Using IMS Caliper Analytics™, Question and Test Interoperability™ and Learning Tools Interoperability™ with EPUB3^TM: EDUPUB Best Practices

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Summary: This document presents the best practice recommendations for using IMS Learning Tools Interoperability™ (LTI™), IMS Caliper Analytics™ and IMS Question & Test Interoperability™ (QTI™) based content within an EPUB3 context. These form a key part of the EDUPUB standard. Examples of these best practices are presented using the Readium open source EPUB3 reader but are generally applicable to other EPUB3 readers provided they follow the conformance requirements.

Executive Summary

This document contains the best practice recommendations for the use of the IMS Learning Tools Interoperability™ (LTI), IMS Caliper Analytics™ and IMS Question and Test Interoperability™ (QTI) with an International Digital Publishing Forum™ EPUB3™ formatted document. This combination of EPUB3 electronic book format with the QTI, LTI and Caliper standards is called the EDUPUB Standard. The use of LTI, QTI and Caliper provides the capability to use third party tools/apps/systems, quizzes for formative assessment and to log the raw data for the creation of learning analytics metrics respectively within the context of an EPUB3-based eBook.

This best practice document provides the key architectural use-cases that can be supported by the new functionality. A detailed description for the use of LTI, Caliper and QTI within EPUB3 is supplied along with annotated examples to demonstrate the key features. Examples and the source code (including the IMS fork of the Readium™ source code) are available at: http://www.imsglobal.org/edupub/. The key architectural use cases are:

a) The use of the eBook in a typical 'consumer mode' in which there is no source learning management system or remote learning analytics server. The eBook is used as a standalone entity and so the formative assessment/quiz must be contained in the eBook itself;

b) The use of the eBook as part of an organized learning activity moderated by some institutional services such as a learning management system and a learning analytics service/repository. In this case network access is, in general, required for access to the learning materials. The eBook can now contain links to external tools (launched using the IMS LTI protocol) and can use the Sensor API™ to report the learning analytics. Furthermore a quiz can be either embedded or accessed as a remote tools using LTI.

The key best practice recommendations detailed within this document are:

a) The eBook Reader, whether a specialist device, or software that runs on a laptop, tablet, etc. should be IMS LTI v1.x Tool Provider and Tool Consumer compliant. This will allow an EPUB3™ resource to use any third party LTI-compliant tool/service/app;

b) The eBook Reader, whether a specialist device, or software that runs on a laptop, tablet, etc. should be IMS Caliper compliant i.e. use the Sensor API™. This will allow all EPUB3™ resources to report the appropriate leaning analytics;

c) The eBook should support QTI-runtime compliant formative tests (quizzes) either as a remote service accessed using an LTI Tool Consumer interaction or as an embedded resource. When embedded the QTI-runtime capability is supplied as a combination of QTI-JSON files, QTI-XHTML files and QTI JavaScript libraries.

It should be noted that this is a work in progress. Over the next 12 months, IMS Global and the IDPF will complete further refinement of this work and will publish updates to this best practices document. In particular, IMS will define and introduce the EDUPUB Conformance Program.

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Acknowledgements

1 Introduction

1.1 Scope & Context

This document contains the best practice recommendations for the use of the IMS Learning Tools Interoperability (LTI) [LTI, 12], [LTI, 14], IMS Caliper Analytics [Caliper, 13] and IMS Question and Test Interoperability (QTI) [QTI, 12a] with an EPUB3 [EPUB3, 11a] document: the International Digital Publishing Forum (IDPF) is responsible for EPUB3. This combination of EPUB3 electronic book format with the QTI, LTI and Caliper standards is called the EDUPUB Standard. The use of LTI, QTI and Caliper provides the capability to use third party tools/apps/systems, quizzes for formative assessment and to log the data for the creation of learning analytics metrics respectively within the context of an EPUB3-based eBook.

This best practice document provides the key architectural use-cases that can be supported by the new functionality. A detailed description for the use of LTI, Caliper and QTI within EPUB3 is supplied along with annotated examples to demonstrate the key features. Examples and the source code (including the IMS fork of the Readium source code) are available at: http://www.imsglobal.org/edupub/.

It should be noted that this is a work in progress. Over the next 12 months, IMS and the IDPF will complete further refinement of this work and will publish updates to this best practices document. In particular, IMS will define and introduce the EDUPUB Conformance Program.

1.2 EPUB3 Overview

The EPUB specification is a distribution and interchange format standard for digital publications and documents. EPUB defines a means of representing, packaging and encoding structured and semantically enhanced Web content including HTML5, CSS, SVG, images, and other resources, for distribution in a single-file format. EPUB 3, the third major release of the standard, consists of a set of four specifications, each defining an important component of an overall EPUB Publication:

- EPUB Publications 3.0 [EPUB3, 11a] that defines publication-level semantics and overarching conformance requirements for EPUB Publications;

- EPUB Content Documents 3.0 [EPUB3, 11b] that defines profiles of XHTML, SVG and CSS for use in the context of EPUB Publications;

- EPUB Open Container Format (OCF) 3.0 [EPUB3, 11c] that defines a file format and processing model for encapsulating a set of related resources into a single-file (ZIP) EPUB Container;

- EPUB Media Overlays 3.0 [EPUB3, 11d] that defines a format and a processing model for synchronization of text and audio.

EPUB has been widely adopted as the format for digital books (eBooks), and these new specifications significantly increase the format's capabilities in order to better support a wider range of publication requirements, including complex layouts, rich media and interactivity, and global typography features. The expectation is that EPUB 3 will be utilized for a broad range of content, including books, magazines and educational, professional and scientific publications.

1.3   IMS Conformance Certification Program

Over the past fifteen years IMS has published an extensive set of e-learning interoperability standards. During the past five years IMS has focused on introducing a Conformance Certification Program for these standards so that vendors can have their products that use these standards recognised through certification. Whenever a new standard is produced by IMS, it is accompanied a Conformance Program so that vendors' systems, applications, tools and content can be certified.

Each Conformance Program consists of a defined conformance process that reflects the nature of the standard: it must be stressed that IMS is concerned *only* with information interoperability and not how the information may be subsequently used within an end system. Self-certification is the basis of the process with IMS moderating the subsequent documentation submission. IMS standards break into two types: data exchange format definition and service exchange definition. The Conformance Programme for a data exchange format based standard consists of the use of the:

- IMS Online Validator to verify that content complies with the required formats. This is used to certify standalone content or to confirm that a system exports data in the right format;

- Reference Test Data Set to verify that systems that import the data are capable of handling all of the various features within the standard.

For service-based standards the Conformance Programme typically consists of:

- A service test harness that is used to confirm that a service provider operates as required. This uses the corresponding service API that is also made available as part of the specification;

- A service test harness to confirm that a service consumer operates as required.

All of the IMS conformance test tools supply a conformance test report that describes the findings of the test tools. The conformance process requires a vendor to complete a functionality matrix that describes the features of the standard that the product supports: in many cases a compliant product is not required to support all the features of a standard. The vendor then uses the appropriate set of conformance testing tools and submits the set of test reports to IMS along with the functionality matrix. IMS inspect and validate the submission.

EDUPUB is based upon two IMS service-based (LTI and Caliper) and one data format (QTI) standards. Therefore the Conformance Programme is based on testing both the service and data functionality.

1.4   Structure of this Document

The structure of the rest of this document is:

2. ARCHITECTURAL FRAMEWORKS

Summary of the individual architectural frameworks for EPUB3, LTI, Caliper and QTI and the integration of these to support the various EDUPUB use-cases.

3. EPUB3 AND LEARNING TOOLS INTEROPERABILITY V1.X

Describes the best practices for using the LTIv1.x specification to provide data exchange between tools and systems;

4. EPUB3 AND CALIPER

Describes how the Caliper learning analytics framework and Sensor API can be used to support analytics reporting from eBooks;

5. EPUB3 AND QUESTION & TEST INTEROPERABILITY

Describes the best practices for providing quizzes that are embedded with an EPUB3-based eBook;

APPENDIX A TERMS & DEFINITIONS

Definition of the key concepts used throughout this document;

APPENDIX B ANNOTATED LTI/EDUPUB EXAMPLES

The detailed, annotated examples showing how to use LTI to support EDUPUB including the use of an external quizzing/assessment tool;

APPENDIX B ANNOTATED CALIPER/EDUPUB EXAMPLES

The detailed, annotated examples showing how to use Caliper to support EDUPUB;

APPENDIX B ANNOTATED EMBEDDED QTI/EDUPUB EXAMPLES

The detailed, annotated examples showing how to use embedded QTI to support EDUPUB;

APPENDIX E METADATA IN EDUPUB

The usage of the various metadata features in EPUB3 and the relational between the various binding forms that can be used;

APPENDIX F READIUM SUPPORT FOR EDUPUB

Collation and summary of all the changes to the Readium source code required to support the LTI, Caliper and QTI functionality;

APPENDIX G BEST PRACTICES CHECKLIST

Collation and summary of all the best practices summarized throughout this document;

APPENDIX H QTI/CALIPER/LTI AND EDUPUB CONFORMANCE

Collation and summary of the conformance steps required for compliance to LTI, Caliper and QTI for EDUPUB.

1.5   Acronyms

AMD   Asynchronous Module Definition

API   Application Programming Interface

APIP   Accessible Portable Item Protocol

CP   Content Package

CSM   Curriculum Standards Metadata

CSS   Cascading Style Sheet

DRM   Digital Rights Management

EPUB   Electronic Publication

HTML   Hypertext Mark-up Language

HTTP   Hypertext Transfer protocol

IDPF   International Digital Publishing Forum

IEEE   Institute of Electrical and Electronic Engineers

IMS   IMS Global Learning Consortium

JSON   Java Script Object Notation

LMS   Learning Management System

LOM   Learning Object Metadata

LRMI   Learning Resource Metadata Initiative

LTI   Learning Tools Interoperability

MP   Metric Profiles

OCF   Open Container Format

ODF   Open Document Format

OEBPS   Open eBook Publication Structure

OPF   Open Package Format

QTI   Question & Test Interoperability

RDF   Resource Description Framework

REST   Representational State Transfer

SDK   Software Development Kit

SIS   Student Information Systems

SVG   Scalable Vector Graphics

URI   Uniform Resource Identifier

URL   Uniform Resource Locator

W3C	World Wide Web Consortium
XHTML	Extensible Hypertext Mark-up Language
XML	Extensible Mark-up Language
XSD	XML Schema Definition

1.6   References

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2   Architectural Frameworks

2.1   EPUB Architecture

EPUB is a standardised format for the electronic publication of books. Therefore, it is a directly rendered format when using an EPUB Reader. EPUB Readers are available in many device and software-only forms. The structure of an EPUB3 file is shown in Figure 2.1.
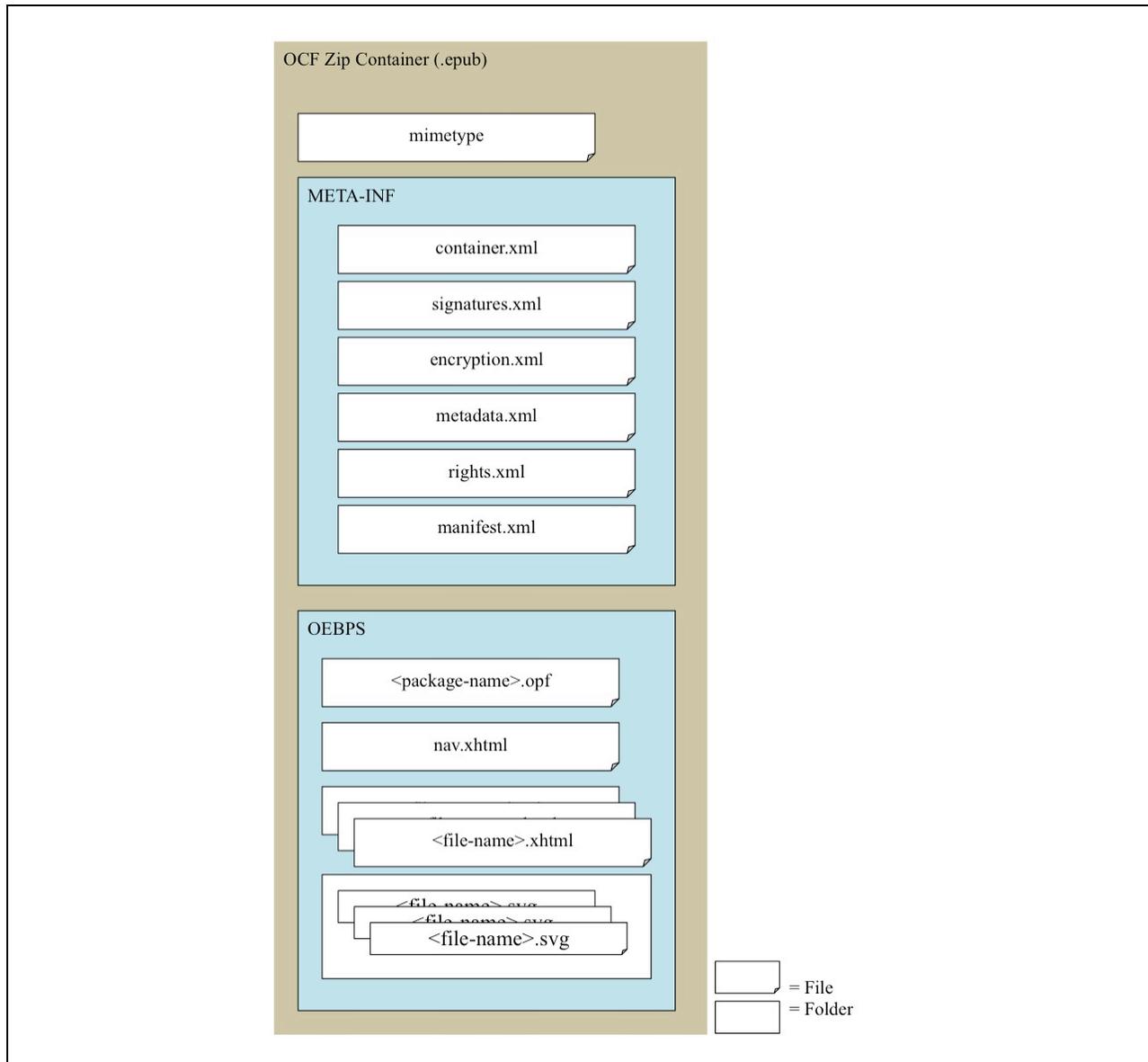
Figure 2.1 – The EPUB3 OCF zip file structure.

Essentially, an EPUB3-comliant eBook is supplied as a zip file with the file extension '.epub'. This is termed the Open Container Format (OCF). Within the zip file are three root-level structures:

a) The 'mimetype' file containing the string 'application/epub+zip'. This must be the first file;

b) The META-INF folder. The contents of the META-INF folder are:

   • 'container.xml' [required] – identifies the file that is the point of entry for each embedded Publication. This identifies the media type of, and paths to, the root files for the EPUB publications included within the container

   • 'signatures.xml' [optional] – contains digital signatures for various assets

   • 'encryption.xml' [optional] – contains information about the encryption of publication resources (this file is required if font obfuscation is used). If this file is not present, the OCF container provides no information indicating any part of the container is digitally signed at the container level. However, it is possible that digital signing exists within any alternate contained rendering

   • 'metadata.xml' [optional] – used to store metadata about the container. This file, if present, must be used for container-level metadata. This version of the OCF specification does not specify any container-level metadata.

