light from a page as it passes by a camera in a paper or microfilm scanner.¹ The format that was universally accepted for creating this raster image was the TIFF.

Some of the early adopters and users of TIFF images began with about 100 dots per inch (dpi) scans, which satisfied the use at that time.

¹ See PRIA Glossary

TIFF

TIFF was created by the Aldus Corporation in 1986 for use in desktop publishing. In 1992, the final version 6.0 was published. Adobe Systems acquired Aldus in 1994 and presently owns all rights to TIFF technology. Heavy usage of fax transmissions resulted in TIFF being widely available and accepted. To date, read-write licensing has not been required.

Fax machines evolved into modern scanning machines in the 1990s. When recorders and title plant operators wanted to incorporate document images into their data storage and retrieval systems, they adopted TIFF as it was familiar and became the *de facto* storage format.² TIFF was adopted by multiple large organizations and government agencies at all levels.

A key attribute of TIFF is its use of a lossless fax compression algorithm originally known as CCITT Group 4³. This compression algorithm was generally adopted by the stakeholders as the preferred method of reducing file size without compromising image quality. CCITT Group 4 is also referred to as ITU Group 4.

Recorders began scanning their daily recordings using TIFF so that more people could readily access images. Once paper documents were scanned, these digitized images could be viewed on multiple computers simultaneously and printed on demand. The competition among in-office title searchers to view “the single roll” of microfilm disappeared. The microfilm reading and printing equipment, along with maintenance costs, could be downsized or eliminated.

In the late 1990s, it became evident that the quality of scanned images needed to be improved. The accepted scan density moved rapidly to the PRIA recommended standard of 300 dpi⁴.

Many recorders then started a process of converting their existing rolls of microfilm to digitized images, based on rising demand from customers and, in some states, legislated mandates. In the early 2000s, recorders started providing internet access to digitized images for the convenience of their constituents, the downstream users. Title workers could “work from their office” as opposed to “living at the recorder’s office.”

TIFF became the accepted format for image storage. It was simple, stable, and dependable. Over time many of these systems offered the option of converting TIFF images to PDF on the fly for ease of viewing, printing, and downloading from web pages.

² Other formats such as GIF & PNG had been developed around the same time, but TIFF was common in fax use.

³ The **CCITT**, now known as the ITU-T (for Telecommunication Standardization Sector of the International Telecommunications Union), is the primary international body for fostering cooperative standards for telecommunications equipment and systems.

⁴ PRIA Recording Electronic Images on Roll Microfilm - A Best Practices White Paper, adopted 7/24/2007, p. 1

Advantages of TIFF

- Simplicity - TIFF images can be easily reverse engineered or reproduced.
- Stability - TIFF has remained stable for more than 20 years.
- Sustainability - TIFF images using ITU Group 4 compression are a lossless, space efficient format. For example, an 8-page document takes approximately 400KB of storage space.

Disadvantages of TIFF

- Desktop Publishing – TIFF did not meet required needs.
- No internal intelligence – A raster image (just a picture at a point in time) reflects the original image quality; storing OCR (Optical Character Recognition) data is inconsistent with the rules and capabilities of TIFF.
- Accessibility issues – TIFF does not comply with current Americans with Disabilities Act (ADA) requirements.
- Quality issues – Resolution, scanner functionality, and source document quality may be issues.
- Proprietary format – Rights to TIFF could be sold by Adobe and the new owner could request payment each time a TIFF image is created.

PDF

PDF was created in the early 1990s to deliver documents in a way that could be shared across operating systems (OS) and devices using any free document display software. Documents could be represented as images with associated text and formatting embedded in the file. Users could transfer the documents between multiple devices and OS; hence the portable document format. Although PDF was developed by Adobe Systems as a proprietary format, the company released PDF as an open standard on July 1, 2008, and transferred rights to the International Organization for Standardization (ISO). Thus, ISO owns all rights associated with PDF and controls standards associated with the various PDF file formats.

