METADATA ENCODING AND TRANSMISSION STANDARD (METS) VERSION 2

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Abstract – The METS Editorial Board is working on version 2 of the Metadata Encoding & Transmission Standard (METS), work which aims to make METS easier to use and implement. Version 2 simplifies the schema, makes it more consistent, and removes reliance on the outdated XLink standard. It aims to retain a clear path for migration from METS 1 for most use cases. In this paper the METS Editorial Board presents the changes in a short form and invites comments and thoughts on the evolution of METS.

Keywords – METS, evolution, transfer formats

Conference Topics – Exchange; Resilience.

I. INTRODUCTION

METS, the Metadata Encoding & Transmission Standard, has been used for describing digital objects since 2001. The METS XML schema version 1.x (METS 1) is used both as an interchange and storage format by numerous systems in the digital preservation space [1,2]. A METS document can describe the manifest of files that make up a digital object, their structural relationship to each other, and include a variety of metadata about the digital object and its component files.

Since the release of METS 1.x, other standards have emerged; most notably, the Portland Common Data Model (PCDM) [3] and the International Image Interoperability Framework (IIIF) [4]. These standards complement rather than replace METS. PCDM is focused on describing digital objects via RDF/linked data, while METS is an XML representation. IIIF is focused primarily on delivering and describing digitized images; METS is often used for this purpose as well, but is considerably more general. Other standards such as BagIt [5] and the Oxford Common Filesystem Layout (OCFL) [6] standardize manifests and directory layouts for digital objects; METS complements these standards by providing a way to describe structure and to link content with metadata.

A. Motivation

METS 1 has been largely stable for many years. No new elements have been added to

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the schema since 2010; changes since then have primarily been to allow new values for specific attributes and to allow arbitrary attributes to appear on a variety of elements (via xsd:anyAttribute). Around 2011, the METS Editorial Board started exploring potential future directions for METS, areas where METS has been successful, and areas where METS has not been as successful [7]. This work did not result in a new version of METS at that time. However, in recent years, the METS Editorial Board has been made aware of a variety of issues and incompatibilities related to the XLink schema used in METS 1 [8]. After discussion, it became clear that the best solution to the XLink issues was to move forward with the design of a new major revision of METS that did not need to maintain strict backwards compatibility. This also enabled consideration of a more general overhaul of the METS schema, building on the earlier exploration in [7].

The basic idea of this new version of METS (METS 2) is to make METS simpler and more flexible by removing rarely-used features and by improving consistency between its various parts. From the beginning of the design process, it was a goal to maintain the general concepts of METS, to continue to support the major use cases of METS, and to make it easy to adapt and migrate a large majority of existing uses of METS 1 to METS 2.

At the same time, the METS Editorial Board recognized that not all systems will migrate from METS 1 to METS 2. The METS 1 schema will continue to be available and will continue to be supported for the foreseeable future. In particular, implementations which rely on elements such as <structLink> and <behaviorSec> in METS 1 will continue to be supported with METS 1; if there are any bugs found, a new version of METS 1 could be released, but most effort from the Board will be on METS 2 going forwards.

Usage of every element and attribute was checked against registered METS profiles [2]. Known problems and inconsistencies of METS 1 were discussed, and possible solutions were considered in terms of their fit with the overall concepts of METS. The result is a kind of "METS Light", improving consistency and ease of implementation without giving up flexibility or versatility.

II. Changes in METS 2

The changes in the METS 2 schema all serve to simplify usage by making the schema more consistent and by removing some rarely-used features. As METS 2 is not backwards-compatible with METS 1, there is a new namespace URI for the schema. METS 2 reorganizes the major sections of the METS file: it removes the <structLink> and <behaviorSec> sections entirely, simplifies the <dmdSec> and <amdSec> metadata sections into a single <mdSec> section, and adopts a parallel organization for the remaining major sections. METS 2 also removes reliance on the XLink specification [9] and removes most lists of allowed attribute values from the schema in favor of suggested external controlled vocabularies. The details of each change and motivation behind each specific change are discussed below.

METS 2 is still in an early stage of development, but is now ready for discussion and feedback. The draft schema, generated documentation, and instructions for feedback are all available in GitHub at https://github.com/mets/METS-schema.

A. Removing XLink

When METS 1 was first drafted in 2001, XLink was in the process of being adopted as a W3C recommendation, and seemed promising for future adoption. In the intervening years, XLink has had little uptake. Although XLink was revised in 2010 [9], there is no browser support for XLink beyond basic XLinks in SVG, and SVG 2 deprecates XLink entirely [10]. The continued inclusion of XLink in METS can also cause validation problems when using METS alongside other XML schemas that also reference XLink but include reference to a slightly different XLink schema [8]. Schemas which used XLink in the past have moved away from it: notably, schemas often used with METS such as PREMIS 3 and EAD 3 drop XLink entirely in favor of schema-

local attributes [11,12].