   • 'rights.xml' [optional] – used to store information about digital rights. This file is reserved for digital rights management (DRM) information for trusted exchange of Publications among rights holders, intermediaries, and users. This version of the OCF specification does not specify a required format for DRM information, but a future version may specify a particular format for DRM information

   • 'manifest.xml' [allowed] – manifest of container contents as allowed by the Open Document Format (ODF);

c) The OEBPS folder that is used to contain the core content of the eBook. The typical contents are:

   • The Package Document (this is the file with the file extension '.opf'). The Package Document carries bibliographic and structural metadata about an EPUB Publication, and is thus the primary source of information about how to process and display it. The Package Document is an XML document consisting of a set of container elements, each dedicated to housing information about a particular aspect of the Publication. These containers effectively centralize metadata for the Publication, detail the individual resources that compose it and provide reading order and other information for rendering the Publication to a User

   • The set of XHTML files that contain the actual HTML5 content

- The set of supporting assets such as the CSS, images, audio, etc. files.

2.1.1   Readium EPUB Reader

All of the examples in this document are based upon the use of the Readium EPUB3 Reader. Readium is an open source EPUB Reader under development by the Readium Foundation (http://www.readium.org). The Readium Foundation develops technology to accelerate adoption of EPUB 3 and the Open Web Platform by the global digital publishing industry. Readium.org was formed in February, 2013 as a non-profit membership organization. Current Readium.org projects include Readium Web (an EPUB 3 rendering engine for browser-based cloud readers) and Readium SDK (an EPUB 3 rendering engine for native apps).

For these best practices, Readium has been used in two modes:

- As a browser-based cloud reader with the Readium engine hosted in IMS Cloud;

- Using the Readium app plug-in for the Chrome browser (Version 2.13.4, released March 17, 2014).

2.2   LTIv1.x Architecture

With LTI 1.x, a Tool Consumer is configured using a Launch URL, consumer key and shared secret provided by the Tool Provider (see Figure 2.2). This is sufficient to enable a user to be able to launch into the Tool Provider's service. The Tool Consumer may be configured to permit (or deny) the passing of different launch parameters, especially personal data such as a user's name and email address. It may also make available the LTI Outcomes service to permit the Tool Provider to return grades associated with the launch link.
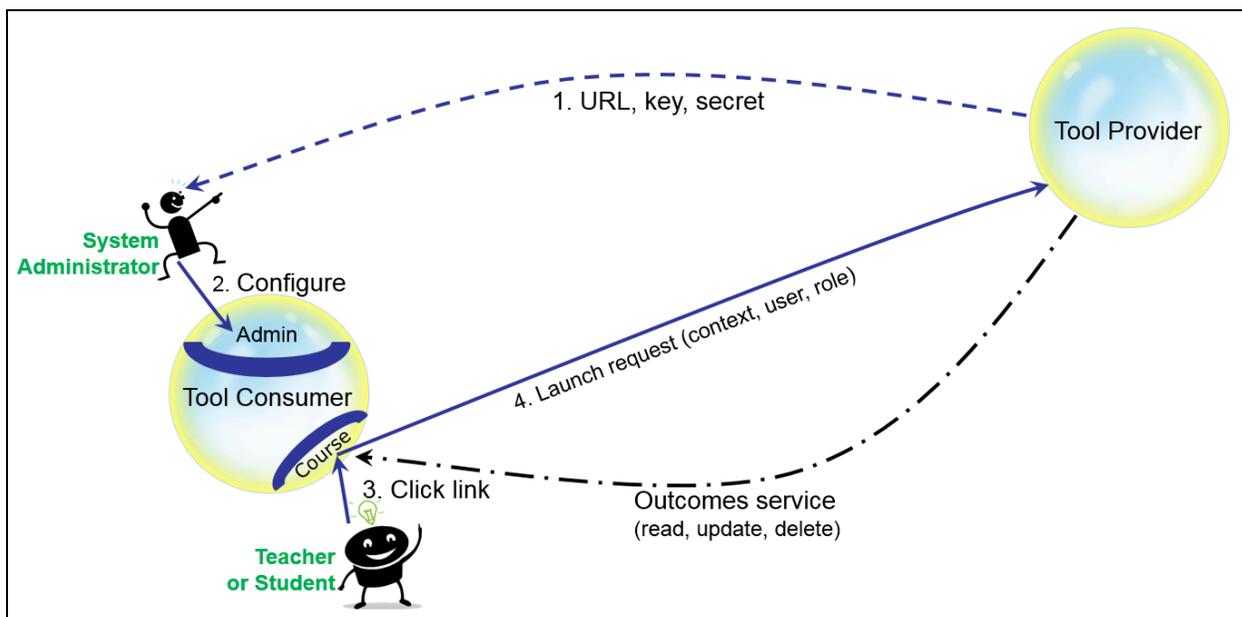
Figure 2.2 – The LTI 1.x architecture.

2.3   LTIv2.0 Architecture[1]

With LTI 2.0, the configuration of the Tool Consumer occurs as part of a dialog between the System Administrator and the Tool Provider. During this process the Tool Consumer makes a profile available which describes its properties, capabilities and supported services. The Tool Provider selects from those elements on offer to generate a Tool Proxy describing the connection details required to configure the Tool Consumer. This process allows a Tool Provider to configure multiple tools (resource handlers) with separate launch URLs all at the same time.
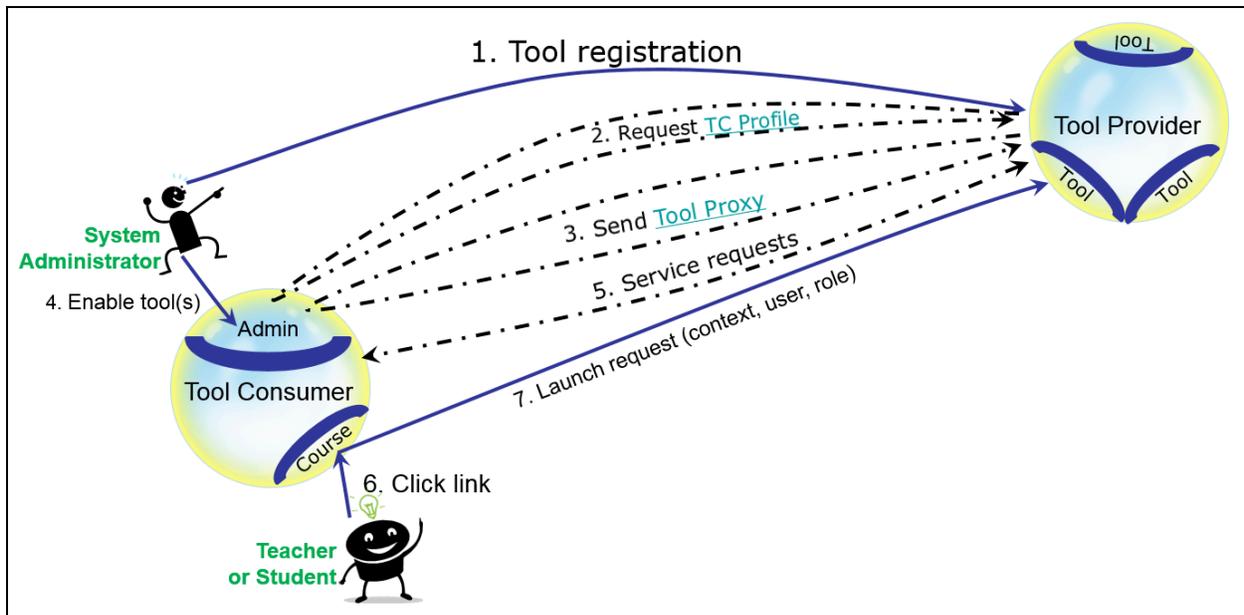
Figure 2.3 – The LTI 2.0 architecture.

2.4   CaliperAnalytics Architecture

The IMS Caliper Framework [Caliper, 13] provides a high-level recommendation of how Learning Systems should capture and share data around learning interactions, using existing and upcoming IMS specifications, which can be used to support and advance Learning Measurement and Analytics. Figure 2.4 shows the components of the Caliper Framework. IMS Caliper is built around the following concepts:

• IMS Learning Metric Profiles that provide a Learning Activity centric focus to standardize on metrics (actions and related context) captured across consumer and producer learning tool's delivery activities and delivery platforms that consume and orchestrate activity based curriculum, while providing for custom extensions and future additions to the profiles;

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[1] LTIv2.0 support within EDUPUB is not defined in this release of the best practices. Information about LTIv2.0 is given to supply context for a later functional addition to EDUPUB.

[2] CSS 3.0 is now available and later releases of the QTIv2.1 specification will address its usage.

- IMS Learning Sensor Application Programming Interface (API) and Learning Events drive standardized instrumentation and metric capture and marshal between tools and their delivery platforms and/or associated analytics service solution aggregating metrics;

- IMS LTI/LIS/QTI leverage and extensions enhance and integrate granular, standardized learning measurement with tools interoperability and the underlying learning information models, inclusive of course, learner, outcomes and other critical associated context.
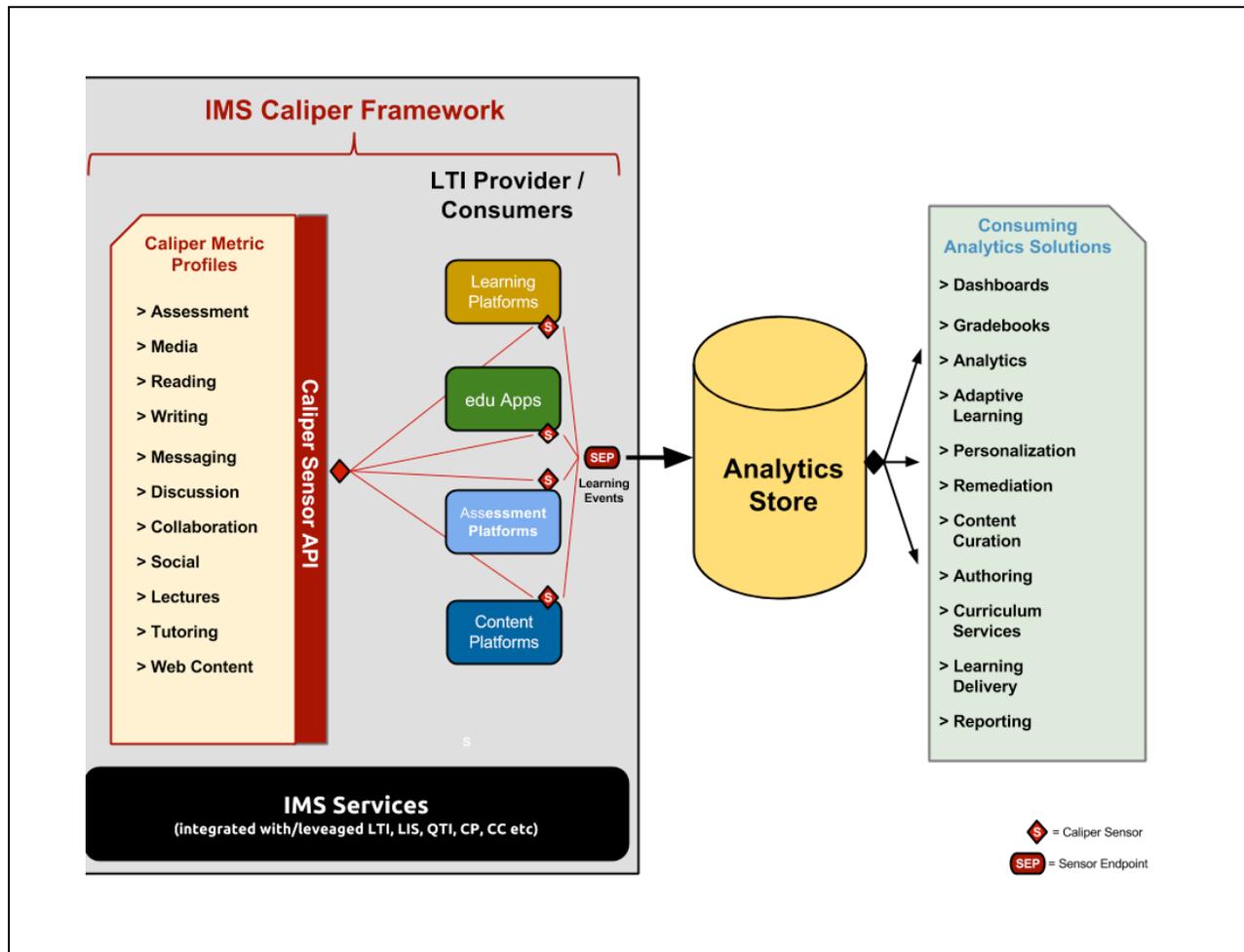
Figure 2.4 – The IMS Caliper Framework.

IMS Learning Metric Profiles are intended to define a standardized, structured collection of Learning Activity Metrics that represent granular measurements specific to actions within each genre of activity including all relevant context for any given action on an activity. In addition, there are pan-genre Foundational Metrics such as engagement, performance, etc., that support common measurement of more generally applicable metrics across all activities. Any given Learning Activity can have (one or more) Metric Profiles associated with it to collect and exchange whatever measurements which need to captured and managed.

In this best practice document the focus is on the use of the IMS Sensor API to report the raw data activity from within the EPUB3 Reader/document. The corresponding learning activity metrics for the use of the EPUB3 reader, in general, and the formative assessment, in particular, are not addressed.

2.4.1   Sensor API Design and Implementation

The IMS Sensor API is intended to support the instrumentation, collection and exchange of data from Learning Tools/Systems and associated Learning Content elements. This enables the availability of standard metrics accessed via any given Analytics Store and associated APIs. At its core, the Sensor API supports the exchange of Learning Events based on interactions with/on Learning Activities.

Learning Events are expressed in the form of a data triple - "Action (Learning) Context" - "Action" - "Activity Context". This is based on the W3C RDF Triple form of "subject/predicate/object" - i.e. an expression linking one object (subject) to another object (object) or a literal via a predicate. In this case, the Learning Event will allow for the expression of the measurement of an interaction with a Learning Activity. Learning Events are consumed by Sensor endpoints. These can be implemented by any application that wishes to consume Learning Events and is expected to support popular protocols like HTTP/REST. Each element of the Learning Event triple defines one or more of the entities in a learning interaction. Together, these entities make up the Learning Graph based on the connectedness of the entities within a learning environment. Each of these elements is based upon existing IMS specifications and vocabulary (for EDUPUB this includes the QTI specification), as well as, the in-progress IMS Learning Activity Metric profiles.

The Learning Events and Metric Profiles are intended to strike a balance between a completely open mechanism and a rigid schema for measuring and analyzing learning in the scope of the Learning Graph. The Metric Profiles are intended to apply a very lightweight schema while allowing for marshaling of custom data specific to a particular App/System with a goal of enhancing the profiles in a very iterative way in order to support the needs of the educational technology community.

2.5   QTIv2.1 Content Architecture

The Question & Test Interoperability (QTI) Specification provides assessment programs and question item developers a data model for standardizing the file format of digital test items [QTI, 12a], [QTI, 12b]. The QTI specification makes use of the IMS Content Packaging (CP) v1.2 specification [CP, 07a]. QTI is based on *AssessmentItem* and *AssessmentTest* models that allow question developers to specify a variety of information for a test (an *AssessmentTest* consists of one or more *AssessmentItems*). The APIP/QTI model provides a comprehensive framework that encompasses the requirements for creating accessible tests.

2.5.1   Tests & Packages

Each Quiz/Test is contained within its own Quiz/Test Package (as a zip file). Each *assessmentTest* must contain one or more *testParts* and each *testPart* must contain one or more

assessmentSections.   Each *testPart* definition is contained within the *assessmentTest* XML instance. It is recommended that each *assessmentSection* in a *testPart* is defined by reference i.e. it is contained in a separate XML instance file.

