EPUB Format Preservation Assessment

Document History

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1. Introduction

This document provides a high level, non-collection specific assessment of the EPUB file format with regard to preservation risks and the practicalities of preserving data in this format.

This format assessment is one of a series of assessments carried out by the British Library's Digital Preservation Team. An explanation of criteria used in this assessment is provided in italics below each heading.

1.1 Scope

This document will primarily focus on two main releases of the EPUB format:

- EPUB version 3 -- the current version of EPUB. The most recent maintenance update of the standard is EPUB 3.1.0, which was published by the International Digital Publishing Forum (IDPF) as a Recommended Specification on 26 June 2014.
- EPUB version 2 -- a release of EPUB initially approved by IDPF in October 2007 with an maintenance update (2.0.1) issued in 2010. While now superseded by EPUB 3, EPUB 2 is still used by a large number of eBook publishers. EPUB 2 superseded, in turn, the proprietary Open eBook Publication Structure (OEBPS) format.

Note that this assessment considers format issues only, and does not explore other factors essential to a preservation planning exercise, such as collection specific characteristics, that should always be considered before implementing preservation actions.

1.2 EPUB Summary

EPUB has been developed by a consortium of publishers and technology companies to provide an open and cross platform file format for representing electronic books, or eBooks. It is designed to offer an optimum viewing experience on a wide variety of devices (and screen sizes) by allowing reflowable text [1] while also providing support for embedded metadata, raster and vector images, audio and video.

EPUB is based on a variety of open standards. An EPUB file is a ZIP container that includes a mix of XHTML files (eBook content), CSS files (formatting), XML files (metadata) and other embedded content such as SVG.

EPUB 2.0.1 is defined by three specifications as follows:

- Open Publication Structure (OPS) 2.0.1 defines the formatting of the contents
- Open Packaging Format (OPF) 2.0.1 is an XML description of the EPUB structure
- Open Container Format (OCF) 2.0.1 defines the collection of all EPUB files as a ZIP archive

EPUB 3.0.1 is defined by the following specifications:

- The EPUB 3 Overview, which provides context and a roadmap for the other documents
- EPUB Publications 3.0.1, which defines semantics and conformance requirements for EPUB publications
- EPUB Content Documents 3.0.1, which defines profiles of XHTML, CSS and SVG
- EPUB Open Container Format (OCF) 3.0.1, which defines how the EPUB components are packaged within a container file (ZIP)
- EPUB Media Overlays 3.0.1, which defines a model for the synchronisation for text and audio

EPUB 3 is currently the closest thing available to an open standard for eBooks. In 2013, Bläsi and Rothlauf concluded that EPUB 3 had the "highest expressive power" of all formats in the eBook ecosystem, and that it included the superset of all features used in proprietary formats like KF8, Fixed Layout EPUB, and iBooks. [2]

2. Assessment

2.1 Development Status

A summary of the development history of the format and an indication of it's current status

The EPUB format was created as an open standard by the International Digital Publishing Forum (IDPF) [3] in September 2007, based on the previously proprietary Open eBook format developed by SoftBook Press [4]. It utilised the same underlying standards, namely XHTML version 1.1 within a ZIP container. Minor revisions were made in version 2.0.1 (the final EPUB 2 release, approved by IPDF in May 2010) and more significant structural and functional changes were made in version 3 (approved by IPDF in October 2011), including support for equations via MathML (Mathematical Markup Language) and greater control of layout and typography including fixed-layout documents. A detailed description of changes can be found on the IDPF website [5]. In late 2014, EPUB 3.0 was submitted to ISO/IEC JTC 1 SC34 (Joint Technical Committee 1, Subcommittee 34, Document description and processing languages) and published as ISO/IEC TS 30135 (parts 1-7). In turn, IDPF anticipates submitting to JTC 1 an EPUB 3.1 update for consideration as a full international standard [6].

EPUB version 3 is based on technologies that themselves are still under development (albeit close to finalisation), such as XHTML5 [7] and CSS3. A minor maintenance release, version 3.0.1, was published in June 2014.

Competing suppliers have produced formats based on EPUB that incorporate DRM and modifications that in some cases restrict eBook use to different platforms. The latest Kindle Fire reader utilises a new format, Kindle Format 8 (KF8), based in part on EPUB version 3, with Amazon DRM. Apple has its own proprietary brand of EPUB, the iBook format. The use of subtle changes to EPUB version 3 and non-standard CSS restrict its use to Apple software. Martin Taylor characterised the situation as it stood in 2012: “So, even before the first EPUB3 eBook goes on sale, we have three (incompatible) variations of the industry standard.” [8]

2.2 Adoption and Usage

An impression of how widely used the file format is, with reference to use in other memory organisations and their practical experiences of working with the format

EPUB adoption

EPUB currently enjoys reasonable (if not universally widespread) support across ereader devices, PC based software, eBook creation services, publishers and online suppliers[1].

