

Digital Preservation Team	Preservation Assessment: JATS/NLM Format Preservation Assessment	Date: 06/10/2015
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JATS/NLM Format Preservation Assessment

Document History

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1. Introduction

This document provides a high level, non-collection specific assessment of the National Library of Medicine (NLM) Journal Archiving and Interchange Tag Suite, and the subsequent Journal Article Tag Suite (JATS) with regard to preservation risks and the practicalities of preserving data adhering to these standards. Documents conforming to these standards are based on the Extensible Markup Language (XML), and so this assessment should be read in conjunction with the British Library's assessment of XML [1].

1.1 Scope

This assessment focuses foremost on the JATS standard, published by the US National Information Standards Organization in August 2012 as NISO Z39.96-2012. However, as JATS is fully backwards compatible to NLM version 3.0 [2], the details provided here should be read as equally applicable to NLM version 3.0 unless otherwise stated. Versions of NLM prior to version 3.0 will also be specifically addressed as required.

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

A separate assessment [1] explores more generic issues around the preservation of content encoded in XML.

1.2 JATS/NLM Summary

JATS is an XML-based mark-up standard for e-Journal articles that evolved from the NLM Archiving and Interchange Tag Suite. Specifically, the standard defines XML elements and attributes that can be used for describing the content of articles and other types of content that are published in journals. As with other XML-based formats, JATS files are text-based, using markup in angle brackets to encode both the content of articles (including text and graphical elements) and/or metadata. JATS files will typically have the file extension `.xml` and the source code will open in many web browsers or text editors.

JATS elements and attributes can be used to construct "Tag Sets" for different uses. The suite itself describes three model Tag Sets - *Journal Archive and Interchange*, *Journal Publishing*, and *Article Authoring* - which, by becoming increasingly prescriptive, provide "models for archiving, publishing and authoring journal article content" [3]. According to the NISO Z39.96-2012, the JATS Journal Archive and Interchange Tag Set is intended to provide "a format in which publishers can deliver content to a wide range of archives, and into which archives can translate content from many publishers" [3].

JATS is a NISO standard (Z39.96-2012) [3], which is based on an updated version of NLM v3.0. The NLM DTD suite itself had quickly become a *de facto* standard, being used by the US National Center for Biotechnology Information's PubMed Central service [4] and by the Portico e-journal preservation service [5]. In 2006, the Library of Congress and the British Library announced that they would support the NLM DTD as a common archiving standard for electronic journals [6]. The Library of Congress list of recommended formats for electronic serials indicates a preference for receiving content compliant with NISO JATS, including XSD/XSL presentation stylesheets, and explicitly stated character encoding [7]. Since 2013, the British Library has been working in partnership with Portico to provide e-journal content (including content in JATS format) for the Library's legal deposit programme [8].

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2. Assessment

2.1 Development Status

A summary of the development history of the format and an indication of its current status

JATS and NLM have their origins in a joint effort by Harvard University Library E-Journal Archiving Project [9], the National Library of Medicine and PubMed Central to standardise the way journal articles created by different publishers could be represented, exchanged and ultimately preserved. NLM version 1.0 was announced in 2003 and underwent gradual development up to the release of version 3.0 in 2008, which was the first to introduce significant backwards incompatibility [10]. Minor updates to version 3.0 were announced with a name change to reflect the creation of a new NISO JATS standard. This was released as a draft standard for trial use in 2011, before being approved as version 1.0 in August 2012. The latest version of the JATS tag suite, 1.1d3, is not yet an official revision of the NISO standard but, according to the official JATS website, it will be submitted to NISO for consideration as the next release of the NISO Standard [11].

Beck [12] provides a detailed overview of the history of NLM and the process of moving it towards a NISO standard. A list of NLM and JATS versions can be found on the official JATS site [13].

Accompanying the standard is a set of schemas (DTD, RELAX NG and W3C XML Schemas) [14], although according to the standard, these are included as “non-normative supporting information”. All three schema types “are, to the extent possible, equivalent, and there is no preference for which is used” [15].