Within a package, the set of XML instances and asset files should be collected in directories based upon the corresponding Item/Section. A separate directory may be used to store assets that are used by more than one Item. The directory composition in a content package is used to ease the packaging of the information. It is not required for end systems to sustain this set of relationships however it must be possible for the end system to obtain all of the files identified by an XML instance. A schematic representation of the composition of a QTI-based Quiz/Test is shown in Figure 2.5.
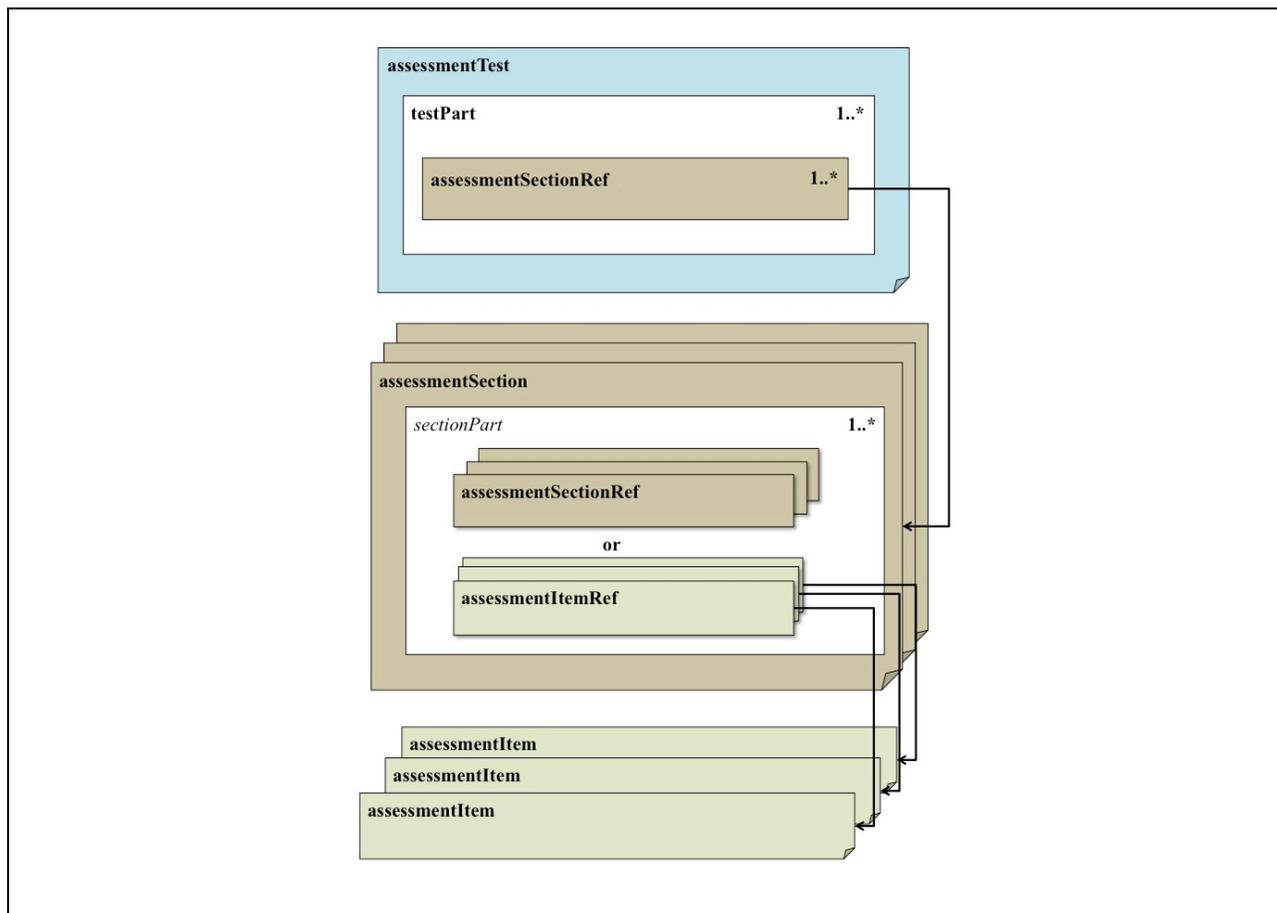
Figure 2.5 – The logical and file composition of a QTI-based assessment.

The key features in Figure 2.5 are:

- *AssessmentTest*, *assessmentSection* and *assessmentItem* objects are contained in their own XML instance files;

- *AssessmentSections* are permitted to contain *assessmentSections* i.e. these are the recursive objects used to build complex *assessmentTests*;

- The links to *assessmentSections* in *assessmentTests* and *assessmentSections* is provided using the *assessmentSectionRef* feature;

- *AssessmentItems* are linked to the *assessmentTest* using the *assessmentItemRef* object within the corresponding *assessmentSection*(s).
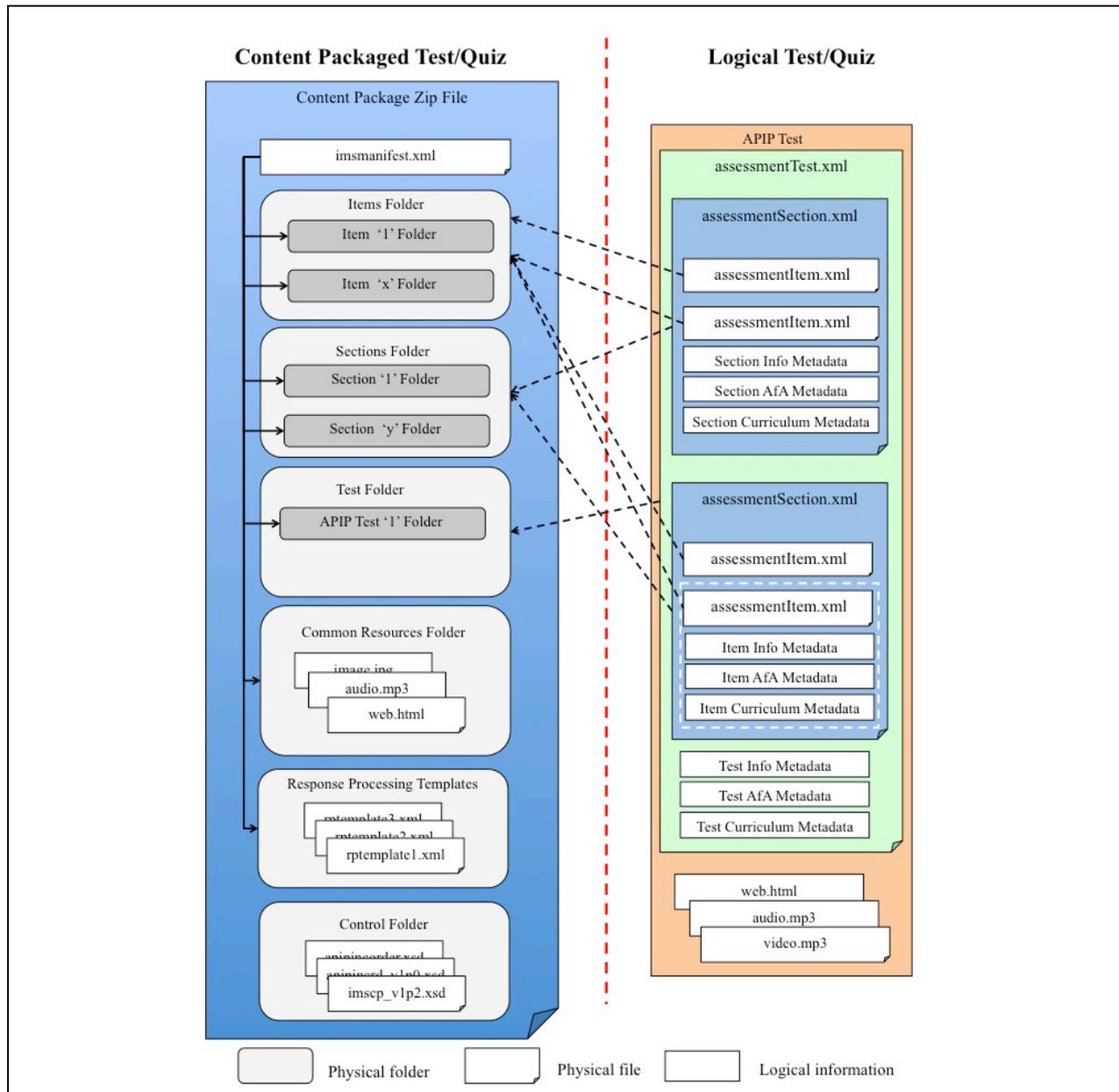
Figure 2.6 The QTI-based quiz/test package.

A Quiz/Test consists of one or more Sections and one or more Items. In fact, a Quiz/Test consists of all of the Items that are, or may be used by the Quiz/Test. Figure 2.6 shows the relationship between the logical data model for a quiz/test and the construction of the Package.

The appropriate 'imsmanifest.xml' file must be included in the Package. The zip file must comply with the IMS Content Packaging requirements and the corresponding profile constraints.

2.5.2   QTI Item Features

The QTIv2.1 specification defines the behavioural expectations for the various QTI features. All of the QTI interactions are permitted within a package. Other QTI *assessmentItem* features available are:

- Composite Items – these are items that contain more than one type of interaction. Composite items may contain multiple instances of the same type of interaction or have a mixture of interaction types. When it isn't 'composite', an item is considered 'simple';

- Use of CSS 2.1 tags for layout and formatting – QTI 2.1 allows for the inclusion of a CSS file reference within the item. APIP enforces the specific use of CSS as the layout specification. The full CSS 2.1 specification can be found at http://www.w3.org/TR/CSS2/.[2]

- Templates – Item templates are templates that can be used for producing large numbers of similar items. Such items are often called cloned items. Item templates can be used to produce items by special purpose cloning engines or, where delivery engines support them, be used directly to produce a dynamically chosen clone at the start of an item session;

- Adaptive Items – adaptive items are a new feature of version 2 that allows an item to be scored adaptively over a sequence of attempts. This allows the candidate to alter their answer following feedback or to be posed additional questions based on their current answer;

- Feedback – feedback consists of material presented to the candidate conditionally based on the result of *responseProcessing*. In other words, feedback is controlled by the values of outcome variables. There are two types of feedback material, modal and integrated. Modal feedback is shown to the candidate after response processing has taken place and before any subsequent attempt or review of the item. Integrated feedback is embedded into the *itemBody* and is only shown during subsequent attempts or review;

- Response Processing Templates – response processing templates are used to simplify response processing. When such templates are used these may be included in the Package as a separate resource. The key open issue for each template is the set of response processing variables that should be defined for each type of interaction;

- Outcomes Declarations – the outcomes defined for an Item can be associated with the learning standards to which they apply. This is achieved using the curriculum standards metadata annotation for a resource in a Package (in the manifest). For each outcome defined in an *assessmentItem*, a separate Outcomes Declaration XML instance file is created. These outcomes declaration instance files are now defined as manifest resources and the appropriate

---

[2] CSS 3.0 is now available and later releases of the QTIv2.1 specification will address its usage. APIP compliant systems are recommended to support CSS 3.0.

CSM annotations are included. Finally, the dependency between the Outcome Declaration resource and the parent *assessmentItem* resource is identified using the resource *dependency* feature in the manifest.

2.5.3   Metadata

There are many types of metadata used within a QTI Package, namely:

- Manifest Metadata – manifest metadata is normally encoded using IEEE LOM [LOM, 02] (all LOM parts are available for use as required). An importing system is expected to make this metadata available for observation to appropriately authorised user roles. An exporting system must ensure that this information can be accurately supplied;

- Resource Metadata – the resource metadata is normally encoded using IEEE LOM (all LOM parts are available for use as required). An importing system is expected to make this metadata available for observation to appropriately authorised user roles. An exporting system must ensure that this information can be accurately supplied;

- QTI-specific Metadata – this metadata describes if the Item is a composite or not i.e. uses more than one interaction form and identifies the type of interaction used. Other QTI metadata is available to describe the tool that was responsible for the creation of the Item i.e. tool name, tool version and tool vendor. The metadata is encoded using the QTI metadata XML binding and this is supplied within the LOM descriptions for the associated resource. An importing system is expected to make this metadata available for observation to appropriately authorised user roles. An exporting system must ensure that this information can be accurately supplied;

- Curriculum Standards Metadata (CSM) [CC, 11] – curriculum standards metadata is supported at the package and resource levels. The design of this support allows for at least the following:

  - Any curriculum standard, learning standards or learning map definition can be used, as long as it supports unique identifiers. The provider of a specific standard is designated by the string-valued 'provider' element. Note that the provider can be accompanied by region and version string-valued attributes. These are intended to be for descriptive value only

  - Any cartridge and resource (hence Item, Section, Test and Outcome Declaration) can be associated with zero or more curriculum standards from one or more providers

  - The provider value and GUID should be sufficient to unambiguously identify a standard

  - An optional GUID label is supported to make standards more readily apparent when examining the cartridge;

- File Metadata – the file metadata is normally encoded using IEEE LOM (all LOM parts are available for use as required). An importing system is expected to make this metadata

available for observation to appropriately authorised user roles. An exporting system must ensure that this information can be accurately supplied;

- Access For All Digital Resource Description (AfA DRD) Metadata [DRD, 09] – AfA DRDv2.0 metadata can be used to described variant QTI Item structures e.g. when an alternative QTI Item based on simplified language is also available. There is no particular recommendation for how to use AfA DRD to support variant resources.

2.5.4   APIP Accessibility Features

The following accessibility features [APIPQ, 14] are available:

- Assessment Item (Item Body) – the principle manner for the description of the alternative accessible forms of the content for the question;

- Assessment Item (Rubric Block) – Item-level content that is presented as rubric information (the specification is silent on best practices for how a system should present this information);

- Assessment Item (Modal Feedback) – Item-level feedback (the specification is silent on best practices for how a system should present this information);

- Assessment Section (Rubric Block) – Section-level content that is presented as rubric information including use as a common stimulus for several Items (the specification is silent on best practices for how a system should present this information);

- Assessment Test (Test Feedback) – Test-level feedback (the specification is silent on best practices for how a system should present this information).

It should be noted that the QTI-based accessibility features are not supported in this first version of EDUPUB.

2.6   The EDUPUB Architecture

The underlying architectural model for EDUPUB is shown in Figure 2.7. The key features are:

- EPUB Reader – the device and/or software that is used to render the eBook for use by the user. The Reader will, in general, contain many eBooks;

- Learning Management System (LMS) – an institutions LMS through which the learning activity is moderated;

- Assessment System – the system responsible for presenting and scoring an online assessment (this can be formative and summative assessment);

- Analytics System – the learning analytics repository plus the services through which the learning metrics are made available;

- Student Information System (SIS) – the institutions system that stores all of the reference information about the learner.
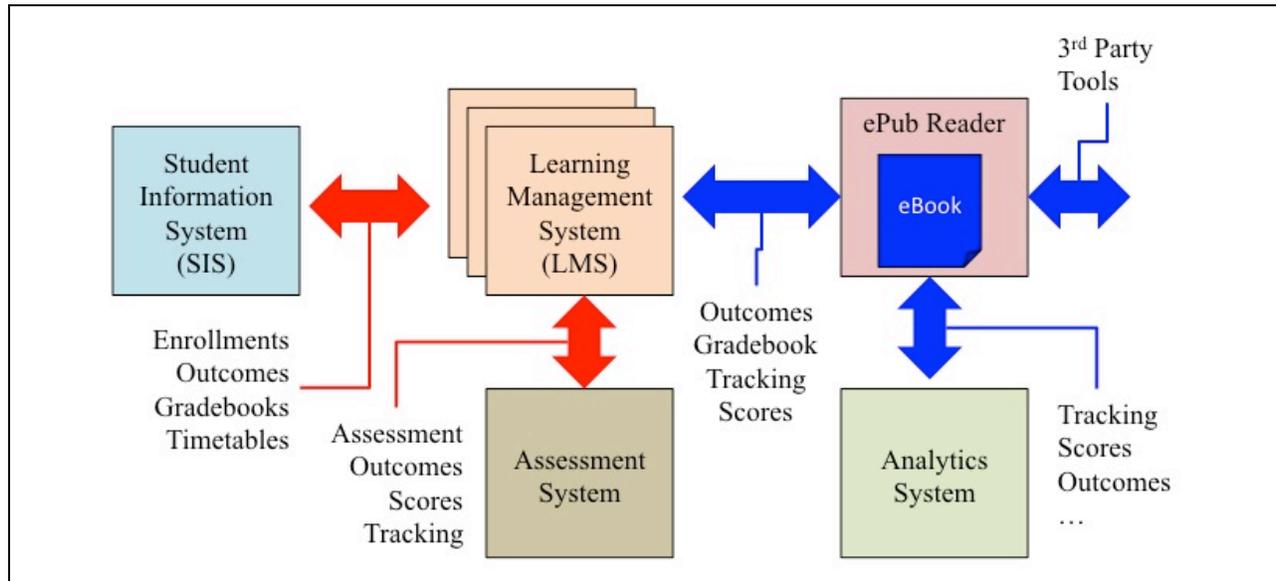
Figure 2.7 – Overarching EDUPUB Architectural Model

2.6.1   The Core EDUPUB Use-cases

The core usage scenarios for this architecture are:

- Standalone Consumer Access – in this scenario the eBook Reader is used without any of the use of institutional or other third party services. This is the typical usage for a consumer;

- Institutional-oriented Access – in this scenario the eBook is part of a larger educational and/or training environment. A number of institutional services such as the LMS, SIS, assessment and analytics systems are used;

- LTI-Mediated Remote Content Access & Reporting – a software-based eReader may be launched via LTI using a pre-configured consumer key and shared secret (see Section 3). A specific eBook may be opened automatically by passing its name in a custom LTI launch parameter. LTI-mediated content can be used in both standalone and institutional-oriented access.