PDF's acceptance has grown since the mid-1990s. Users can easily view, retain and search documents based on the more sophisticated PDF technology. There are three core technologies that have been integrated to promote PDF's general usability: 1) use of the PostScript page description programming language as the basis for image graphics and layout; 2) embedding font definitions in the file; and 3) data compression of the bundled elements into a single file format.⁵

Advantages of PDF

- Uniformity – The appearance of the document is rendered consistently across multiple OS and devices.
- Acceptance – Most vendors integrated the PDF format into software to create, retain and view documents, based on user demand.
- Vision – ISO has indicated a long-term interest in the standard for PDF.
- Intelligence – The PDF format embeds the textual content along with associated fonts and metadata to provide additional document functionality.
- ADA Compliance – This format provides better visual access to employees and software system users.
- Validation – PDF achieves document auditing by verifying that content and formatting are present and tracked.

Disadvantages of PDF

- Hackability – In the 2000s, hackers embedded malicious code into PDFs, which slowed acceptance.
- Development/evolution – Under ISO guidance, the standards for PDF may continue to evolve.
- Storage space – A PDF file is usually larger than the TIFF equivalent and, therefore, may require more storage space.

⁵ Wikipedia, "Portable Document Format"

PDF/A (Archival)

As document standards have evolved during this period of rapidly changing technology, the issue of long-term format preservation has become an area of focus. To address this need, ISO established “a document format based on PDF, known as PDF/A, which provides a mechanism for representing electronic documents in a manner which preserves their visual appearance over time, independent of the tools and systems used for creating, storing or rendering the files.” (ISO 19005-1, quoted from the introduction). The ISO committee refers to this as PDF/A (archival)⁶. The value of PDF/A lies in the fact that this format promotes consistency in the reproduction of document images, longevity of document reproduction, and support for the retention of document intelligence throughout the lifecycle of the document.

The first version of the PDF/A technical standard, PDF/A-1, was established in 2005. Since then, two additional versions have been published: PDF/A-2 (since 2011) and PDF/A-3 (since 2012)⁷. This paper focuses on the PDF/A-1 and PDF/A-2 versions as being most applicable to the U.S. property records industry. “The PDF/A standards family regulates how to create electronic documents to ensure they can be reliably reproduced for decades to come. The standard does not describe how to build a revision-safe archive, nor the theory behind one.”⁸

Advantages of PDF/A

- Completeness – A PDF/A file contains everything needed to display it and nothing which could negatively impact the display. PDF/A documents are self-contained.
- Device independence – PDF/A files can be used on any OS platform.
- Display – Free programs exist for displaying PDF/A files.
- Flexibility – The multi-part PDF/A technical standard offers great flexibility to users⁹.

Disadvantages of PDF/A

- Learning curve – Training is needed for preparers on how to create and send PDF/A-compliant documents.

⁶ In this context, archival refers to the ability to preserve the document format and appearance over the long term as opposed to the definition of archival from an archivist’s standpoint. “Archivists keep records that have enduring value as reliable memories of the past, and they help people find and understand the information they need in those records” (Richard Pearce-Moses). Archival records are frequently unique and there is concern with the preservation of custody of the information carrier (physical document) as with its informational content. Archival storage key requirements include long-term data integrity, resistance to environmental contaminations, very low media costs, and low shelf-space costs.

⁷ Oettler, Alexandra, “PDF/A in a Nutshell 2.0,” PDF Association, 2013, p. 8

⁸ Oettler, Alexandra, “PDF/A in a Nutshell 2.0,” PDF Association, 2013, p. 5

⁹ Oettler, Alexandra, “PDF/A in a Nutshell 2.0,” PDF Association, 2013, p. 5

- Multi-format challenges – Potential software technology changes will be needed for LRMS and title plant systems to incorporate PDF/A-compliant documents into the electronic Official Record repository.
- Continuing development – PDF/A is an evolving technology, which will require evaluation of current and future standards at the time of adoption.

PDF/A Versions

The federal court system adopted a PDF requirement in 1995 for the submission and retention of federal court filings through the PACER¹⁰ service. It recognized the importance of moving to PDF/A to ensure long-term archiving. The State of Florida adopted PDF/A for its statewide court record repository. PDF/A is becoming more widely adopted across industries because it builds off the benefits of using the PDF format.