An earlier draft of the JATS tag suite, 1.1d1, extended the standard to cover an XML model for Scientific, Technical and Medical (STM) books. Named the Book Interchange Tag Suite (BITS) [16], the intention is to enable publishers and archives to exchange and archive books or book parts (e.g. chapters), building upon the knowledge and investment they may have already invested in JATS. Although at V1.0 and based on JATS, BITS itself is not a NISO standard.

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

JATS/NLM has been widely adopted by a range of players within the academic publishing and preservation communities. JATS is used for the publication of full text and metadata by many academic publishers, although support is not universal. JATS/NLM is also utilised by publishing service providers such as Atypon [17] and Highwire [18]. Publishers do not always use the standard natively, but often generate it as an exchange format, e.g. for delivering metadata and/or full text to journal archives.

JATS/NLM is also used by libraries and archives for the preservation of e-journal content, e.g. by PubMed Central, Portico, and the British Library. The Library of Congress and the British Library announced support for the NLM DTD as a common archiving standard for electronic journals in 2006 [6] and JATS is currently one of the Library of Congress’s preferred formats for e-journal content [7]. The preservation approach is to use JATS/NLM as a structured means of normalising content from different publisher systems. For example, Portico has developed their own NLM profile to normalise received documents [5; 19].

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

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Being XML, JATS is human readable¹ and renderable by a range of text and XML editors. Support for rendering JATS as XHMTL is provided by CSS style sheets that can be tailored to particular use cases [20]. JATS is often migrated to other formats (e.g. EPUB) for distribution and this strategy is covered in Preservation Software Support: Migration, below.

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 of XML documents is supported by DROID, JHOVE, Apache Tika, and other tools, but only if they contain an XML declaration (which they must in order to be classified as “valid”). To characterise them as JATS files would require enhancements to these tools to further process the XML contents.

Validation, Conformance Checking and Detecting Preservation Risks

As noted in the XML Assessment [1], validation of syntactic well-formed-ness and document validity against a DTD or schema can only go so far in ensuring a particular JATS file can be understood and interpreted effectively. Experience of those working with JATS suggests that an array of issues are typically encountered with non-standard data due to differing implementations and interpretations of the JATS/NLM standard or simply due to artefacts of the publishers workflow process. For example, Morrissey notes encounters with a publisher who uses a publication month value of “32” [21]; this is not a mistake and merely reflects that publisher’s encoding scheme, however it does cause problems with interpretation outside of that publisher. Automated processing, rendering or interpretation of data is challenging in these circumstances.

Morrissey notes problems (which are not specific to JATS) encountered by Portico in validating XML, as described in the XML assessment. These problems typically revolve around the incorrect or lack of explicitness in the XML document, such as documents declaring to be instances of one schema version but actually using elements from a different version [21].

Morrissey also goes on to note that the processing and normalisation of publisher produced JATS files provides vital quality and conformance checking: “Often the processing of these files by Portico is the first test of the viability of this content outside the publisher’s own work flow. Sometimes this is the first test of the content’s conformance to its own putative standards—and hence of its interoperability, even at just a syntactic level, with standard parsing tools”. Portico’s processes are discussed in further detail in [22]. It is perhaps worth noting that most problems with the transformation of JATS are not specifically related to the format itself but relate to the transformation of XML. Portico’s experience is that transformations between different flavours of JATS are much easier than transformations from publishers’ proprietary XML to JATS.

Metadata Extraction

JATS provides comprehensive e-Journal metadata mark-up, enabling easy extraction.

Migration

As would be expected with an XML based format, interoperability or conversion to and from JATS is well supported, although this is subject to flexibility and interpretation of the standard, as noted above. The National Centre for Biotechnology Information provides XSLT’s for migrating pre-JATS/NLM version 3 to the latest version of the standard [23]. An array of conversion tools to and from JATS, are provided on the JATS wiki [20]. Eikebrokk *et al* provide

¹ Human readable in the sense that a person can open the file in a text editor or web browser and read the data contained within. For the most part, this information is also human understandable (e.g. there are tags for article-title, authors, abstracts, etc.), however comprehension is hindered by formatting (e.g. italicised text, tables, etc.) and structural elements (e.g. cross references between elements), which can obfuscate the text.