2.6.2   Supporting Learning Analytics

Support for learning analytics requires various systems and the content itself to have the ability to report the appropriate data to the analytics server/repository. This gives rise to the use of the IMS Sensor API as shown in Figure 2.8.
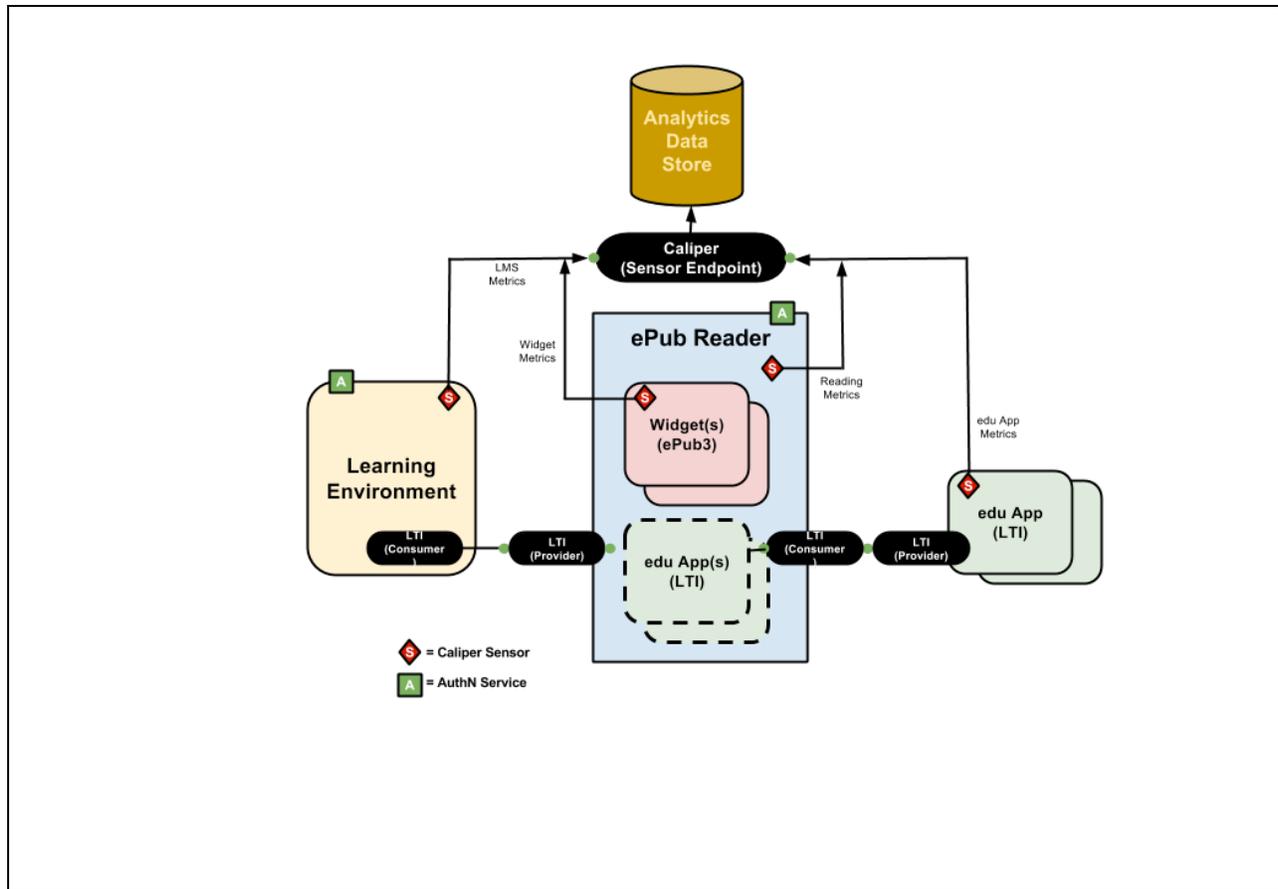
Figure 2.8– Supporting learning analytics within the EDUPUB Architectural Model

There is no co-ordination between each of the Sensor deployments. Therefore each data log sent by each sensor must have sufficient semantic information so that the data from the different streams can be collated and aggregated as appropriate to the learning metrics. A sensor can send to any endpoint and multiple end points can be supported by one physical analytics repository. Endpoint differentiation can be used for data segregation e.g. different levels of data privacy may be handled at different endpoints.

3 EPUB3 and Learning Tools Interoperability v1.x

IMS has developed the LTI specifications to allow remote tools and content to be integrated into a LMS. LTI has two main components:

- What is traditionally named as the LMS is referred to as the "Tool Consumer" (TC) as it "consumes" the tool;

- The external tool or content is called the "Tool Provider" (TP) as it "provides" the tool for use in the Tool Consumer. Example Tool Providers might include an externally hosted testing system or a server that contains externally hosted premium content.

3.1 LTIv1.x Tool Provider Support in EPUB3 Readers

3.1.1 Configuring Access for a Tool Consumer

A Tool Consumer may be given the ability to launch Readium by issuing it with a unique consumer key and shared secret. These properties are configured in Readium by adding an element to the `LTI_CONSUMERS` array variable in `server/main.js`;[3] for example:

```
{
    "key" : "imsglobal.org",
    "secret" : "ASecureSecret"
}
```

The consumer key and shared secret should be securely submitted to the Tool Consumer for use in their configuration process of the LTI tool; the launch URL is the address of the Readium server with a path of `/ltilaunch`.

3.1.2 Processing Launch Request Messages

When a launch request message is received by the `/ltilaunch` path, the following steps are followed:

1. Check that a consumer key, OAuth signature and timestamp have been included in the request;

2. Check that the timestamp is within 5 minutes of the Readium server time;

3. Check that the consumer key has been configured in the Readium server (see Subsection 3.1.1);

4. Verify the OAuth signature using the shared secret configured for the consumer key;

---

[3] A hard-coded JavaScript array is currently used to record these values, but should be replaced by a more persistent form of storage in a future version.

5. Check that the following required launch parameters are present:

    a. context_id
    b. required_link_id
    c. user_id

6. Display the Readium home page exposing the following variables:

    a. `LTI` – an object containing all of the LTI launch parameters for this session (see below)

    b. `LTI_TOOL_TARGETS` – containing the display target for each available tool provider (see Subsection 3.2.1);

If a parameter named `custom_epub` is included in the launch request, then its value will be used as the name of the eBook to be opened;

7. If the launch request is not valid then the user is redirected to the return URL with an error message, or if no return URL is provided, an error page is displayed.

The LTI variable is an array with one element named "session" containing an object with the following structure:

```
{
   "id" : "14535562111996114",
   "user" : {
      "id" : "29123",
      "firstname" : "John",
      "lastname" : "Baird",
      "email" : "jbaird@uni.ac.uk"
   },
   "context" : {
      "id" : "S3294476"
   }
}
```

The session ID (`LTI["session"].id`) is used to keep each launch request received separate and should be passed when performing any launches to an LTI Tool Provider (see Subsection 3.3). The other properties can be accessed via JavaScript in a similar way; for example, a user's email address is `LTI["session"].user.email`. Each property is guaranteed to exist and will be filled with dummy data when the corresponding launch parameters have not been passed from the tool consumer. The following dummy values are used:

- `user.firstname`: User;

- `user.lastname`: same as `user.id`;

- `user.email`: empty.

3.2 LTIv1.x Tool Consumer Support in EPUB3 Readers

3.2.1 Configuring Access to a Tool Provider

A Tool Provider may be made available for launch from within Readium by adding an element to the `LTI_PROVIDERS` array variable in `server/main.js`;[4] for example:

```
{
   "id" : "test",
   "name" : "Test launch",
   "key" : "testing.edu",
   "secret" : "secret",
   "url" : "http://tp.server.com/lti/launch",
   "target" : "window",
   "presentation_document_target" : "popup",
   "displayWidth" : 800,
   "displayHeight" : 600,
   "custom" : {
      "debug" : "true",
      "one" : "1"
   }
}
```

For each Tool Provider there are the following attributes:

- `id` – a unique id used in launch links to identify the tool to be launched (see);

- `name` – a human readable name for the tool;

- `key` – the consumer key issued for use by the tool provider;

- `secret` – the secret issued for use by the tool provider;

- `url` – the launch URL;

- `presentation_document_target` – where the tool should be opened ("window" and "popup" are currently supported);

- `displayWidth` – the width of the window to be opened when the target is set to "popup", a default value of "400" is used when this attribute is not specified;

- `displayHeight` – the height of the window to be opened when the target is set to "popup", a default value of "400" is used when this attribute is not specified;

- `custom` – a set of custom parameters which will be included in launch requests.

---

[4] A hard-coded JavaScript array is currently used to record these values, but should be replaced by a more persistent form of storage in a future version.

3.2.2　LTI Launch Parameters

The parameters listed in Table 3.1 are currently included in launch requests to available Tool Providers:

Table 3.1 – The parameters available for an LTI launch request.

Name	Source
context_id	C
context_title	C
context_type	C
launch_presentation_document_target	P
launch_presentation_width	P
launch_presentation_height	P
launch_presentation_locale	C
lis_person_contact_email_primary	C
lis_person_name_family	C
lis_person_name_full	C
lis_person_name_given	C
lis_person_sourcedid	C
lti_message_type	S
lti_version	S
oauth_callback	S
oauth_consumer_key	S
oauth_nonce	S
oauth_signature	S
oauth_signature_method	S
oauth_timestamp	S
oauth_version	S
resource_link_id	Q
resource_link_title	Q
roles	C
tool_consumer_info_product_family_code	P

Name	Source
tool_consumer_info_version	P
tool_consumer_instance_guid	P
user_id	C
user_image	C

Key to source values:

- C – passed on from the original LTI launch request received from the Tool Consumer (omitted if the parameter was not included in the original request);

- P – based on data held within Readium;

- Q – value specified in the construction of the launch link within Readium;

- S – values generated automatically as part of the launch process.

Any custom parameters specified in the Tool Provider configuration will also be added to the launch request, and the parameters named custom_caliper_service_url and custom_caliper_api_key will also be passed on if present in the original launch request.

3.3   LTIv1.x Usage in the EPUB3 Books

One of the available Tool Providers may be launched by sending an HTTP request to the Readium server with a path of /ltitool and including the following query parameters:

- session – the id for the user session (as passed in LTI["session"].id);

- tool – the id for the tool to be launched;

- id – the id of the link from which the tool is being launched (each link should have a unique id which is passed as the resource_link_id parameter on an LTI launch;

The URL is constructed by a JavaScript function so a launch link can be created by inserting a hyperlink similar to the following into an eBook:

```
<a href="" onclick="return ltiLaunchTool(this, 'test', '54935405')"
   title="Test launch">Test launch</a>
```

Clicking this link will attempt to launch the tool which has the ID of test with a resource link ID of 54935405. The link text in this example is taken from the Tool Provider configuration but may be changed as desired for each link. The title attribute is optional but, when present, will be used as the value of the resource_link_title launch parameter.

3.4   EDUPUB and LTIv1.x Conformance

At the time of publication the EDUPUB Conformance Programme has not been finalised. This Section will be completed in later versions of this document.

3.5   Readium and LTIv1.x Compliance

At the time of publication the Readium tool has not undergone LTIv1.x conformance testing. This Section will be completed in later versions of this document.

4   EPUB3 and Caliper

4.1   Caliper Support in EPUB3 Readers

Caliper support in EPUB3 readers is enabled by

- (Ideally) having the EPUB3 Reader also be a LTI Tool Provider;

- As part of the LTI Launch into the EPUB3 reader, propagating both the LTI context (userId, contextId) and the Caliper Context (passed as custom LTI launch parameters at the current time) to any installed Caliper sensors;

- Installing a Caliper Reading Sensor to the EPUB3 Reader and initializing it with both the Caliper and LTI Contexts during an LTI launch;

- Using the Caliper Readium Sensor to instrument key events in the EPUB3 reader via the Caliper Reading Metric Profile (see Subsection 4.1.2).

4.1.1   Reader Sensor(s) to Collect Learning Metrics

Most modern application, including Readium have event handling code/callbacks to deal with key user interactions with the functionality/content provided by the application. By using the appropriate Caliper Metric Profile, an application developer can plug into the existing event handling code and send Caliper Events to the endpoint (propagated during the LTI Launch).

4.1.2   Applicable Metric Profiles

In general, the Caliper Metric Profiles (MP) define the ontology and vocabulary representative of both learning activity common as well as specific measures or metrics and their related contextual attributes. Specifically, for the EDUPUB Reading activity, the following Caliper Metric Profiles initially apply and are extensible as required per profile elements as well as in the ability to apply additional or new profiles as the Reading activity is further enhanced with more activity related functionality. The key MPs are:

- Reading MP – covers the metrics and contextual elements for the core reading activity functionality inclusive of but not limited to e-text related navigation, e-text interactions, and engagement;

- Annotation MP – covers the metrics and contextual elements for the typical annotations capabilities made available for e-text reading activity functionality inclusive of but not limited to highlighting, notes and marks;

- Media MP – covers the metrics and contextual elements for any embedded media elements contained within the EDUPUB e-text content such as images, audio and video;

- Assessment MP – covers the metrics and contextual elements for an embedded formative or otherwise quiz activity contained within the EDUPUB e-text content such as quiz level interactions and attributes, item level interactions and attributes, and performance related item and quiz results (note that a separate but related Performance MP can be leveraged to accommodate more comprehensive detail for scores, results and/or outcomes).

4.1.3   Caliper Sensor Endpoint Use/Propagation

When the Readium EPUB3 Reader/LTI Tool Provider is launched, custom LTI parameters are passed as part of the launch (the Caliper Context). This enables propagation of a Caliper EventStore endpoint URL and a shared API Key from the LTI Consumer into the LTI Provider. Therefore, when the Readium EPUB3 Reader/LTI Provider launches a book as part of an LTI launch, it can propagate the Caliper Context using the code shown in Code 4.1:

Code 4.1 – Caliper context provision from LTI.

```
0000
0001   var loadEbook = function (packageDocumentURL)
0003                             {
0004                              readium.openPackageDocument(
0005                                   packageDocumentURL,
0006                                   function(packageDocument){
0007
0008       // Initialize the Readium Caliper Sensor for this LTI Session
0009       // We now have a fresh context for the sensor for each book
0010
0011            if (window.LTI) {
0012
0013                 // Extract required Caliper and LTI context
0014
0015                 var host    = LTI["session"].caliper.serviceurl;
0016                 var apiKey   = LTI["session"].caliper.apikey;
0017                 var personId = LTI["session"].user.id;
0018                 var courseId = LTI["session"].context.id;
0019
0020                 // Initialize the Readium Sensor
0021                 ReadiumSensor.initSensor(apiKey,
0022                                          host,
0023                                          courseId,
0024                                          personId,
0025                                          packageDocument.getMetaData()
0026                                          );
0027                          };
0028
0029            …
0030                                                 };
0031
0032            …
0033                          };
0034
```

4.2   Caliper Support in EPUB3 Books

The method calls available from the Sensor API are listed in Table 4.1.