METS 2 follows this trend by removing extended XLinks entirely, dropping references to rarely-used XLink attributes, and using a locally-defined LOCREF attribute instead of the xlink:href attribute in <FLocat> and <mdRef> elements. The draft METS 2 schema also allows LOCREF to be any string, not just a URI as with xlink:href in METS 1. In practice the xlink:href attribute was used even when the location was not actually a URI – for example, locally-defined identifiers, or relative paths defined without reference to a base URI. Changing the attribute name and type removes this potential semantic confusion.

B. Unrestricted Attribute Values

The draft METS 2 schema removes the restriction on allowed values for several attributes such as MDTYPE, LOCTYPE, CHECKSUMTYPE, and others. Enumerated lists of values in the schema limit extensibility and flexibility for users, delay the availability of values for new standards, and add to the proliferation of schema versions over time. With METS 1, implementers could use (for example) MDTYPE="OTHER" and provide an OTHERMDTYPE value, but this literally serves to "other" and devalue data types not explicitly approved by the METS Editorial Board. Alternatively, implementers could request new approved values, but the overhead of evaluating and approving requests and releasing a new version of the schema means there is a significant delay between the request and the availability of the new term for use. With METS 2, recommended standards and values for these attributes will instead be documented externally to the schema itself, as it was done for PREMIS 3 [13]. This will both reduce changes required to the schema and reduce the barrier to extending lists of possible attribute values.

C. Removing Rarely-Used Sections

Neither the <structLink> nor <behaviorSec> sections are included in METS 2. Both these sections are rarely used in METS 1, as determined through a review of registered profiles as well as general web and GitHub searches.

The <structLink> element was added in METS 1.1 for recording hyperlinks between media represented by <structMap> nodes. These hyperlinks were represented by extended XLink objects that could be used to record links between <structMap> nodes separately from the <structMap> nodes themselves. The primary documented use case for <structLink> was to indicate links between web pages described in a METS object [14]. However, in the intervening years the Web ARChive (WARC) file format has emerged as a standard way of capturing web archives, minimizing the need for METS to handle this use case. Likewise, XLink (especially extended links) did not come into widespread usage. Thus, METS 2 removes support for <structLink>.

The <behaviorSec> element was added to the 'epsilon' revision late in the design process of METS 1 to support referencing executable code from METS objects. This was primarily to support a use case for earlier versions of the Fedora digital repository system [15]. Fedora has since moved away from the use of METS and XML in general, and this section has not been widely used or supported by other METS implementations.

D. Simplified Metadata Section

In METS 1, metadata is recorded in purpose-specific sections and elements. Descriptive metadata is recorded in section <dmdSec>; all other metadata is recorded in an administrative metadata section <amdSec>. This parent section <amdSec> is separated into four subsections for technical metadata (<techMD>), intellectual property rights (<rightsMD>), analog/digital source metadata (<sourceMD>), and digital provenance metadata (<digiprovMD>). Multiple instances of the element <amdSec> can occur within a METS document and multiple instances of its subsections <techMD>, <rightsMD>, <sourceMD> and <digiprovMD> can occur in one <amdSec> element.

METS 2 makes all metadata sections more

generic by using general elements <mdSec>, <mdGrp> and <md> following the hierarchy of the file section. All these elements can be referenced using the general MDID attribute instead of the more specific DMDID and ADMID attributes from METS 1. METS 2 does not prescribe a specific vocabulary or syntax for encoding metadata. These changes simplify the schema and in turn processing software while enhancing flexibility in the structuring of the metadata.

In METS 2, the metadata section <mdSec> contains all metadata pertaining to the digital object, its components and any original source material from which the digital object is derived. The optional <mdGrp> element allows grouping related kinds of metadata. This could be all metadata of a particular type, all metadata coming from a particular source, all metadata pertaining to a certain file or set of files, or any other relevant grouping; the <mdGrp> can then be referenced from an MDID attribute elsewhere. The <md> element records any kind of metadata about the METS object or a component thereof. As with metadata elements in METS 1, the <md> element can include the metadata inline with <mdWrap>, reference it in an external location via <mdRef>, or both. The <mdSec> element can contain any number of <mdGrp> elements which in turn contain any number of <md> elements, or it can include <md> elements directly if grouping is not needed. As in METS 1, included or referenced metadata can be in any format, XML or otherwise. METS 2 replaces the varied element names with a USE attribute comparable to that on <fileGrp>. Values could include DESCRIPTIVE, TECHNICAL, RIGHTS, SOURCE, PROVENANCE to correspond to the various metadata sections available in METS 1, or could use any other value according to local needs.