As “born digital” (created by a text editor) documents become more prevalent, the advantages of PDF/A multiply. PDF/A documents retain original intelligence and are searchable. Many other features are retained throughout the history of the document such as links, annotations, and digital signatures. PDF/A yields the exact visual display (image) of the document. There are no errors in content, such as those created by a poorly scanned document. The ability to search the content of the document (also known as searchability) is reliable; content generated for a scanned document using OCR may include inaccuracies.

By design, the contents of a PDF/A document are locked as “read only.” The document identity can also be locked and verified using technology that would invalidate the document if the slightest change is made. Design tools, such as the Adobe Software Development Kit (SDK) toolset, are available to allow, track, and validate changes to a document during an authorized document workflow process. PDF/A will minimize unauthorized changes to a document. All of these capabilities optimize the integrity of the document throughout its life.

¹⁰ PACER = Public Access to Court Electronic Records, the federal court online access service providing court records and documents nationwide for U.S. Appellate, District and Bankruptcy cases.

PDF/A Comparison Chart

	PDF/A-1	PDF/A-2	PDF/A-3
ISO Standard	ISO 19005-1:2005	ISO 19005-2:2011	ISO 19005-3:2012
Conformance Levels	<p><u>PDF/A-1a</u> - Level A - Accessible Conformance</p> <p><u>PDF/A-1b</u> - Level B - Basic Conformance</p>	<p><u>PDF/A-2a</u> - Level A - Accessible Conformance</p> <p><u>PDF/A-2b</u> - Level B - Basic Conformance</p> <p><u>PDF/A-2u</u> - All Level B conformance, in addition to requirement that all text have Unicode mapping.</p>	<p><u>PDF/A-3a</u> - Level A - Accessible Conformance</p> <p><u>PDF/A-3b</u> - Level B - Basic Conformance</p> <p><u>PDF/A-3u</u> - All Level B conformance, in addition to requirement that all text have Unicode mapping.</p>
PDF Based Version	1.4	1.7	1.7
Publish Date	October 1, 2005	July 1, 2011	October 15, 2012
Allows JPEG2000 Image Compression ¹¹	No	Yes	Yes
Transparent objects and layers allowed (Optional Content Groups)	No	Yes	Yes
Provisions for digital signatures (PAdES ¹²)	No	Yes	Yes
Embedded files allowed	No	Yes - PDF/A Only	Yes - Any File Format (XML, CSV, etc...)
Embedding of OpenType fonts	No	Yes	Yes

Level A (Accessible) includes all requirements for the standard, including the logical structure of the document and its correct reading order. Text must be extractable. Fonts used must meet stringent requirements. This level generally is only met by converting born-digital documents. This level generally provides support for physically impaired individuals; for example, with screen readers, the text can be read to you, including graphs, photos and text boxes.

Level B (Basic) guarantees that the content of the document can be unambiguously reproduced. Level B files are easier to create than Level A, but Level B does not guarantee 100% text extraction or searchability. Scanned paper documents can usually be converted to PDF/A Conformance Level B without any extra work.

¹¹ JPEG 2000 Image Compression – See PRIA Glossary

¹² PDF Advanced Electronic Signatures

Level U (Unicode) was introduced along with PDF/A-2. It expands the Conformance Level B to specify that all text can be mapped to standard Unicode character codes.

As of the March 15, 2017, PDF/A-2a is the conformance level best suited to property records. This format means that documents that are born digital are maintained without being flattened (converted into an image format such as TIFF). This document format retains original and added intelligence (time stamp, electronic notarization, electronic signature, and annotations,) throughout the life of the document. To achieve this, the proper toolsets to maintain this document intelligence must be used by any software that is part of the document workflow process.

PDF/UA (Universal Access)

There is an increased emphasis on making documents accessible to users with visual disabilities. In the PDF realm, this focus is defined as Universal Access (UA). PDF/UA refers to documents that conform to universal access requirements defined in the ISO 14289-1¹³ standard.