Table 4.1 – The list of Sensor API methods.

Method Name	Functionality
initialize()	Initializes the API instance. This method must be called before the API can be used. The method parameters are: • API Key – the API authorization key; • Server URL – the URL for the target analytics repository; • Sensor Identifier – the identifier for the source sensor instance.
describe()	Sends a description of the context in which the measurements are to be supplied. The methods parameters are: • Type – the type of object being described; • Entity Identifier – identifier of the entity producing the measurements; • Properties – metadata about the measurements to be reported; • Time Stamp – date/time log for the description report.
measure()	Sends a measurement to the learning analytics repository. The method parameters are: • Action – the name of the action (from a predefined vocabulary); • Learning-context – information about the learning context for the measurement • Activity-context – the information about the learning activity i.e. the activity measurement itself; • Time Stamp – date/time log for the measurement report. See Subsection 4.1 for more details on the form of the measurement triple.

An example of the Sensor API being used in the context of a quiz within an EPUB3 is provided in Appendix D4.1.

4.3   EDUPUB and Caliper Conformance

At the time of publication the EDUPUB Conformance Programme has not been finalised. This Section will be completed in later versions of this document.

4.4   Readium and Caliper Compliance

At the time of publication the EDUPUB Conformance Programme has not been finalised. This Section will be completed in later versions of this document.

5   EPUB3 and Question & Test Interoperability

5.1   Open Approaches for Formative Assessment in EPUB3

Two approaches for the support of formative assessment within EPUB3 are presented in this best practices document:

- LTI-mediated – the use of LTI links placed within the EPUB3 eBook. When a link is activated the corresponding LTI launch request to the remote quizzing/assessment tool is made. The tool now presents the quiz (in this scenario the quizzing tool does not have to be compliant to QTIv2.1). For this scenario the eBook Reader must be connected to a network;

- Embedded – the quiz content is embedded within the EPUB3. This scenario is ideal when the eBook is used in standalone mode without access to a network. In this approach it is also possible to use remote services to support the embedded quiz e.g. for the response processing and so avoid the answer to the question being stored in the EPUB3 file.

In both cases the QTIv2.1 XML form of the quiz/test is the *definitive* content. All other forms *must* be derived from this reference baseline. This ensures that any identification/mapping information that is required by other services e.g. the learning analytics using the Sensor API, is available through any of the intermediate forms because they are all derived from the single reference source.

Both approaches are demonstrated using the examples described in Appendices B and D.

5.2   LTI-Mediated Assessment Content Delivery

A schematic representation of the LTI-mediated approach for assessment delivery is shown in Figure 5.1. For LTI-mediated delivery the only information contained within the EPUB3 file is the LTI-link and the associated launch request. The launch request requires that either the eBook Reader be an LTI-compliant Tool Consumer or the EPUB3 file itself contain all of the required code (for example as JavaScript) and the Reader permit direct network access by the EPUB3 content.

In this scenario, the remote quiz/test tool is responsible for any learning analytics data logging i.e. this data does not go via the eBook Reader. The LTI launch passes all of the relevant user identification code and so this can be used to provide the user-context for the analytics data to be logged. Once the quiz has been completed, control is returned to the eBook along with an outcome (the latter requires the use of LTIv1.1).

An example of the relevant EPUB3 page is shown in Figure 5.2. This page has two LTI links: one to the Questionmark assessment tool (which is LTI compliant but which uses QTIv1.2, and which supports the Sensor API; the other to the video-centric LMS YouSeeU. The use of these two LTI links is explained in Appendix B.
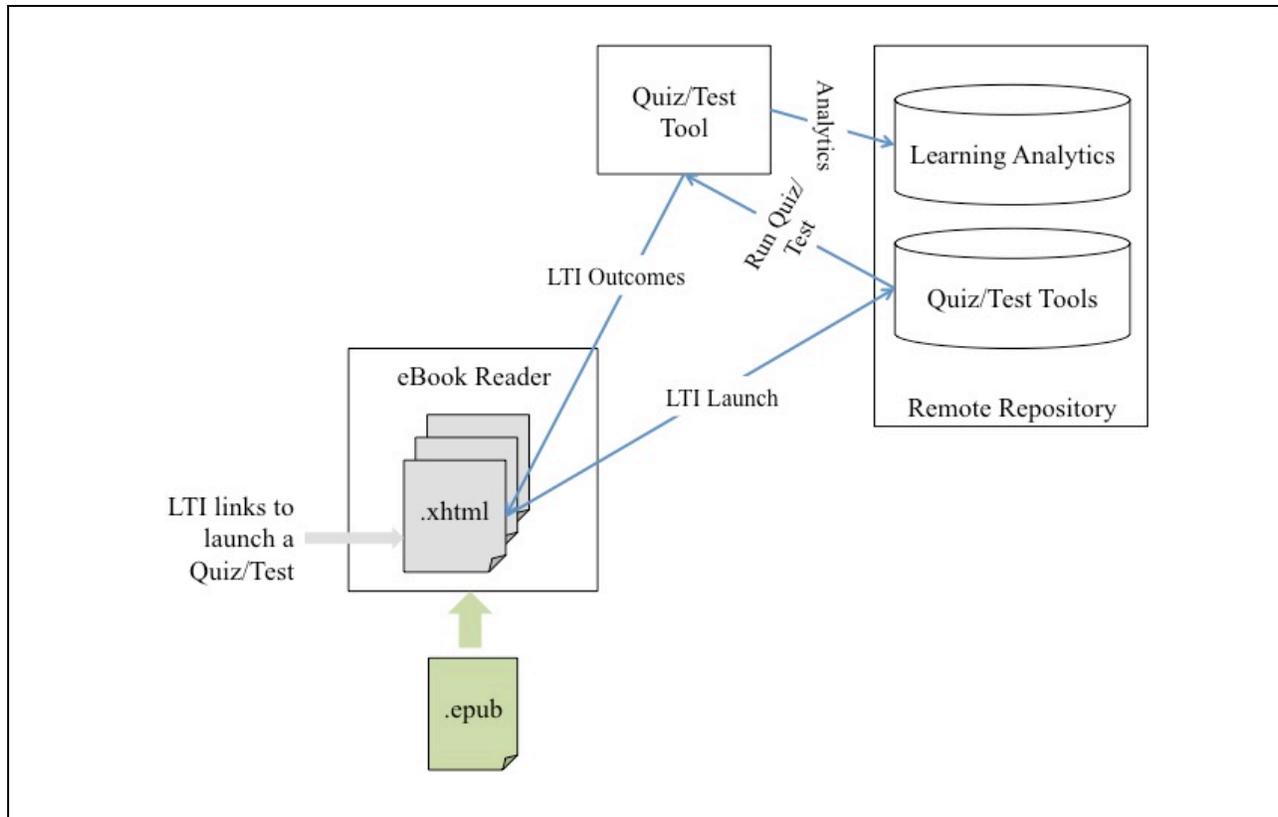
Figure 5.1 LTI-mediated delivery of a quiz/test from an EPUB3.
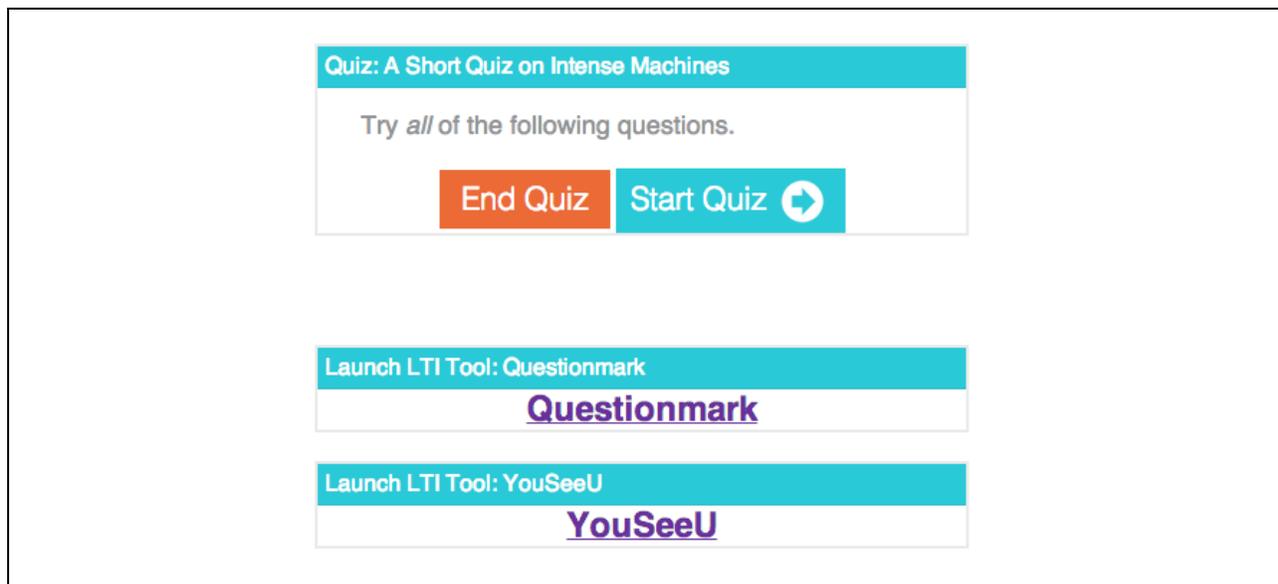
Figure 5.2 – LTI links embedded within an EPUB3 page.

5.3   Assessment Content Embedded in the EPUB3 Book

5.3.1   Overview of the Approach

In the scenario in which the quiz/test is embedded within the EPUB3, not only must the actual content for the quiz be contained, all of the associated code to support the rendering, response processing, feedback and outcomes processing and analytics reporting must be supplied. A schematic representation of the embedded content within the EPUB3 is shown in Figure 5.3.
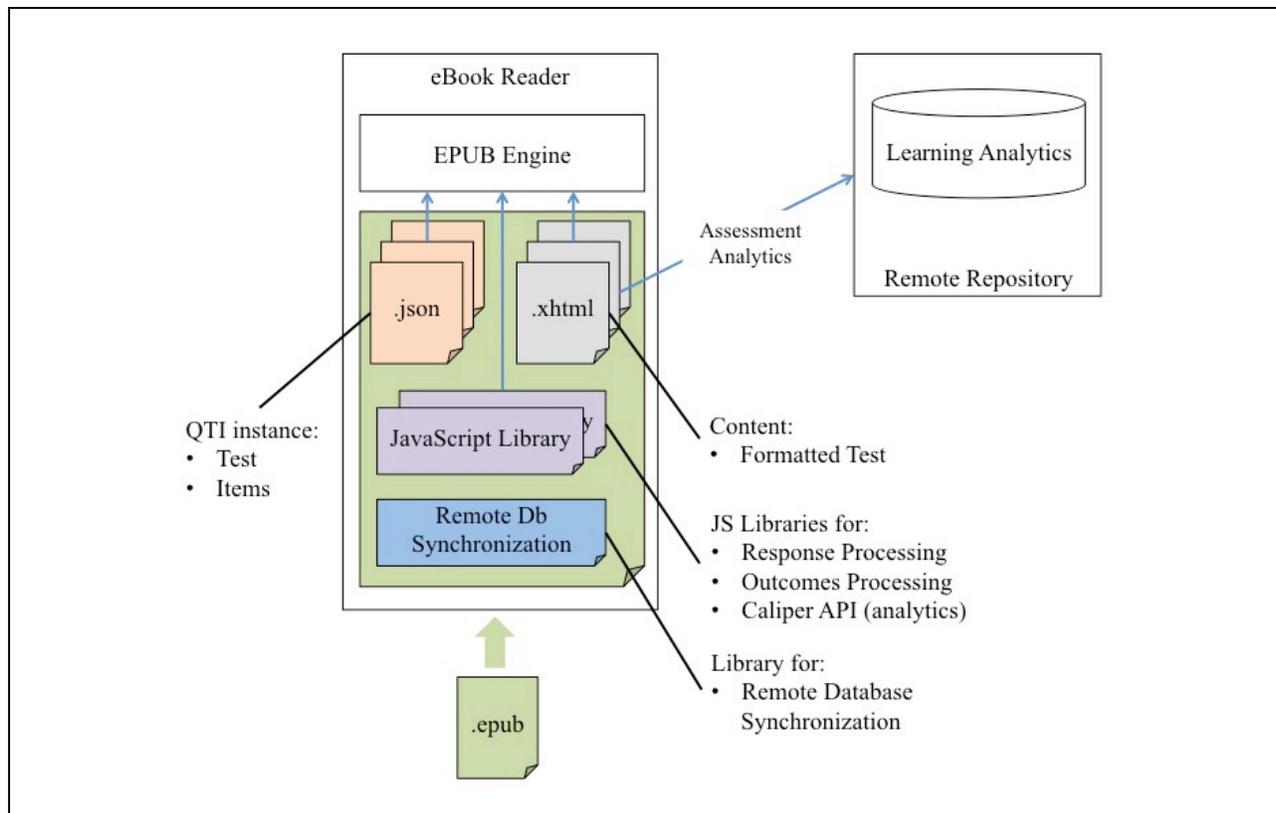
Figure 5.3 Embedded QTI-based delivery of a quiz/test in an EPUB3.

A workflow is required to start from the QTI-XML and to end with the quiz embedded within the EPUB3. This workflow is[5]:

a) The QTIv2.1 quiz package is unzipped. All of the QTI files are supplied in a profiled form of IMS Content Package (essentially this profile requires the <organizations> element in the 'imsmanifest.xml' file to be empty and prohibits sub-manifests). The 'imsmanifest.xml' file explains the structure of the QTI package with the essential features being:

---

[5] This workflow is presented for discussion and feedback. A number of modified versions are under evaluation and so IMS make no claims that this is the final and definitive mechanism to embed the quizzes. However, this approach produces a valid, operational solution.

- Each QTI Item is contained within its own XML instance file

- The Quiz QTI Test file is contained within its own XML instance file

- Every file in the package has its own resource definition. The <dependency> element is used to define the dependencies between these resource e.g. the test resource has a dependency on each of the item resource;

- Each resource has accompanying metadata that is encoded using the IMS Metadata v1.3 binding of the IEEE LOM v1.0 standard;

- The manifest-level metadata is also encoded using the IMS Metadata v1.3 binding of the IEEE LO v1.0 standard;

- The manifest, as a while, and each resource, can be annotated with the associated curriculum standards identifiers (this uses the IMS Curriculum Standards Metadata, CSM, standard metadata approach).

b) The set of XML files are now transformed from their XML format into the JSON equivalent (each XML file becomes a separate JSON file). This conversion is achieved using the NodeJS tool. The configuration settings required for this tool are:

```
var parser = new xml2js.Parser({
    attrkey : "_",
    mergeAttrs : true,
    charkey : "__text",
    normalize : true,
    explicitArray : false,
    explicitRoot : true
});
```

Before this conversion is undertaken, all of the embedded HTML should be escaped. For example, if the original mark-up is:-

```
<modalFeedback
   outcomeIdentifier="FEEDBACK"
   showHide="show"
   identifier="Incorrect"
   title="Incorrect Answer Feedback">
   <p>No, wrong answer. A <em>Combine</em> is used to collect the kernels
   of corn.</p>
</modalFeedback>
```

should become

```
<modalFeedback
   outcomeIdentifier="FEEDBACK"
   showHide="show"
   identifier="Incorrect"
   title="Incorrect Answer Feedback">
   &lt;p&gt;No, wrong answer. A &lt;em&gt;Combine&lt;/em&gt; is used to
   collect the kernels of corn. &lt;/p&gt;
```

```
</modalFeedback>
```

c)   The next stage is to create the XHTML file(s). At present this is a manual process using a set of question layout templates, a corresponding CSS file and insertion of the appropriate AngularJS primitives. The AngularJS primitives are used to obtain, in real-time, the relevant parts of JSON encoded data and to insert it into the HTML5 layout;

d)   The Sensor API calls are inserted in the AngularJS controller code. These controllers are invoked the handle the associated AngularJS calls within the XHTML file. These controllers plus all of the associated JavaScript libraries to the Sensor API, the AngularJS runtime, etc. are now inserted into the EPUB3 file structure layout;

e)   The OPF file for the EPUB3 has to be amended to include the references for all of the new files inserted to support the embedded quiz i.e. the contents of the <manifest> element are extended;

f)   The final change is that the navigation file ('nav.xhtml' has to be amended to include the new link to the embedded Quiz within the Table of Contents for the EPUB3 (see Figure D1.4);

g)   The set of files can now be zipped to create the new EPUB3-compliant eBook. This can now be accessed using an eReader such as Readium.