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an illustration of the ease of generating dissemination formats (such as EPUB, Mobi and XHTML) from JATS [24].

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

JATS is an open NISO standard, which is fully documented online [3]. NLM however, is not an official standard.

The schemas accompanying the JATS standard are non-normative however, implying that whilst every intention is made to keep these in line with the standard, it is the standard that takes precedence over the schemas. In essence, it is possible that the schemas may contain errors or discrepancies with respect to the standards; this may result in document implementations that differ from the intentions of the standard, causing interoperability problems.

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 experiences of organisations such as Portico suggests that managing and preserving a wide variety of XML content, such as JATS e-Journals, is a challenging process. This appears to be mainly due to what Portico describes as the “varying usage in which the semantic richness of XML vocabularies often results” [22] (i.e. interpretation and implementation of the standard enabled by flexibility in XML schemas), as touched upon above and in the XML assessment. Consequently, knowledge of the publisher variations of JATS, as built up by Portico via close working with their content and interaction with the publishers themselves, appears to be as vital as understanding of the JATS standard itself.

“In general, the problems Portico experiences with transforming JATS are really about transforming XML and not specific to JATS. When we receive content in JATS from publishers we do transform it to our internal version of JATS. Those JATS to JATS transformations are much, much easier for us than transformations from proprietary XML to JATS. In fact a full-text JATS to JATS transformation is much easier than a header-text proprietary XML to JATS transformation. While JATS isn’t a panacea on the transformation and migration front (we do still encounter publisher specific issues), it makes things much simpler than the old style of everyone doing their completely separate thing.”

2.6 Embedded or Attached Content

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

Content can be embedded in JATS XML, although more typically publishers provide additional referenced content in other formats within a submission package.

See the XML assessment for further details about embedded content.

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

Remotely hosted DTDs or schemas, whether standard JATS or publisher or preserver specific, are typically referenced from XML documents, posing a preservation risk as described in the XML assessment. Building a local catalogue of such schemas can help alleviate potential problems, as Portico does for the publisher specific DTDs/schemas that define the 290+ different XML and SGML vocabularies that it receives [21]. Despite this however, Portico still

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has “seen content from publishers whose DTDs do not validate” or “whose content does not validate against its own DTD” [19]. Collating schemas only goes so far it would appear; the obtained schemas need to be thoroughly checked first.

Related content can easily be referenced from JATS files, posing a potential preservation risk if said content becomes disassociated (or is remote from the JATS itself), if referenced with insufficient specificity, if it becomes out of date or changes, or if itself contains formats that are problematic for preservation. Morrissey *et al* note that “many of the XML article files received by Portico contain links to supplemental files provided along with the XML file, as well as other sorts of linking information. These external links can be addresses (email, ftp, web URL) or well-known persistent identifiers of one sort or another, such as CrossRef’s DOI, or keys that map to content in the gene or protein databanks” [22]. The future stability of these links poses a long-term preservation problem. Whilst some attempt can be made to preserve linkages, for example through link manipulation to direct users to web archived pages, it is typically only links that refer to supplemental files provided with the original XML source can be maintained [22].

This situation is likely to grow steadily more challenging for preserving organisations as content becomes more dynamic and distributed. Beagrie notes that “the atomic and static PDF files of the early e-journals days are steadily being replaced by bundles of dynamic and interdependent resources that are distributed across the web” [25]. How far a preserving organisation might want to pursue the preservation of remotely referenced content could well constitute a difficult curatorial, and possibly even philosophical, debate.

Practical preservation policies should be clearly defined to give guidance on the approach to take with referenced material. These should take into account the perceived business and end user needs, along with technical and other restrictions/capabilities (for example, preserved personal email addresses will eventually fail to reach the intended recipient). All these requirements, restrictions and capabilities change over time however, and so the policies should be periodically reviewed.

2.8 Legal Issues

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

JATS is an open standard with no known legal restrictions [2].

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

None; but see the XML assessment for related encryption risks.