PDF/UA is not a file format. It is a standard that defines the test for a document's compliance to universal accessibility. It is up to the document preparer to create documents consistent with the UA standard. For those with visual disabilities, the UA standard allows document reader software to navigate PDF documents easily. The document's structure and internal tags, for items such as pictures and tables, are created consistent with the standard.

Any organization that adopts the PDF/A document format and that promotes compliance with general human rights of people with disabilities, such as the ADA, can use the PDF/UA standard to confirm that documents meet the test of universal access or to determine what is lacking.

¹³ First published in July 2012, this standard is titled "ISO 14289-1. Document management applications – Electronic document file format enhancement for accessibility – Part 1: Use of ISO 32000-1 (PDF/UA-1)."

Security and Reliability

Security

With the increasing risk of technology exploits and sophisticated attacks against businesses, government offices, and individuals, it is important to evaluate the potential security risks that could be introduced by adopting the PDF/A format as a recording standard. There are inherent risks that apply to the industry regardless of whether PDF/A is adopted or not. For example, the fact that a document could be transmitted in “plain text” to a web service with potential sensitive information exists whether TIFF or PDF/A is used. This paper focuses only on the new risks that could be introduced by the adoption of PDF/A.

Potential new security risks introduced by PDF/A adoption:

- 1) One well-known security concern of PDF in general is the potential malicious execution of JavaScript code embedded in the PDF. This concern does not apply to PDF/A since a conforming document does not allow embedded JavaScript (<http://www.pdfa.org/2011/08/pdfa-%E2%80%93-a-look-at-the-technical-side/>).
- 2) Another potential risk that does not exist in a TIFF adoption is the potential malicious usage of an active hyperlink (URL) placed in the PDF/A document. Since most PDF viewers allow users to follow or navigate to a link, this introduces a potential security concern.

Overall the usage of PDF as a document type is largely considered to be safe, and, because of the large number of users, any security flaw will likely be quickly suppressed. Since PDF/A has restrictions on certain functionality (JavaScript code) that PDFs do not have, PDF/A can be considered a safer document format.

In summary, there do not appear to be any security concerns that would prevent PDF/A adoption.

Reliability

The PDF/A format is designed to meet the long-term electronic preservation requirements of government, enterprise, and academia. While electronic preservation of information is dependent upon external factors such as storage format, backups, and file-integrity, PDF/A fulfils the reliability requirement in some very specific ways, including:

- 1) Device independence – A PDF/A compliant file is not exclusive to any OS and is built on an open international standard (ISO 19005).
- 2) Self-containment – Components required to render a PDF/A, such as fonts, must be included in the file itself, thus eliminating a dependency on external systems to view a PDF/A document.
- 3) Self-documentation – Metadata about the document is self-contained and can be used for searching and describing the document.
- 4) Limited external dependencies – External dependencies (specific JavaScript, audio-video, attachments, or external links) are not allowed in a PDF/A compliant document. Users are able to view a document that has been archived for many years without concern.

In summary, PDF/A-compliant documents are a very reliable format for long-term electronic document preservation.

Practical Solutions and Costs for Migrating to PDF/A

Introduction

Migrating from TIFF to PDF/A may impact stakeholders from all areas of the property records industry.

The key decision the industry must make is to determine the degree to which it wishes to leverage the enhanced functionalities that can be derived from a document created or “born” in the PDF/A format (Path One) versus simply adopting PDF/A as the archive and storage format (Path Two). Based upon this decision, two primary migration paths exist with differing impacts to each of the stakeholder categories.

Path One: embrace and leverage all advantages offered with the PDF/A format. Data associated with the documents could be used for a variety of purposes such as auto-indexing and enhanced searching. This path will potentially impact all stakeholders and likely entail major software upgrades, workflow revisions, integration upgrades, training, and possibly conversion services. Migration to this path would be a mid- to high-level implementation project for most stakeholders.

Path Two: establish PDF/A as an archive format only. Essentially, a system that accepts non-PDF/A images, then converts and stores in the PDF/A format. Full text searching is possible if OCR is implemented. This migration path minimizes impacts to the submitter, but there may be some software system modifications to consider by custodians and downstream users. The final consideration using this path would be to decide on the value of converting historical image repositories. This conversion would be a small-to mid-level implementation project.