An example of this workflow is detailed in Appendix D.

5.3.2   The Supported QTI Features

The full QTIv2.1 standard is an extensive and powerful representation mark-up for tests and items. A considerably reduced subset has been adopted as the starting point for EDUPUB quizzes. EDUPUB is primarily concerned with formative assessment. The QTI features that are supported by this initial version of EDUPUB are:

• The Quiz/Test will be constrained to a single Testpart, will contain a single Section which will have at least one rubric block. The Section will not contain other Sections. The Section will contain any number of Items (but at least one) and each Item will have at least one rubric block. The Test will include support for test-level feedback;

• A predefined set of test-level outcome variables will be used i.e. 'TOTAL_SCORE', 'TOTAL_MAXSCORE', 'TOTAL_MINSCORE', 'MASTERY_SCORE', 'TOTAL_NUMBERINCORRECT', 'TOTAL_NUMBERCORRECT', 'TOTAL_NUMBERPRESENTED', 'TOTAL_NUMBERSELECTED', 'TOTAL_NUMBERRESPONDED' and 'FEEDBACK';

• Test-level outcomes processing will be defined using an implied template. The actual outcomes processing rules will be supplied in the QTI-XML but these do not need to be parsed;

- Choice interactions (used for True/False, Multiple Choice/Single Response an Multiple Choice/Multiple Response types of question). All of the associated content must be appropriately rendered. Support for shuffled answer options will be provided;

- Text entry interactions (used for Fill-in-Blank type of question). Inline support will be supported because the question(s) will, typically, be embedded in a larger paragraph of text. Only simple string comparison will be used for the response processing;

- Simple Hotspot interactions. This will include the use of a single background image with circular hotspot areas. The user will be expected to select a singe region, or hotspot;

- Response processing to provide the appropriate feedback to the reader. The response processing will be based upon fixed, predefined, response processing templates that detect the correct answer and trigger the corresponding feedback statement, and which detect an incorrect answer and provide a single form of corresponding feedback (this is item-level modal feedback only);

- A predefined set of item-level outcome variables will be used i.e. 'SCORE' and 'FEEDBACK'. 'SCORE' will be used to contain the score assigned by the response processing and 'FEEDBACK' to control the item-level feedback to be shown to the user. Item will have the maximum and minimum scores defined;

- The content HTML will be restricted to the use of <p>, <em> and <img> elements;

- Shared stimulus, usage statistics and results reporting are not supported.

The CP-XML features that must be addressed are:

- The quiz QTI-XML instance file will also contain the XML for the single QTI-Section. Each Item QTI-XML will be in its own file. The associated manifest will include all of the dependency definitions;

- Each resource will include only one physical file reference. The dependency element will be used to link together the relevant resources e.g. the quiz file will have a dependency on each of the item files;

- Access and use of the resource-level metadata including the CSM, and the QTI-specific metadata contained within the LOM-encoded resource-level metadata (use of the AfA DRD will not be addressed). This metadata may be supplied in the examples but usage/processing is not required;

- Access and use of the manifest-level metadata including the CSM. This metadata may be supplied in the examples but usage/processing is not required;

- The response processing templates may be included in the QTI-package but these will not e parsed to create the response processing. Instead the response processing template identifier will be used to identify the corresponding runtime software embedded in the EPUB3.

5.3.3   The Quiz Interface & User Experience

The original QTIv2.1 specification had an abstract user interface that defined the context interactions for a question. In this case the QTI is to be rendered and so an outline user experience has been established for the framing and interactions of the quiz and its questions as a whole. The opening page layout is shown in Figure 5.4 (an example of an the actual layout used in the examples is shown in Figure D2.1).

Quiz: < Title of Quiz>

< Test Rubric >

End Quiz
Button

Start Quiz
Button
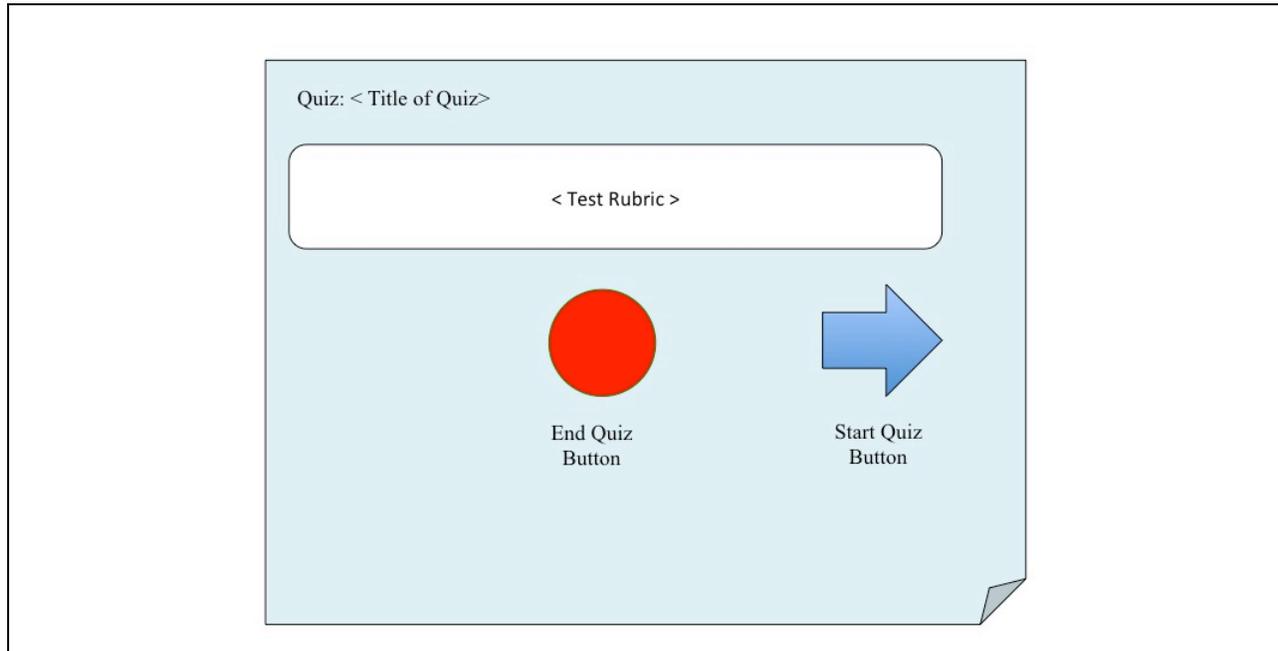
Figure 5.4 – The entry page for the quiz.

The opening page displays the title of the quiz, the section-level rubric (as defined for the user) and provides buttons to start or end the quiz. If the 'Start' button is pressed the user progress to the layout shown in Figure 5.5 else if the 'End' button is pressed the layout shown in Figure 5.6 is shown. The general layout for a question is shown in Figure 5.5 (this is amended if the first or last questions are encountered by removing either the previous or next item buttons respectively).

The Item layout has a region for the display of the Item-level rubric, the body of the Item i.e. the actual question and the associated content, and the feedback once an answer has been submitted. The 'Next' and 'Previous' buttons move to another Item (the sequential order is defined by the order the Items are referenced in the Section and not from the order of the resources in the QTI-Package). Once the user has answered the question, this attempt is scored only when the 'Submit' button is pressed. Examples of the layout for each of the supported question types are shown in Figures D2.2, D2.3, D2.4 and D2.5.

When the final question has been answered the end page is presented. The layout for the test summary page is shown in Figure 5.6.
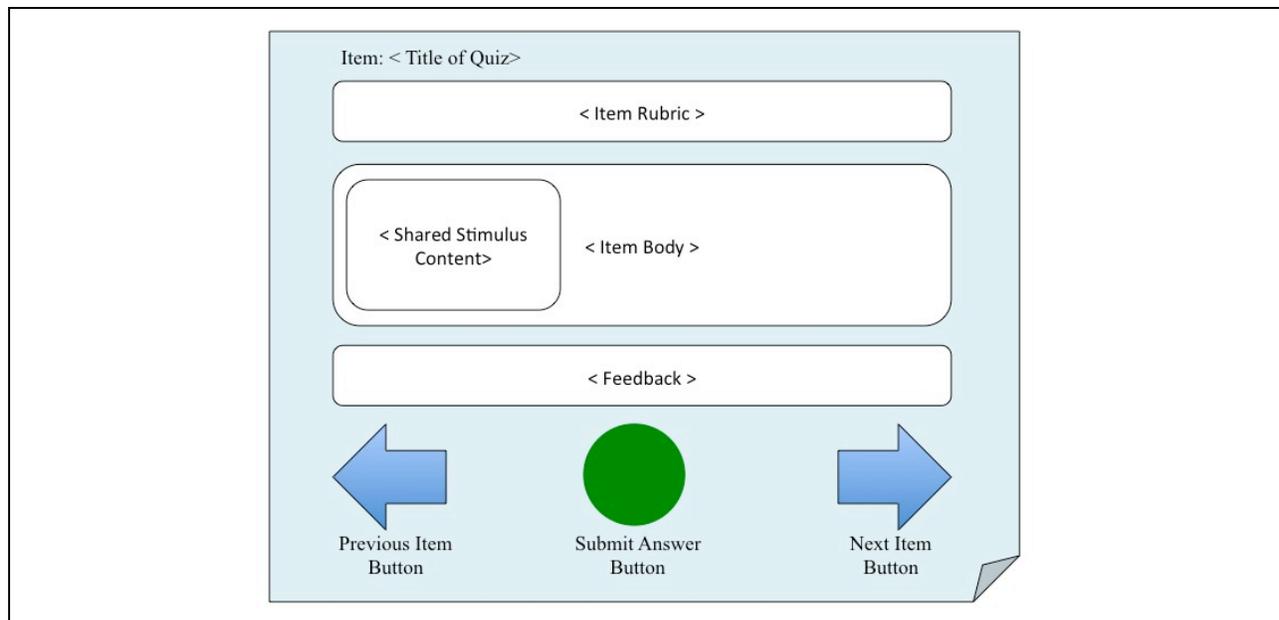
Figure 5.5 – The page layout for an item.
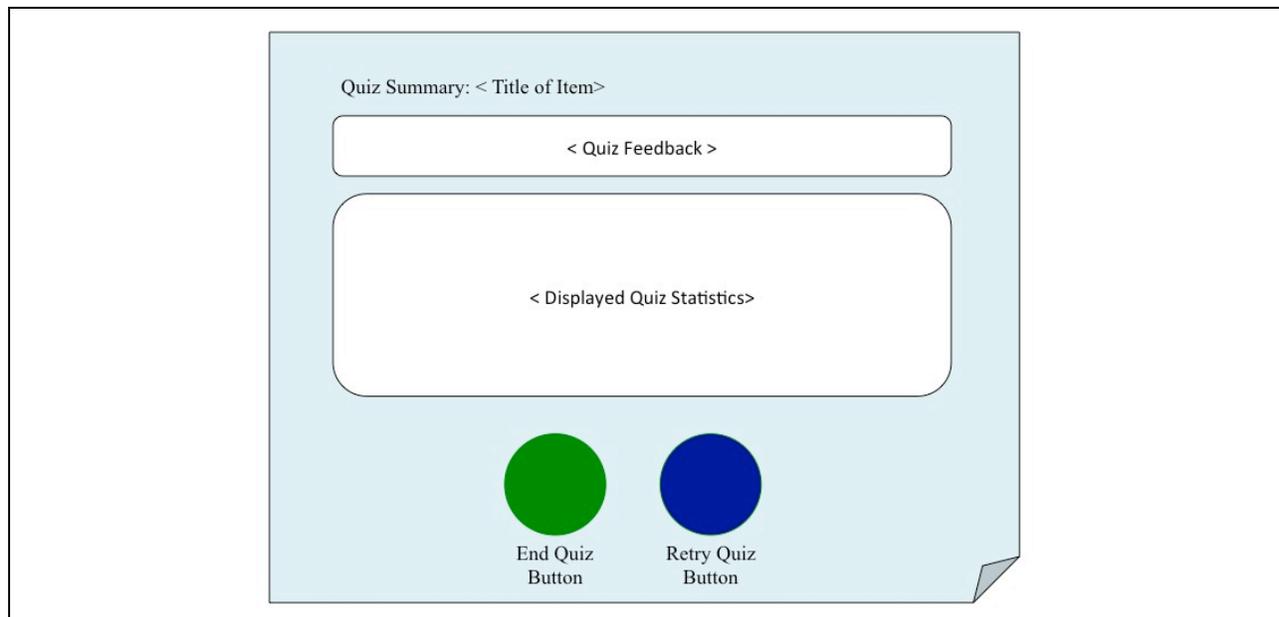
Figure 5.6 – The quiz completion page.

The layout for the quiz completion page has a region for the test-level feedback and the quiz statistics (the actual statistics to be presented has not be finalized). An example of this layout is shown in Figure D2.6.

5.3.4   Mapping from QTI to EDUPUB Quiz Format

Currently, mapping from the QTI-XML to embedded EDUPUB format is achieved by hand. This is to enable a range of approaches be evaluate without wasting effort on needless computer transformations. The details of the mappings are derived by examining the source QTI-XML files in Appendix D3 with the equivalent embedded files contained in Appendices D4 (XHTML) and D5 (JSON). The mapping details are summarised in Tables 5.1 and 5.2.

Table 5.1 – QTI-XML to embedded EDUPUB mappings for the quiz.

QTI-XML Feature	Equivalent EDUPB Feature
Title	Assigned in the XHTML via application of AngularJS model 'qti.assessmentTest.title' to the 'qti.assessmentTest.title' object in the quiz JSON file.
Outcome Variables	No transformation. Implicit variables used in the outcomes processing library.
Test Part	No transformation. A single *testPart* is assumed.
Assessment Section	No transformation. A single *assessmentSection* is assumed.
Item References	Insertion of a set of AngularJS question handlers for the True/False, Multiple Choice-Single Response, Multiple Choice-Multiple Response, Fill-in-Blank and Hotspot question types.
Rubric Block	Assigned in the XHTML via application of AngularJS binding to 'qti.assessmentTest.testPart.assessmentSection.rubricBlock. text'.
Outcomes Processing	No transformation. Implicit outcomes processing code used in the outcomes processing library.
Feedback	Assigned in the XHTML with the AngularJS 'data-ng-show' value of 'showResponsePage'.

Table 5.2 – QTI-XML to embedded EDUPUB mappings for an Item.