Many of the suppliers, publishers and application developers who support EPUB version 2 are moving towards support for EPUB version 3 with recent announcements from a number of publishers such as Elsevier[2]. Support for all aspects of this more recent version of the format has yet to be verified [9][3]

EPUB in Memory Institutions

On behalf of the UK Legal Deposit Libraries, the British Library has been collecting eBooks under legal deposit since 2013. This includes content in EPUB (currently mainly EPUB 2), which can be either received directly from publishers or distributors (by arrangement) or uploaded by pubishers via a deposit portal.

Similarly, the German National Library (DNB) receives eBooks in EPUB format through legal deposit. While covered in principle by the German legal deposit regulation, the DNB does not collect proprietary eBook formats like those used by Kindle [10]. However, it does provide

advice to authors that retain distribution rights on how to create and deposit self-published eBooks in unencrypted EPUB, e.g. by using conversion tools like Calibre [11].

Of the four memory organisations examined by Kirchhoff and Morrissey as case studies in a recent DPC technology watch report, only the Library of Congress were already receiving files in EPUB format, having received content in EPUB 2, while expecting to receive files in EPUB 3 "soon". HathiTrust, Portico and the National Library of the Netherlands had not received EPUB files, although the latter were expecting "...to be receiving content in EPUB 2 and EPUB 3 in the near future..." [12].

The popularity of EPUB for the publication or supply of material by memory organisations is unclear, but the Kirchhoff and Morrissey report notes that HathiTrust supplies some content in generated EPUBs. Similarly, the Bibliothèque nationale de France makes some of its digitised content available in EPUB format via its Gallica portal [13]

2.3 Software Support

2.3.1 Rendering Software Support

An overall impression of software support for rendering the format with reference to: typical desktop software; and current support on British Library reading room PCs

A considerable number of hardware ereaders [14] and software applications provide support for viewing EPUB files. Most of the leading dedicated e-reader devices are able to render EPUB files, for example, ereaders produced by Kobo, Barnes and Noble (Nook) and Sony (Sony Reader), but with the significant exception of Amazon's Kindle.

On most platforms, EPUB files will primarily be rendered by software applications, which range from browser plugins [15], to open source eBook suites such as Calibre [16], and commercial applications like Adobe's Digital Editions [17]. Reader software for EPUB files is also widely available for tablet computers and mobile telephones, including the iBooks app (iPhone or iPad), and Aldiko Book Reader (Android).

IDPF has been supporting the development of a reference implementation for EPUB version 3 in the form of the Readium rendering engine and software development kit [18]. This has progressed sufficiently to enable the launch of an EPUB reader for IOS7 based on Readium [19]. Version 1.0 of Readium SDK was released in January 2015, described as an "open source library designed to support rendering of EPUB 2 and EPUB 3 content in native applications for mobile and desktop operating systems" [20].

EPUB content collected by the British Library through legal deposit provisions are made available on reading room PCs through Ericom's AccessNow client, which provides remote access through a web browser (and includes an eBook viewer).

Issues

The BISG EPUB 3 Support Grid (part of the EPUBTest.org website) evaluates reading systems based on a testsuite of EPUB 3 documents [21]. The results reveal limited support (in terms of functionality coverage) offered by many applications. The extent of any correlation between functionality in eBook files and areas of functionality not supported by major eBook applications is unknown, and the impact of these shortcomings on long-term preservation is therefore hard to estimate.

EPUB version 3 files may not render correctly on viewers that only support EPUB version 2 as EPUB version 3 is based on XHMTL5 rather than XHTML1.1. Publishers such as O'Reilly have produced EPUB 3 files that will render correctly on EPUB 2 viewers, but they commented that achieving complete backwards compatability was not trivial [22].

EPUB version 3 dropped support for the DTBook (DAISY Digital Talking Book) format and some EPUB viewers (e.g. Calibre, Readium) are unable to process EPUBs that contain DTBook content [23].

2.3.2 Preservation Software Support

An impression of the availability and effectiveness of software for managing and preserving instances of the file format

Format identification

Identification is supported by DROID and Apache Tika but, as at the time of writing (in DROID signature file version 74 and Apache Tika 1.5), the EPUB version is not identified (this may be significant, see Rendering Software Support, above). EPUB does not have a MIME-type, but "application/epub+zip" is unofficially used. As an EPUB file is composed of a number of XHTML and other files within a ZIP container, it is possible that format identification could also be run at lower levels of aggregation.