Considerations

Stakeholders should make a business analysis/assessment of existing records, data, workflow (internal and third party), technical infrastructure, project management needs, and customer impact.

- **Conversion**

- What is the value of converting historical documents versus conversion costs? If the answer is “I would really like all my documents in the same format,” then the answer involves determining how to go about converting the historical documents. The cost, the value, and the time involved in converting all documents have to be evaluated. An alternate strategy establishes a “go forward” policy. After successful deployment of PDF/A capable software, all documents on a go-forward basis are processed and stored as PDF/A. This strategy requires no conversion of historical records. The caveat is that the software systems must support multiple document formats for processing and viewing purposes.
- A hybrid approach would be to adapt the “go forward” policy and convert historical images “on the fly,” as requested for viewing and use. Again, the caveat is that the software systems must support multiple document formats for processing and viewing purposes and have the ability to

convert and store historical images “on the fly.” There may also be a slight performance impact when historical documents are pulled and converted.

- **Software**

- Software should conform to PDF/A capability in terms of accepting, viewing, processing, converting, and storing. The stakeholder will need to determine if the existing software system will meet requirements, or if migration to new software will be needed.
- Recommendations for base level functionality of software:
 - Scan document
 - Append pages
 - Replace pages
 - Delete pages
 - Copy/Paste pages
 - De-speckle¹⁴ pages
 - De-skew¹⁵ pages
 - Convert non-PDF/A documents to PDF/A document format
 - Accept PDF/A document
 - Stamp PDF/A document
 - Initial record stamp
 - Remove stamp
 - Replace stamp
 - Annotation stamp(s)
 - View a PDF/A document throughout internal and external workflow and searching
 - Redact a PDF/A document
 - eRecord processing
 - Ability to accept, process and send a PDF/A document
 - Convert non-PDF/A documents to PDF/A document format
 - Web
 - Viewing PDF/A document
 - Searching PDF/A document
 - eCommerce
 - Track and bill PDF/A document
 - Save PDF/A document
 - Print PDF/A document
 - Exports
 - Ability to export PDF/A documents in bulk
 - Ability to export PDF/A documents by predetermined criteria
 - OCR document
- Recommendations for “wish list” functionality that leverages the PDF/A document format
 - Auto-indexing
 - Enhanced searching capability
 - Redaction

¹⁴ A filter used to remove small defects due to dust, or scratches, on a scanned image,

¹⁵ The process of straightening an image that has been scanned or photographed crookedly — that is an image that is slanting too far in one direction, or one that is misaligned. This process is done in the post-production stage using graphics software.

- ADA compliance
- **Project Management**

Migration to PDF/A will be an implementation project of varying scales. The scale will be contingent on the conversion strategy, software needs, workflow changes, and infrastructure needs. Regardless of the scale of the implementation, the migration should be treated as a project and generally accepted project management standards should be employed. These standards should include, but not be limited to:

 - Assign Project Manager and project team members
 - Define project scope, goals and acceptance criteria
 - Conduct a gap analysis
 - Establish a project plan/timeline
 - Develop conversion, test, training and communication plans
- **Equipment**
 - Disk space considerations
 - Raster TIFF images converted to raster PDF/A images will be slightly larger
 - Adding search capabilities increases the file size by a small percentage
 - Taking advantage of additional PDF/A features will require extra disk space
 - Born digital documents will require significantly less disk space
 - Additional servers may be needed for processing the conversion/creation of a PDF/A to avoid slowing down production systems.
- **Workflow**
 - Coordinate with third party vendors to assess capabilities
 - Plan implementations as necessary
 - Set up new capabilities, test, remediate, and bring online

Conclusion

The intent of this work project was to produce a White Paper about document formats, while providing the reader with the tools to make decisions.

As of the March 15, 2017, PDF/A-2a is the conformance level best suited to property records.

For additional information regarding this paper or any other PRIA work product, send an Email to info@pria.us.