QTI-XML Feature	Equivalent EDUPB Feature
Title	Assigned in the XHTML via application of AngularJS model 'qti.currItem.assessmentItem.title' to the 'qti.currItem.assessmentItem.title' object in the quiz JSON file.
Response Variables	No transformation. Implicit default variable names used in the response processing library.
Outcome Variables	No transformation. Implicit variables used in the outcomes processing library.
Rubric	Assigned in the XHTML via application of AngularJS binding to 'qti.currItem.assessmentItem.itemBody.rubricBlock. text'.
Presentation	Insertion of a set of AngularJS question handlers for the True/False, Multiple Choice-Single Response, Multiple Choice-Multiple Response, Fill-in-Blank and Hotspot question types.
Response Processing	No transformation. Implicit response processing code used in the response processing library.
Feedback	Assigned in the XHTML with the AngularJS 'data-ng-show' value of 'itemFeedback'.

5.4   Metadata

All of the metadata from the QTI-Package is contained within the manifest of the content package. The metadata used within a QTI Package:

- Manifest Metadata – about the package as a whole;

- Resource Metadata – about the resource s a whole;

- QTI-specific Metadata – supplied for assessment-based resources;

- Curriculum Standards Metadata – to indicate the curriculum standards that are addressed by the use of the resource or manifest

- File Metadata – metadata specific to a file used as part of a resource. This metadata is not used in this version of EDUPUB;

- AfA DRD Metadata – to provide information about the accessibility features of a resource. Support for this metadata is not addressed in this version of EDUPUB.

This metadata has to be mapped into the equivalent binding form before it can be stored within an EPUB3. The above metadata is to be stored within the new QTI-XHTML file, one for each quiz that is used that must be stored within the EPUB3. Therefore, Schema.Org based micro-data binding must be used. A full description of the range of metadata that can be supplied from a QTI-Package and the corresponding mapping to the Schema.Org-based representation is explained in Appendix E.

A simple example of the mapping of the QTI-XML to Schema.Org metadata for the quiz resource is supplied in Code inserts 5.1 and 5.3. In Code 5.1 the resource-level metadata is supplied in lines 0003-0044 (in this example all of the metadata has been supplied within the context of LOM i.e. using LOM extensions to contain the QTI-specific and the CSM). Within this the core LOM metadata is supplied in lines 0005-0023, the QTI-specific in lines 0024-0027 and the CSM in lines 0028-0042.

Code 5.1 – An example of resource-level XML-based metadata for a quiz.

```
0000  …
0001  <resource type="imsqti_test_xmlv2p1" identifier="ResourceTest01"
0002          href="…">
0003      <metadata>
0004          <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0005              <general>
0006                  <identifier>
0007                      <entry>MACHINE-QUIZ01</entry>
0008                  </identifier>
0009                  <title>
0010                      <string>A Short Quiz on Intense Machines</string>
0011                  </title>
0012              </general>
0013              <lifeCycle>
0014                  <contribute/>
0015                  <version>
0016                      <string>Final 1.0</string>
0017                  </version>
0018              </lifeCycle>
0019              <educational>
0020                  <description>
0021                      <string>EPUB3/QTI Example Quiz 1</string>
0022                  </description>
0023              </educational>
0024              <qti:qtiMetadata>
0025                  <qti:feedbackType>nonadaptive</qti:feedbackType>
0026                  <qti:solutionAvailable>false</qti:solutionAvailable>
0027              </qti:qtiMetadata>
0028              <csm:curriculumStandardsMetadataSet
0029                  resourceLabel="…" resourcePartId="…">
0030                  <csm:curriculumStandardsMetadata providerId="…">
0031                      <csm:setOfGUIDs region="Florida" version="1.0">
0032                          <csm:labelledGUID>
0033                              <csm:label>GUID01_Label<csm:label>
0034                              <csm:GUID>GUID01<csm:GUID>
0035                          </csm:labelledGUID>
0036                          <csm:labelledGUID>
0037                              <csm:label>GUID02_Label</csm:label>
0038                              <csm:GUID>GUID02</csm:GUID>
0039                          </csm:labelledGUID>
```

```
0040                    </csm:setOfGUIDs>
0041                </csm:curriculumStandardsMetadata>
0042            </csm:curriculumStandardsMetadataSet>
0043        </lom>
0044      </metadata>
0045    …
0046  </resource>
0047  …
0048
```

Code 5.2 – Mapping of the test XML metadata to its Schema.Org microdata equivalent.

```html
0000
0001  <html xmlns="http://www.w3.org/1999/xhtml" data-ng-app="myApp">
002   <head>
0003      <title>Intense Machines Quiz</title>
0004      <meta name="viewport" content="width=1100, height=1650"/>
0005      …
0006
0007  </head>
0008  <body id="quiz_body" itemscope itemtype="http://schema.org/Quiz">
0009     <div class="Basic-Text-Frame" data-ng-controller="MainCtrl">
0010        <div class="qti-item" data-ng-hide="hideIntro">
0011           <meta itemprop="version" content="Final V1.0"/>
0012           <meta itemprop="description"
0013                content="EPUB3/QTI Example Quiz 1"/>
0014           <div itemprop="name" class="qti-item-header"
0015               data-ng-model="qti.assessmentTest.title">Quiz:
0016               {{qti.assessmentTest.title}}</div>
0017           <div class="item-content">
0018           <div class="qti-item-prompt"
0019                 data-ng-bind-html=
0020  "qti.assessmentTest.testPart.assessmentSection.rubricBlock.__text">
0021           </div>
0022        </div>
0023  …
0024     </div>
0025  </body>
0026  </html>
0027
0028
```

The, partial, Schema.Org microdata encoded equivalent of the quiz Code 5.1 is shown in Code 5.2. This microdata identifies the object as a 'Quiz' (line 0009) with the version encoded in line 0012, the description encoded in lines 001-0014, and the title encoded in line 0015. If the available content is not defined within HTML flow then the <meta> element would have to be inserted to associate the relevant metadata with the corresponding <div> structure.

In Code 5.3 the resource-level metadata for the example Item is supplied in lines 0004-0048 (in this example all of the metadata has been supplied within the context of LOM i.e. using LOM extensions to contain the QTI-specific and the CSM). Within this the core LOM metadata is supplied in lines 0006-0025, the QTI-specific in lines 0026-0031 and the CSM in lines 0032-0046.

Code 5.3 – An example of resource-level metadata for an Item.

```
0000  …
0001  <resource type="imsqti_test_xmlv2p1" identifier="ResourceTest01"
0002       href="…">
0003     <metadata>
0004         <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0005             <general>
0006                 <identifier>
0007                     <entry>MACHINE-ITEM01</entry>
0008                 </identifier>
0009                 <title>
0010                     <string>Number of Engines on a Jumbo Jet</string>
0011                 </title>
0012             </general>
0013             <lifeCycle>
0014                 <contribute/>
0015                 <version>
0016                     <string>Final 1.0</string>
0017                 </version>
0018             </lifeCycle>
0019             <educational>
0020                 <description>
0021                     <string>True/False Question on Number of Engines on a
0022  Jumbo Jet.</string>
0023                 </description>
0024             </educational>
0025             <qti:qtiMetadata>
0026                 <qti:interactionType>choiceInteraction
0027                 </qti:interactionType>
0028                 <qti:feedbackType>nonadaptive</qti:feedbackType>
0029                 <qti:solutionAvailable>false</qti:solutionAvailable>
0030             </qti:qtiMetadata>
0031             <csm:curriculumStandardsMetadataSet
0032                 resourceLabel="…" resourcePartId="…">
0033                 <csm:curriculumStandardsMetadata providerId="…">
0034                     <csm:setOfGUIDs region="Florida" version="1.0">
0035                         <csm:labelledGUID>
0036                             <csm:label>GUID01_Labelcsm:label>
0037                             <csm:GUID>GUID01csm:GUID>
0038                         </csm:labelledGUID>
0039                         <csm:labelledGUID>
0040                             <csm:label>GUID02_Label</csm:label>
0041                             <csm:GUID>GUID02</csm:GUID>
0042                         </csm:labelledGUID>
0043                     </csm:setOfGUIDs>
0044                 </csm:curriculumStandardsMetadata>
0045             </csm:curriculumStandardsMetadataSet>
0046         </lom>
0047     </metadata>
0048  …
0049  </resource>
0050  …
0051
```

Code 5.4 – Mapping of the item XML metadata to its microdata equivalent.

```
0000    …
0001        <div id="wrapper" data-ng-hide="hideQuiz">
0002            <div itemscope itemtype="http://schema.org/Question"
0003                class="qti-item" data-ng-hide="showResponsePage">
0004              <div class="qti-item-header">
0005                  <div itemprop="name"
0006                      data-ng-model="qti.currItem.assessmentItem.title"
0007                      class="title">{{qti.currItem.assessmentItem.title}}
0008                  </div>
0009                  <div class="points">1 pt</div>
0010              </div>
0011
0012            <div class="qti-item-rubric">
0013                <div class="qti-item-prompt"
0014                    data-ng-bind-html="qti.currItem.assessmentItem.itemBody.
0015                                       rubricBlock.__text">
0016                </div>
0017            </div>
0018
0019            <div class="item-content">
0020                …
0021            </div>
0022            …
0023        </div>
0024    …
```

The, partial, Schema.Org microdata encoded equivalent of the Item Code 5.3 is shown in Code 5.4. This microdata identifies the object as a 'Question' (line 0002) with the version encoded in line 0012 and the title encoded in line 0005. Again, if the required content is not available within HTML flow then the <meta> element would have to be inserted to associate the relevant metadata with the corresponding <div> structure.

5.5 Using Caliper with EDUPUB/QTI-based Content

The Sensor API is used to report the analytics measurements as the quiz is used. The measurements to be reported are defined using the Caliper Quiz Activity Metric Profile. The measurements reports are triggered by the corresponding user actions within the quiz. The state diagram for this activity is shown in Figure 5.7. In Figure 5.7 the seven states are linked using transitions that are marked with the user action required to trigger the transition and the corresponding list of learning analytics actions to be reported (the logical user interface is shown in Figure 5.4, 5.5 and 5.6). The seven state definitions are:

- S1 (In Content) – the user is interacting with the other, non-assessment, content. This is the active initial and end states;

- S2 (In Test) – the user has clicked on the test and started an assessment activity. Background information will be displayed e.g. rubric;

- S3 (Active Test) – the test has been started and further information may be displayed e.g. rubric informing what the user do to complete the test;
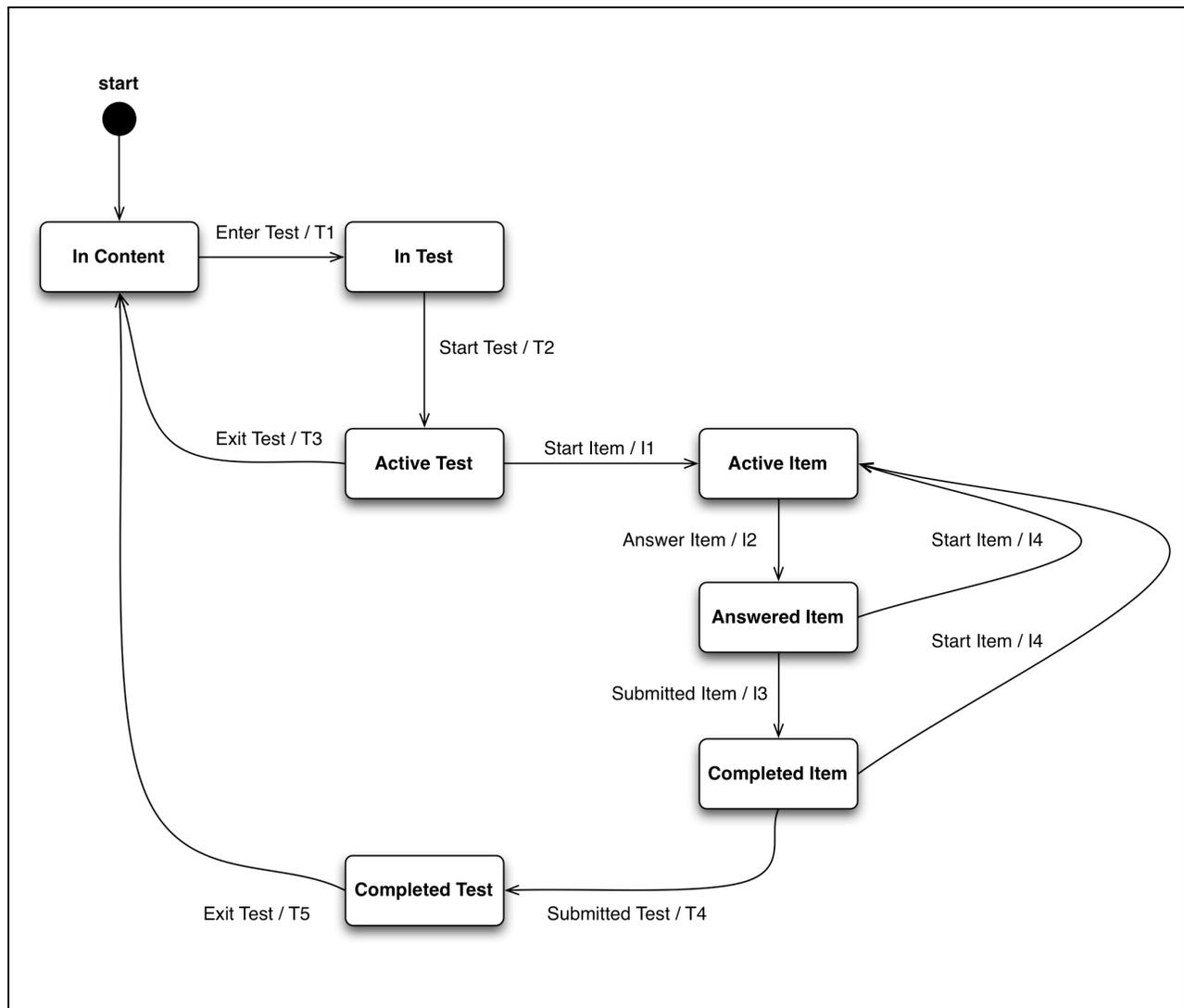
Figure 5.7 – The state diagram for the quiz interaction and Caliper reporting.

- S4 (Active Item) – the Item has been entered and the question presented to the user. Any Item rubric is also presented;

- S5 (Answered Item) – the user has started to interact with the question and has made one or more answer selections but has not yet submitted these answers for scoring;

- S6 (Completed Item) – the user has submitted the answers for scoring i.e. pressed the 'Submit' button. The corresponding feedback has been presented and the score for the question stored;

- S7 (Completed Test) – the user has completed the test. The score for the quiz is presented along with the appropriate test-level feedback.

The set of User Actions are:

- Enter Test – the user clicks on the test to initiate the assessment activity

- Start Test – the user confirms that they wish to start the test using an appropriate button e.g. 'Start Quiz';

- Exit Test – the user leaves the quiz using an appropriate button e.g. 'End Quiz';

- Start Item – the user enters the first, next or previous Item by pressing the appropriate button;

- Answer Item – the user selects or uses the various options available to select an answer e.g. press and radio button for a multiple choice-single response question, etc;

- Submitted Item – the user presses the 'Submit' button and so invokes the response processing and associated Item-level feedback;

- Submitted Test – once the full set of Item have been viewed, and perhaps answered and scored, the test itself can be completed by pressing the 'End Quiz' button and the corresponding quiz score and feedback presented.

