WHITE-PAPER

PDF Primer

getting started with the format PDF

The 3-Heights™ product family from PDF Tools AG stands for:

High Quality – High Volume – High Performance

PDF Tools AG
Kasernenstrasse 1, 8184 Bachenbülach, Switzerland

Tel.: +41 43 411 44 51 , www.pdf-tools.com

INTRODUCTION

PDF files are prevalent in virtually all market segments worldwide. Most people know and use the term „PDF" but have misconceptions what it can and can't do. The purpose of this White Paper is to explain what PDF actually is and what it's strengths and limitations are.

What does PDF stand for?

PDF is an abbreviation for „Portable Document Format".
PDF was originally developed by Adobe Systems Inc. and has been an ISO standard since 2008.

Why was PDF designed?

PDF was created in the early 1990's as a new platform independent file format with the following goals:

- Exchange and view electronic documents
- Represent text and graphics in a resolution independent manner
- Optimize documents for (web) viewing
- Enhance with interactive features

Why is PDF attractive?

PDF is attractive as an electronic document format for a variety of reasons:

- **Portability** - PDF is platform independent, e.g. a PDF file created in a Windows application can be subsequently processed on a Linux server and then viewed on a Macintosh computer
- **Electronic Document with added Features** - PDF builds on the very successful PostScript page description language by adding many features such as random access,compression, encryption and interactive navigation features to PostScript's underlying imaging model.
- **Industry Standard** – PDF has become the de-facto standard (ISO 32000) for the electronic exchange of documents. In addition, PDF is now the industry standard for the representation of printed material in electronic prepress systems. Private corporations, government agencies, and educational institutions are redesigning their business processes by replacing paper-based workflows with an electronic exchange of information.
- **Free Viewer** - One main reason why PDF managed to expand so quickly in the market is because Adobe's PDF reader has been available at no cost, virtually since PDF format was introduced. Only their PDF creation and manipulation applications must be purchased.

PDF FEATURES

PDF offers several features that make it so versatile and in some cases unique:

- **Graphics separated from rendering** - PDF separates graphics (shapes and colors) from rendering (raster output device). The appearance of pages is specified in the PDF file in a device-independent way. Rendering the pages (e.g. for viewing or printing) can be optimized based on the output devices' specific characteristics.
- **Compression** - PDF objects, especially images, can be highly compressed with different compression algorithms without a visible loss of quality. A PDF file can be a fraction the size of the original file.
- **Font Management** - All fonts used in a PDF file can be embedded in the file, guaranteeing that the text will look exactly the same when the file is reproduced. To save space fonts can be subset, i.e. the fonts only contain those parts that are really needed.
- **Single Pass File Generation** - When creating a PDF file, the physical order of the objects in the file is irrelevant, so that the objects do not need to be first organized in a preliminary processing step. This makes it possible to generate a PDF file in one single processing action.
- **Random Access** - PDF files can be randomly accessed. For example, if you want to view page 733 in a 800-page document, PDF can identify and load the objects needed to display page 733 first. You do not have wait for the entire file to load before the page can be viewed.
- **Security (Encryption, Digital Signatures)** - PDF supports different levels of encryption, access control, and digital signatures. This makes it attractive for processing sensitive documents that are sent over the internet or used in web browser applications. PDF documents can be encrypted such that their contents cannot be reconstructed without knowing the password.
- **Incremental Update** - If you append a PDF document, the changed objects are simply added to the end of the PDF file. The entire PDF file is not regene rated from scratch. Small amendments (e.g. adding a watermark or a text correction) can be easily made with a very short processing time. Larger changes can however lead to larger file sizes.
- **Extensibility (Document Interchange)** - PDF files contain numerous features that do not affect the final appearance of a document, but are useful for the interchange of documentsamong application. The inclusion of metadata in the file (e.g. title, author, creation date, modification date etc.) and file identifiers (for reliable reference from one PDF file to another) are two such examples.

PDF PAGE CONTENT

Page Description Language

PDF is a page description language, i.e. it describes how a page looks so that it can be reproduced for viewing and printing. The language resembles Postscript, but is much simpler to allow for more efficient processing. For example, it does not contain control structures like loops and „if" statements.