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

A lack of clarity of the nature of a JATS file and how a preservation process should engage with it is possibly due to a number of issues:

- JATS is an XML based format that typically describes both the metadata and full text of an e-Journal article
- JATS can sometimes represent artefacts of a publishers production process
- JATS is typically not the end result of a publisher's production process

In other words, what is the 'published artefact' that might need, or is obligated, to be preserved as part of a (for example) legal deposit framework, in the case of e-Journal articles? Where these issues are unclear the development of preservation use cases and the requirement to carefully document the decisions behind preservation planning activities appears essential.

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2.11 Preservation Risk Summary

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

The considerable work required by organisations such as Portico to normalize disparate e-Journal content from large numbers of publishers raises the question as to whether the creation and evolution of JATS/NLM has been a success for the preservation organisations or not. Without the flexibility of JATS, adoption across the industry might have been less successful than it undoubtedly has been. But with flexibility in the standard, preservation activities to normalize the resulting XML (effectively ensuring understanding and enabling validation and quality checking) are not straightforward.

Addressing variance or quality issues with deposited JATS appears to be the greatest preservation risk. Implementation of a normalisation workflow (which doubles as a thorough quality check of deposited content) appears to be the best way to mitigate it. The challenge of externally referenced or embedded content is likely to grow as scientific papers integrate more closely with other research outputs, including the research data itself. Otherwise the open nature and well supported interoperability of JATS makes it a good option for preserving e-Journal articles.

- **Invalid or badly formed JATS**
 - Invalid or poorly formed XML (e.g. without XML declaration, incorrect schema declaration, etc.) could impact on interpretation, transformation and long term preservation.
- **Misunderstandings or insufficiently specified JATS**
 - JATS documents with publisher specific encodings or artefacts could impact on interpretation and long term preservation.
 - The non-normative JATS schemas could result in interpretations of the standard that differ from the normative standard itself, leading to interoperability issues.
- **External references may become out-of-date or unavailable, or may themselves be problematic**
 - DTDs and schemas are typically referenced externally and could cause problems interpreting and validating the JATS files if they are unavailable.
 - Other relevant data may also be externally referenced posing potential preservation problems if these become disassociated, out-of-date or simply unavailable.
- **Identification beyond XML requires deeper processing**
 - Identifying files as XML depends on the presence of an XML declaration. Specifically identifying a file as JATS (i.e. beyond just XML) requires deeper processing.
- **Embedded content**
 - Content may be embedded in CDATA sections (but is more likely attached) and may not be easily rendered without appropriate knowledge of that content and/or software support.
- **Unclear target of preservation**
 - JATS is typically not the end result of a publisher's production process, opening up the question of what is the 'published artefact' that should be preserved.

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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 non-preservation issues such as resourcing.

Thoroughly checking content on receipt of deposited JATS and associated content appears to be essential to ensure completeness of the deposit, and understanding of variability in content deposited by different publishers. Timely normalisation to a standard form of JATS appears to be a useful method of achieving this quality checking while also addressing variability in content that may cause preservation issues at a later date. Maintaining a copy of the original package deposited by the publisher will provide some insurance against conversion issues.

Handling Recommendations

- Thoroughly check completeness and validity of JATS and associated content on deposit
- Normalise files to a standard form of JATS as a means of checking quality and addressing publisher variability.
- Maintain a copy of the original package deposited by the publisher.

Knowledge Recommendations

- Clarity should be sought over what 'published artefact' needs to be preserved (particularly for legal deposit).
- Define practical preservation policies to provide guidance on referenced material and links
 - Take into account business and user needs, along with technical and other capabilities and restrictions.
 - Ensure these are periodically reviewed.
- Development of preservation use cases and documenting decisions behind preservation planning activities is essential.
- Strive to understand variability in content deposited by different publishers, particularly around publisher specific encodings.

Software Recommendations

- Support enhancements to format identification tools to more accurately detect XML documents (e.g., through parsing techniques which enable identification without XML declaration)

Monitoring Recommendations

Rapid changes to JATS specifications are unlikely with many risks revolving around the varying interpretations and instantiations of the specification. Review of this document should be on a biennial basis with medium priority.

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