Example with METS 1:

```
<mets>
  ...
  <dmdSec>...</dmdSec>
  <amdSec>
    <techMD>...</techMD>
    <rightsMD>...</rightsMD>
    <sourceMD>...</sourceMD>
    <digiprovMD>...</digiprovMD>
  </amdSec>
  ...
</mets>
```

Example with METS 2, preserving METS 1 semantics

```
<mets>
  ...
  <mdSec>
    <mdGrp USE='DESCRIPTIVE'>
      <md USE='DESCRIPTIVE'>...</md>
    </mdGrp>
    <mdGrp USE='ADMINISTRATIVE'>
      <md USE='TECHNICAL'>...</md>
      <md USE='RIGHTS'>...</md>
      <md USE='SOURCE'>...</md>
      <md USE='PROVENANCE'>...</md>
    </mdGrp>
  </mdSec>
  ...
</mets>
```

Example with METS 2 without <mdGrp>

```
<mets>
  ...
  <mdSec>
    <md USE='DESCRIPTIVE'>...</md>
    <md USE='TECHNICAL'>...</md>
    <md USE='RIGHTS'>...</md>
    <md USE='SOURCE'>...</md>
    <md USE='PROVENANCE'>...</md>
  </mdSec>
  ...
</mets>
```

E. Removing Nested File Groups

METS 2 retains the file section <fileSec> that lists the files that comprise the digital object described in the METS document.

METS 1 supported arrangement of files with nested file group (<fileGrp>) elements, and allowed mixing both <fileGrp> and <file> elements at the same level. In METS 2, the <fileGrp> element is made optional, and <fileSec> may contain either <fileGrp> elements or <file> elements directly. This simplifies the schema and processing software; it also makes <fileSec> / <fileGrp> / <file> consistent with <mdSec> / <mdGrp> / <md>.

In METS 1, nested file groups were sometimes used to describe structural information about the object. METS 2 clarifies that <fileSec> is for listing a manifest of files in the object and that the <structMap> element

is the way to represent structure. As in METS 1, <file> elements themselves may still be nested, which is often useful for representing the physical structure of archive formats such as .zip, etc.

In this METS 1 example, the dprov-001 metadata section applies to all nested <fileGrp> elements:

```
<mets>
  ...
  <fileSec>
    <fileGrp ADMID="dprov-001"
             USE="Images">
      <fileGrp USE="Original">
        <file ID="file-001"
              ADMID="tech-001">
          <FLocat LOCTYPE="URL"
xlink:href="https://example.org/
img001.tif"
            />
        </file>
      </fileGrp>
      <fileGrp USE="Thumbnails">
        ...
      </fileGrp>
    </fileGrp>
    <fileGrp ADMID="dprov-002"
             USE="Documents">
      <file ID="file-doc-001"
            ADMID="tech-doc-001">
        <FLocat LOCTYPE="URL"
xlink:href="https://example.org/
doc001.pdf"
          />
      </file>
    </fileGrp>
  </fileSec>
  ...
</mets>
```

In METS 2, there may be no more than one level of <fileGrp> elements, so the reference to dprov-001 is repeated across multiple <fileGrp> elements:

```
<mets>
  ...
  <fileSec>
    <fileGrp MDID="dprov-001"
             USE="Original Images">
      <file ID="file-001" MDID="tech-
001">
        <FLocat LOCTYPE="URL"
LOCREF="https://example.org/
img001.tif" />
      </file>
    </fileGrp>
    <fileGrp MDID="dprov-001"
             USE="Thumbnails">
      ...
    </fileGrp>
    <fileGrp MDID="dprov-002"
             USE="Documents">
      <file ID="file-doc-001"
            MDID="tech-doc-001">
        <FLocat LOCTYPE="URL"
LOCREF="https://example.org/
doc001.pdf" />
      </file>
    </fileGrp>
  </fileSec>
  ...
</mets>
```

As with <mdSec> and <md>, if there is no need for multiple groups, <file> elements may be added directly under the <fileSec> element:

```
<mets>
  ...
  <fileSec>
    <file ID="file-001"
          MDID="tech-001 dprov-001">
      <FLocat LOCTYPE="URL"
LOCREF="https://example.org/
img001.tif" />
    </file>
    ...
    <file ID="file-doc-001"
          MDID="tech-doc-001 dprov-002">
      <FLocat LOCTYPE="URL"
LOCREF="https://example.org/
doc001.pdf" />
    </file>
  </fileSec>
  ...
</mets>
```

Instead of repeating the references to dprov-001 and dprov-002 in <file> elements, these could be included in elements in a structural map.

F. Structural section

METS 1 and 2 both support including multiple structural maps. In METS 1 the structural maps were included directly to the main level as <structMap> elements. In METS 2, these <structMap> elements are included in a new structural section <structSec>. Although <structMap> was required in METS 1, to match other sections and to support using METS as a simple manifest of files, <structSec> is optional in METS 2.

III. FUTURE WORK

In addition to accepting and discussing

comments and feedback, the METS Editorial Board will undertake additional work before publishing METS 2 as a released standard:

- Release a white paper describing these changes in greater detail and providing additional examples
- Create an XSLT transformation and/or other tools to aid in migration from METS 1 to METS 2
- Update the METS primer and tutorial for METS 2
- Publish vocabularies for attributes whose allowed values are no longer encoded in the schema
- Review and update the METS profile schema to support METS 2

Our hope is that METS 2 simplifies and further encourages the adoption of METS for the purposes of describing, preserving, and providing access to digital objects.

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