PDF Page Content Elements

Basically PDF recognizes three types of page content elements:

- Text (fonts programs)
- Graphic paths (lines and curves)
- Images (raster samples)

Content Objects

PDF uses objects and object types to describe the content. Every string of text and all graphics and images are defined by one or several objects, created from one or more object types.

- **Text Objects** – Text objects are defined by a number of attributes including font family, style and size, a string of characters, and a position on a page. PDF does not recognize nor store objects for line breaks, headers, paragraphs, indentation etc. (i.e. paragraph formatting operators used in word processing applications like Microsoft Word). Text is broken down into fragments as small as single characters but not more than one line.
  The fragments can be randomly stored and are like pieces of a puzzle that all have to be placed in their correct location on the page to complete its appearance.
- **Graphic Path Objects** – A graphic path object is an arbitrary shape made up of straight lines, rectangles, and cubic Bézier curves. A graphic path object ends with one or more painting operators that specify whether the path is stroked, filled, used as a clipping boundary or some combination of these operations.
- **PDF Image Objects** – A PDF-specific image format is used for embedding images in a PDF file. This format is independent of the input image format. For example, scanned pages in TIFF format or GIF images that are converted to PDF are newly packaged into PDF image format. Once an image has been converted to PDF image format, it is usually not possible to determine what the original image format was. It is however possible to export PDF images into raster image formats, provided the raster image format supports all features of the image (e.g. transparency).

PDF FILE STRUCTURE

Logical vs. Physical File Structure

So what does a PDF file look like? To answer this question, we have to differentiat between the logical document structure and the physical structure of a PDF file.

Logical Document Structure

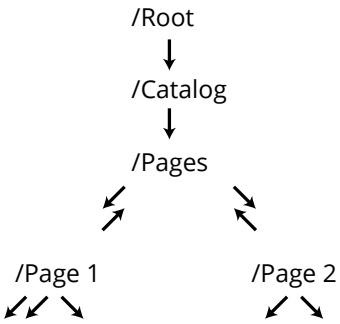
The logical structure of a PDF document refers to how the document is reproduced for viewing or printing:

Page 1
- Object1
- Object 2

Page 2
- Object 3
- Object 4

Page 3

...

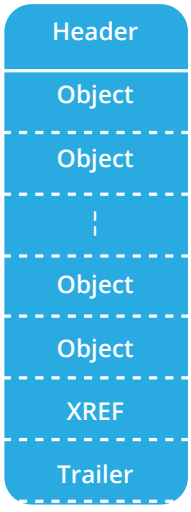


Logical PDF Document Structure

Physical File Structure

The physical structure of a PDF file is quite different from it's logical document structure. A PDF file consists of a header, objects, a cross-reference table, and a trailer.

The objects on a page are not stored in any particular order (e.g. top to bottom). Their location in the physical file is usually completely random.



Physical PDF File Structure

Accessing a PDF File

When accessing a PDF file (e.g. to render for viewing or printing), the header is read first. This identifies the file as PDF. Next the trailer is read. The trailer points to the cross-reference table, which then points to the objects containing pages, fonts, text, images, etc. Pages are rendered by randomly retrieving all of the objects required on that page and displaying them according to their x and y coordinates.

PDF CAPABILITIES

Strengths

There are a number of key strengths to PDF that have helped it become so popular in such a short time, and to remain popular.

- PDF is a world-wide industry standard. It was released in 2008 by the ISO (International Standards Organisation) as a standard with the number ISO-32000. It is used throughout the world thanks to its portability, comparatively small file size, and the availability of free viewers.
- PDF was designed in part for the internet and, with the explosive expansion of the internet during the past 10 years, PDF has established itself as the format of choice for documents available on-line.
- Multi-page PDF files can be optimized for fast web viewing. A PDF file can start by loading a specific page, for example page 6537 in a 10'000 page document. Page 6537 will then be displayed first, before the preceding 6536 pages are loaded by the viewer.
- PDF files can be compressed to extremely small sizes. Images in particular can be greatly optimized.
- PDF readers can still be obtained for free, unless you want to integrate a PDF viewer into an application.
- PDF supports multi-page documents in all paper sizes.
- Adobe has created an excellent PDF Specification. It goes into great depth and contains explicit details on all aspects of PDF. This makes it possible for software development companies to create their own PDF programming tools.
- There are a large number of application opportunities with PDF. Tools are available for creating and manipulating PDF files in numerous manners: on-the-fly document generation, merge & split, stamp, extract content, encrypt, convert, view, print, formfilling...
- And finally, PDF has evolved into more than just a document format. Advanced features and modern technologies like multimedia, JavaScript, XML, forms processing, compression, custom encryption etc. can be used with or embedded into a PDF file, making PDF a powerful, interactive and intelligent file format.