Validation, Conformance Checking and Detecting Preservation Risks

Both epubcheck [24] and flightcrew [25] provide open source validation facilities for EPUB. Epubcheck outputs a detailed array of information including basic descriptive metadata, reports of validation errors, a report on the presence (or otherwise) of DRM and a summary report on validity, using the JHOVE schema. As with other validation tools and formats, interpreting the validation reports is not always straightforward and intuitive. A commercial tool called Flightdeck [26] may provide some value here [27]. Tools should be tested for EPUB3 support, as Flightcrew has not seen any development effort since August 2011. Epubcheck saw significant development in late 2013 with little since then [28].

The SCAPE Project [29] developed a modular tool, FLint (previously called DRMlint), which wraps and applies a number of tools with the aim of validating files against a profile, such as identifying DRM in eBook formats, including EPUB [30].

The market situation for eBooks, while creating uncertainty, also provides some potential for optimism with regard to preservation. Application support for the quality assurance of files created by the self-publishing movement is driven by the submission requirements from publishers and the complex situation for the eBook market described above.

Metadata Extraction

The open and XML based nature of EPUB, makes metadata extraction straightforward [31]. A variety of tools, including epubcheck (see above), therefore support metadata extraction.

Migration

A number of applications support migration to and from EPUB formats (version 2 and 3) including the open source Calibre tool, described above [32]. As with the market drivers for quality assurance tools, the need for authors to provide eBook versions in different formats to meet the requirements of publishers and suppliers has created a market for eBook migration tools and services. However the quality of migration is unknown and quality assurance may be challenging without extensive manual testing.

2.4 Documentation and Guidance

An indication of the availability of practical documentation or guidance with specific reference to the facilitation of any recommended actions

As noted above, EPUB version 3 has been published by the International Organisation for Standardisation as ISO/IEC TS 30135 parts 1-7. IDPF intends to work with ISO in order to submit to ISO JTC 1 an EPUB 3.1 update for consideration as a full International Standard. IDPF has also publishedd the file format specifications that make up the EPUB version 2 and 3 formats [33].

Guidance for supporting users of EPUB is not in short supply due to the market for self-publishing. The development of the Readium reference implementation for EPUB version 3 [18], mentioned above, should also be noted. The Mobileread wiki has detailed format descriptions, recommendations for working with the format and notes on tool support [34].

2.5 Complexity

An impression of the complexity of the format with respect to the impact this is likely to have on the British Library managing or working with content in this format. What level of expertise in the format is required to have confidence in management and preservation?

The choice of human readable open web standards (such as XHTML and CSS) on which EPUB is based considerably simplifies the accessibility of the EPUB format to non-experts. For this reason, expertise in management and preservation of web content, as well as eBooks specifically, may be helpful with EPUBs.

2.6 Embedded or Attached Content

The potential for embedding or attaching files of similar or different formats, and the likely implications of this

EPUB files may include a variety of embedded media types (or *publication resources* as the EPUB specification refers to them as), such as raster graphics, audio or video. EPUB readers must, according to the specification (but see the section on Rendering Software Support, above), support all media types on its *core media types* list. The *core media types* for EPUB version 3 [35] were extended, with some deprecations and replacements over those allowed in EPUB version 2 [36]. In particular, EPUB 3 (and EPUB 3.0.1) allows embedded JavaScript. If the format to be embedded is not on the list of *core media types*, an alternative that is on the list (a *fall back*) must be included as well.

Whilst the specification's requirement to include a *fallback* version of embedded media should enable an e-reader to present an appropriate rendering to a user, there appears to be no guarantees that *fallback* versions will present the exact same rendition as intended by the original embedded file. This presents a potential preservation problem, in terms of authentic rendition of the EPUB.

2.7 External Dependencies

An indication of the possibility of content external to an instance of the file format that is complimentary or even essential to the intellectual content of the instance

In EPUB version 2 all *publication resources* (see Embedded or Attached Content, above) must be embedded (i.e. included in the EPUB ZIP container) with the exception of fonts. The same applies to EPUB version 3 with an additional exception for audio and video resources which may be externally referenced with only embedded image or text based *fallbacks* required.

2.8 Legal Issues

Legal impediments to the use, management or preservation of instances of the file format

A facility is provided in EPUB to provide basic protection of embedded commercial fonts through encryption of the first 1040 bytes of a font file, known as font obfuscation. Its aim is to provide basic protection against casual font piracy, as embedded fonts can otherwise easily be removed from EPUB ZIP containers. The presence of font obfuscation could cause difficulties in migrating EPUB files from one format to another. While defeating the encryption would not be challenging, it may not be legal to do so. Van der Knijff notes that basic tests suggested that epubcheck was able to detect font obfuscation [37].