PDF LIMITATIONS

Weaknesses

PDF also has, despite its strengths, its weaknesses and limitations.

- New versions are coming out more rapidly. Each new version brings not only new features but unfortunately possible incompatibilities with older versions. The reduced time between version releases is beginning to compound this problem. For example, if you are still using Adobe Acrobat 5, you won't be able to open a lot of PDF documents that are being optimized with the current Acrobat version.
- PDF is beginning to offer too many 'foreign' formats and technologies for embedded objects (PostScript, Fonts, XML, etc.). Each of these formats can cause corruption and undesirable / unexpected effects.
- PDF is not necessarily WYSIWYG (what you see is what you get). This is particularly true in the areas of colors and fonts. PDF files may look a lot different than the presentation in their original (non-PDF) document format. Only when using the rules of specific standards such as PDF/A these problems can be solved.
- PDF is not easy to process due to certain design issues, and includes a huge number of technologies which have to be mastered. A deep understanding of PDF technology is required for developing quality solutions.
- PDF doesn't recognize paragraphs, formatting, headers, footers, indentations, broken words (line-breaks) etc. This makes it difficult to convert a PDF file back into a formatted Microsoft Word file, for example. Comparing PDF files is also especially challenging due to text being stored in fragments on a page, and not sequentially or as part of a sentence or paragraph.

FURTHER INFORMATION

Where to go from here?

The goal of this White Paper was to present an initial introduction into the world of PDF. Hopefully you now have a better understanding of what PDF is, how it is structured, and what some of the main strengths and weaknesses are.

Additional White Papers

If you would like to read more about specific PDF technologies, there are numerous web portals and white papers that could help you out. PDF Tools AG (http://www.pdf-tools.com) is publishing a complete series of White Papers dealing with a variety of PDF technologies.

PDF Expert Blog

For information from the PDF Experts - out from our develoment team - visit our Blog on blog.pdf-tools.com.

At your disposal

If you wish more information about standards, comparions and product information inclusive a tailored quote to your requirements, please don‘t hesitate to contact us.

Components & Solutions for PDF and PDF/A document processing

Get your own fully functional trial version of our PDF software for 30 days. Just visit our website for further details.

ABOUT PDF TOOLS AG

PDF Tools AG counts more than 4,000 companies and organizations in 60 countries among its customers, making it one of the world's leading producers of software solutions and programming components for PDF and PDF/A products.

Dr. Hans Bärfuss, founder and CEO of PDF Tools AG, began using PDF technology in customer projects more than 15 years ago. Since then, the PDF and PDF/A format have evolved into a powerful, widely used format and ISO standard that can be used for almost any application.

During this time, PDF Tools AG has developed into one of the most important companies on the market for PDF technology, and has played a significant part in developing the PDF/A ISO standard for electronic long-term archiving.

As the Swiss representative on the ISO committee for PDF/A and PDF, the company's knowledge flows directly into product development. The result is high quality, efficient products based on the 3-Heights™ philosophy of the development team, which consists of experienced engineers.

The portfolio of PDF Tools AG ranges from components to services through to solutions. The products support the entire document flow, from raw materials to scanning processes through to signing and storage in a legally compliant long-term archive. An advantage of the components and solutions is the broad range of interfaces, which ensure smooth and easy integration into existing environments.

Due to the growing demands of the market, the products are enhanced and refined continuously. Support is provided by the developers themselves, allowing them to identify trends and customer requirements quickly and use this knowledge when planning enhancements and components.

All development activities are performed in-house at PDF Tools AG in Switzerland. The company does not outsource any programming, so that the entire development process can take place centrally in a single location. This helps to ensure the high standards expected by the company, particularly with regard to the 3-Heights™ technology.

The effectiveness of this approach is confirmed by the success of the products on the market. Our customers include well-known global companies from every industry. That is the greatest compliment of all – and the perfect motivation to continue shaping the world of PDF and PDF/A.

SWISS MADE