2.9 Technical Protection Mechanisms

Encryption, Digital Rights Management and any other technical mechanisms that might restrict usage, management or preservation of instances of the file format

The EPUB standard does not prescribe a specific DRM scheme, though EPUB files may use DRM that requires a registration key or password to access them. Various publishers and suppliers use their own DRM technology, with Amazon's DRM system, Apple's FairPlay DRM [38] and Adobe's ADEPT system [39] being the common varieties. A major consequence of such publisher/supplier specific DRM is that eBooks tied into one DRM system are restricted to that publisher/supplier's rendering devices and/or applications.

2.10 Other Preservation Risks

Other evidence based preservation risks, noting that many known preservation risks are format specific and do not easily fit under any of the sustainability factors above

None known.

2.11 Preservation Risk Summary

A summary of preservation risks and recommended actions (where possible).

EPUB is widely used and supported within the eBook sector and is encouragingly based upon an array of open standards. However, the eBook market is still developing and this means that EPUB remains just one choice within a wider range of available formats. EPUB exists within a complex market situation that many have described as a format war. Adaptations of EPUB have created competing formats and incompatible DRM schemes that have left the eBook consumer in an unsatisfactory situation. This suggests that eBook formats are not yet at the end of a period of rapid evolution. EPUB, and other eBook formats, will need to be carefully monitored over the next few years at the very least.

The existence and continued development of open source viewers and SDK's increase confidence in EPUB preservation considerably, but the degree of completeness of support for functionality described in the standard is a concern. Epubcheck provides vital validation and metadata extraction capabilities, and it is encouraging to see adoption of the JHOVE schema for the XML output.

The widespread use of DRM, implemented in an array of schemes, is another significant area for concern for EPUB preservation.

Of the remaining risks, the potential for obfuscated or non-embedded fonts appears to be the most concerning and the impact and incidence of this risk will need to be monitored

- **Lack of EPUB format stability**
  - Evolving standards, context and the format itself places uncertainty on the future preservation situation
  - Proprietary changes and non-standard use of specifications may be used to restrict access to specific manufacturer hardware/software.
- **Encryption**
  - Multiple widely used DRM schemes have the potential to prevent viewing and preservation. Obfuscated fonts could hamper preservation action
- **Incomplete support in EPUB viewers**
  - Support for all aspects of the standard appears to be mixed, although the impact of this is unclear
- **Missing font information**
  - Where not easily substituted, non-embedded fonts could lead to loss of critical information

- **Invalid or badly formed EPUB files**
  - May affect ability to render files now or in the future, but there is some cause for optimism that this will not be as significant a problem as with (for example) PDF
- **Legal issues**
  - Embedded copyrighted fonts can be obfuscated
- **JavaScript**
  - Enabling complex interactive behaviour (EPUB 3 only)
- **Embedded content**
  - Embedded content not on the core media type list and not support by an EPUB reader will be rendered using a specified fallback that is a core media type. There are no guarantees this will present the exact same rendition.
- **External References**
  - Externally referenced audio or video content may be difficult to preserve (EPUB 3 only). Embedded fallbacks should provide some degree of graceful failure, however these are only required to be image or text.

3. Recommendations for Action

Recommended actions in usage and handling of the format. Recommend actions in the support or development of software applications that provide, or have the potential to provide, significant risk mitigation for the format. Note that these recommendations do not take into account other requirements such as those driven by specific British Library collections, or preservation issues like resourcing.

The eBook market is an evolving space; changes to the standards are expected and this is reflected in the monitoring recommendations below.

Handling Recommendations

- Deposited EPUBs should be validated and, in particular, the absence of DRM verified (subject to Software Recommendations, below).

Knowledge Recommendations

- Consider developing and maintaining expertise in management and preservation of web content (in particular enhancing knowledge of open web standards such as XHTML and CSS upon which EPUB is based).

Software Recommendations

- Assess suitable validation tools, such as epubcheck, to gain a better impression of their effectiveness in identifying characteristics associated with the preservation risks described above; however this must be considered against the early stage in the lifetime of EPUB.
  - It is vital to confirm that confidence can be held in epubcheck's ability to detect obfuscated and non-embedded fonts and detect DRM.
- Support enhancements to format identification tools to improve version detection

Monitoring Recommendations

The lack of stability of EPUB and the standards on which it is based, plus the rapidly evolving EPUB market suggests that this assessment should be reviewed on an annual basis.

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