The set of 'Learning Analytics Action List' definitions is (the order of the actions is significant and reflects the sequence of event processing):

- T1 – { 'VIEW TEST', 'VIEW TESTPART', 'VIEW SECTION' }. This list shows that the Quiz, Test Part and Section have been entered (at present this is a single action but when multiple test parts and multiple assessment sections are supported a more complex sequence will be created);

- T2 – { 'ATTEMPT TEST', 'ATTEMPT TESTPART', 'ATTEMPT SECTION' }. This indicates that the test has been started (as opposed to just entered);

- T3 – { 'EXIT SECTION', 'EXIT TESTPART', 'EXIT TEST' }. This list indicates that the test has been left without any questions being entered and so exit actions from the Section, Test Part and Quiz are reported;

- T4 – { 'EXIT ITEM', 'SUBMIT SECTION', 'SUBMIT TESTPART', 'SUBMIT TEST' }. This list indicates that the last Item has ben completed and the quiz itself submitted for final scoring and feedback;

- T5 – { 'EXIT SECTION', 'EXIT TESTPART', 'EXIT TEST' }. This list indicates that the test has been completed and so exit actions from the Section, Test Part and Quiz are reported;

- I1 – { 'VIEW ITEM' }. This list indicates that the first question has been displayed;

- I2 – { 'ATTEMPT ITEM }. This list indicates that an Item has been answered but not submitted for scoring';

- I3 – { 'SUBMIT ITEM' }. This list indicates that the item has been scored and Item-level feedback presented;

- I4 – { 'EXIT ITEM', 'VIEW ITEM' }. This list indicates that the next/previous Item has been displayed

In current implementation, only a small pat of this state diagram is implemented.

5.6   Remote Data Synchronization

Most people expect their computer applications to work as well offline as they do online. Offline use is a common scenario for EPUB documents. Data that is presented to the learner can often be stored as part of the EPUB file. But what about a scenario where the learner takes a quiz and each part of their movement through the quiz and their answers to questions need to be captured and stored offline?

There are a number of technologies emerging that can answer that question. All of the major browsers now support some form of local database storage accessible through JavaScript. To make things even easier for developers, technologies such as PouchDB have emerged that allow for easy offline storage of data and later synchronization with a compatible server whenever the application is online again.

Code 5.1 – Example of storing learning events offline to synchronize later

```
0000
0001   var db = new PouchDB(quizresults);
0003
0004   db.put({
0005       activityId: "quiz-22321",
0006       percentageScore: ($scope.qti.finalScore / $scope.qti.MAX_ITEMS) *
0007   100,
0008       achievedScore: $scope.qti.finalScore},
0009       Date.now()
0010   });
0011
0012   db.replicate.to('http://example.com/mydb');
0013
```

The sample above is very simple but also very powerful. On line 0001 a new database instance of PouchDB is created. On line 0004 the put() method is used to store a Javascript object that contains the key/value pairs for activityId, percentageScore, achievedScore, and a current time stamp. Line 00012 is where the magic happens. PouchDB will synchronize or replicate its stored data to an online CouchDB compatible database whenever it is online again.

5.7   EDUPUB and QTI Conformance

At the time of publication the EDUPUB Conformance Programme has not been finalised. This Section will be completed in later versions of this document.

5.8   Readium and Assessment Support Compliance

At the time of publication the EDUPUB Conformance Programme has not been finalised. This Section will be completed in later versions of this document.

Appendix A – Terms & Definitions

Content Package   The key exchange object defined in the IMS Content Package v1.2 standard. A profiled version of CP is used in the IMS QTIv2.2 standard for the exchange of *assessmentItems* and *assessmentTests*.

IMS Curriculum Standards Metadata (CSM)   This is the IMS standard that is used to provide the curriculum standards annotation metadata. This metadata is used to identify the set of globally unique identifiers (this GUID can take any form e.g. URI, etc.) that are relevant to the parent resource to which the CSM is attached. The context for the GUID is also supplied and so together this information can be used to identify the external standards definition documents.

EDUPUB   From the perspective of this best practices, the EDUPUB standard is the combination IMS Learning Tools Interoperability (LTI), IMS Caliper and IMS Question and Test Interoperability (QTI) with the EPUB3 eBook format (as defined by the International Digital Publishing Forum).

EPUB   The EPUB specification is a distribution and interchange format standard for digital publications and documents create and distributed by the IDPF. EPUB defines a means of representing, packaging and encoding structured and semantically enhanced Web content including HTML5, CSS, SVG, images, and other resources, for distribution in a single-file format.

Feedback   Within QTI, this is the information that is displayed to the user once they have answered a question. Within EDUPUB the available feedback is for correct and incorrect answers (feedback for partially correct answers is not supported – this is possible within the QTI-XML). The appropriate feedback is selected as part of the QTI response processing rules.

Fill-in-Blank (FIB) Question   One of the question-types that is supported by EDUPUB. This question contains a space in which the user is expected to type a short response (typically one word but short phrases are also common). These words/phrases are then scored using the associated set of response processing rules i.e. only simple computer-based scoring is used.

Hotspot   One of the question-types that is supported by EDUPUB. This question is based upon the use of an underlying image on which there are overlaid a number of hotspot regions that the user can select. The response processing and scoring is based upon the

hotspot selected by the user.

IDPF

The International Digital Publishing Forum (IDPF) is the global trade and standards organization dedicated to the development and promotion of electronic publishing and content consumption. The work of the IDPF promotes the development of electronic publishing applications and products that will benefit creators of content, makers of reading systems, and consumers. The IDPF develops and maintains the EPUB content publication standard that enables the creation and transport of reflowable digital books and other types of content as digital publications that are interoperable between disparate EPUB-compliant reading devices and applications.

IMS Caliper

The IMS Caliper Framework provides a high-level recommendation of how Learning Systems should capture and share data around learning interactions, using existing and upcoming IMS specifications, which can be used to support and advance Learning Measurement and Analytics.

IMS Global

The IMS Global Learning Consortium (IMS Global) is a global, nonprofit, member organization that strives to enable the growth and impact of learning technology in the education and corporate learning sectors worldwide. IMS Global members provide leadership in shaping and growing the learning industry through community development of interoperability and adoption practice standards and recognition of the return on investment from learning and educational technology.

IMS Learning Tools Interoperability (LTI)

The LTI specification to allow remote tools and content to be integrated into a Learning Management System (LMS). LTI has two main components: what is traditionally named as the LMS is referred to as the "Tool Consumer" (TC) as it "consumes" the tool; and the external tool or content is called the "Tool Provider" (TP) as it "provides" the tool for use in the Tool Consumer. Example Tool Providers might include an externally hosted testing system or a server that contains externally hosted premium content.

IMS Question & Test Interoperability (QTI)

An information model describing data structures that are used to provide interoperability of assessments/tests and questions/items. This specification was created by IMS and the latest version available is V2.1 (released in 2012).

IEEE LOM Metadata

LOM, or IEEE 1484.12.1:2002, is the IEEE standard for the describing of "learning objects". There is a long list of metadata attributes many of which have little relevance and common

usage. LOM and the IMS Global Metadata have a community origin and either the IEEE or IMS Global XML Bindings can be used to create LOM metadata instances. IMS use the IMS LOM binding.

LTI Tool Consumer

A Web application (such as an LMS or portal) from which users connect to LTI Tool Providers.

LTI Tool Provider

A Web application that provides access to resources or other functionality that can be integrated with LTI Tool Consumers.

Manifest

Within the IMS CP context this is the XML structure contained within the file "imsmanifest.xml" that must be included within a content package. A QTI Package is described by its manifest.

Within the EPUB3 the manifest is the container of content as allowed by the Open Document Format. This manifest has its own XML structure.

Manifest Metadata

This is the metadata that is defined at the top level of the *manifest*. LOM is used as the required format and manifest metadata is required in a QTI *Content Package*. This metadata is used to describe the QTI content package as a whole and not just the manifest within the package.

Multiple Choice-Multiple Response (MC-MR) Question

One of the question-types that is supported by EDUPUB. This question contains a set of answer options that are presented to the user who can select any combination of options. The associated response processing in EDUPUB provides feedback for the correct selection and a different feedback for the wrong answers (this feedback is the same for all wrong answers i.e. feedback for partial correctness is not supported).

Multiple Choice-Single Response (MC-SR) Question

One of the question-types that is supported by EDUPUB. This question contains a set of answer options that are presented to the user who must select only one. The associated response processing in EDUPUB provides feedback for the correct selection and a different feedback for the wrong answers (this feedback is the same for all wrong answers).

Open Container Format (OCF)

The OCF is the EPUB3 file format and processing model for encapsulating the sets of related resources that comprise one or more EPUB Publications into a single-file container.

Open Container Package (OCP)

This is the EPUB3 Package Document that carries bibliographic and structural metadata about an EPUB Publication, and is thus the primary source of information about how to process and display it. The Package Document is an XML document

consisting of a set of container elements, each dedicated to housing information about a particular aspect of the Publication. These containers effectively centralize metadata for the Publication, detail the individual resources that compose it and provide reading order and other information for rendering the Publication to a User

QTI Item

This is the representation of an Item using QTI. Each *assessmentItem* is contained in its own XML instance file.

QTI Section

This is the representation of a Section using QTI. In the current version of EDUPUB only one *assessmentSection* is permitted and this is contained in the same XML instance as the *assessmentTest*.

QTI Test

This is the representation of a Test using QTI. Each *assessmentTest* is contained in its own XML instance file. The associated *assessmentItems* are contained in their own XML instance files.

QTI TestPart

An *assessmentTest* is composed of one or more *testPart*. In the current version of EDUPUB only one *testPart* is permitted and this is contained in the same XML instance as the *assessmentTest*.

Readium

Readium is an open source EPUB Reader under development by the Readium Foundation. The Readium Foundation develops technology to accelerate adoption of EPUB 3 and the Open Web Platform by the global digital publishing industry. Readium.org was formed in February 2013 as a non-profit membership organization. Current Readium.org projects include Readium Web (an EPUB 3 rendering engine for browser-based cloud readers) and Readium SDK (an EPUB 3 rendering engine for native apps).

Resource

A resource is a structure in a content package that is used to identify the physical resources that are used. In QTI the resource types are the original QTI XML instance, the set of related asset files (such as images, audio files, etc.) and the set of control files (such as XSDs) contained within the content package. Every physical file contained within the content package must be identified in a resource.

Resource Metadata

This is the metadata defined for a *resource* within the *manifest* of a content package. Each resource is expected to have its own metadata description. The metadata for a resource is based upon a profile of the LOM metadata that also includes an extension to support the *QTI Metadata*.

Response Processing

This is the set of instructions contained within the QTI-XML that

define the rules that are to be used to convert the response received from a user, when interacting with a question, into the corresponding score. Within EDUPUB the specific rules are replaced by the equivalent JavaScript response processing library that performs the task defined by the corresponding QTI-XML response processing rules.

Schema.Org Metadata

Schema.org is an initiative launched on 2 June 2011 by the operators of the then world's largest search engine to "create and support a common set of schemas for structured data markup on web pages." They propose using their ontology and Microdata in HTML5 in to mark up website content with metadata about itself. Such markup can be recognized by search engine spiders and other parsers thus gaining access to the meaning of the websites. The initiative started with a small number of formats, but the long-term goal is to support a wider range of schemas including those for education.

Sensor API

The IMS Sensor API is intended to support the instrumentation, collection and exchange of data from Learning Tools/Systems and associated Learning Content elements. This enables the availability of standard metrics accessed via any given Analytics Store and associated APIs. At its core, the Sensor API will support the exchange of Learning Events based on interactions with/on Learning Activities.

True/False Question

One of the question-types that is supported by EDUPUB. The user is presented with an either/or selection (this is equivalent to a multiple choice-single response question with just two choices).

Appendix B – Annotated LTI/EDUPUB Examples

B1   Using LTI to Launch a Tool from within an EPUB3 eBook

When the 'QTI Assessment' link is clicked in the 'INTENSE! Machines' table of contents the page shown in Figure B1.1 is displayed.
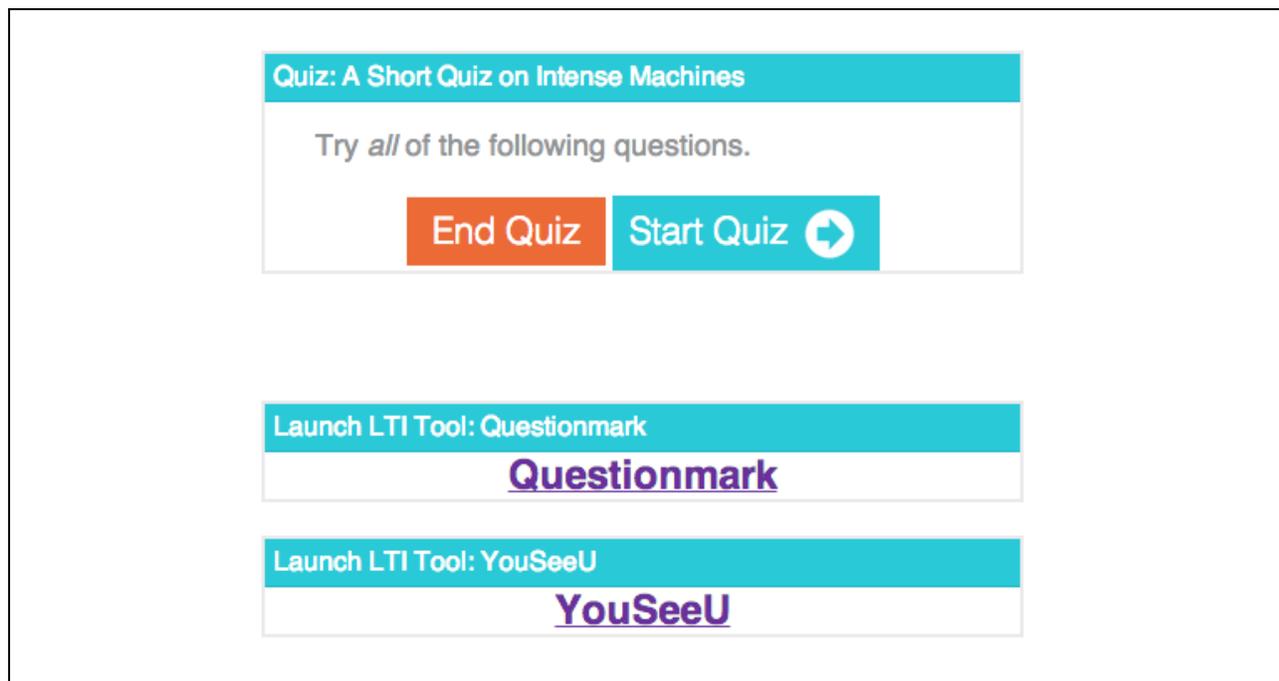
Figure B1.1 – The quiz launch options.

The two LTI-based links are for:

- Questionmark – to launch into the Questionmark assessment tool;

- YouSeeU – to launch into the YouSeeU video-centric LMS.

Before this approach can be used, the Radium tool must be configured to support the Questionmark and YouSeeU tools i.e. LTI cannot be used to launch a tool that has not been registered within the Readium system. This configuration is described in Section 3.2. In the case of the Questionmark and YouSeeU systems the code in Code B1.1 is inserted into the 'LTI_PROVIDERS' variable in the file main.js in the 'server' folder.

Code B1.1 – Code to use LTI to launch the Questionmark system.

```
0000   …
0001   {
0003       "id": "qm",
0004       "name": "Questionmark",
0005       "key": "{…}",
0006       "secret": "…",
0007       "url": "…",
0008       "target": "window"
0009   }, {
0010       "id": "youseeu",
0011       "name": "YouSeeU",
0012       "key": "…",
0013       "secret": "…",
0014       "url": "…",
0015       "target": "window"
0016   }
0017   …
```

B2   Launching the Questionmark System

The code within the EPUB3 for the LTI-launch link (in the file 'qti_assessment.xhtml' with the OEBPS folder inside of the EPUB3 zip file) to the Questionmark system is listed in Code B2.1.

Code B2.1 – Code to use LTI to launch the Questionmark system.

```
0000
0001   <div class="qti-item" data-ng-hide="hideIntro">
0003       <div class="qti-item-header">Launch LTI Tool: Questionmark</div>
0004       <div class="navigation">
0005           <h2>
0006               <a href="" onclick="parent.ltiLaunchTool(this, 'qm',
0007                                                 'qm001');"
0008                       title="Questionmark">Questionmark</a>
0009           </h2>
0010       </div>
0011   </div>
0012
```

Once the launch is completed the user is presented with the page shown in Figure B2.1.
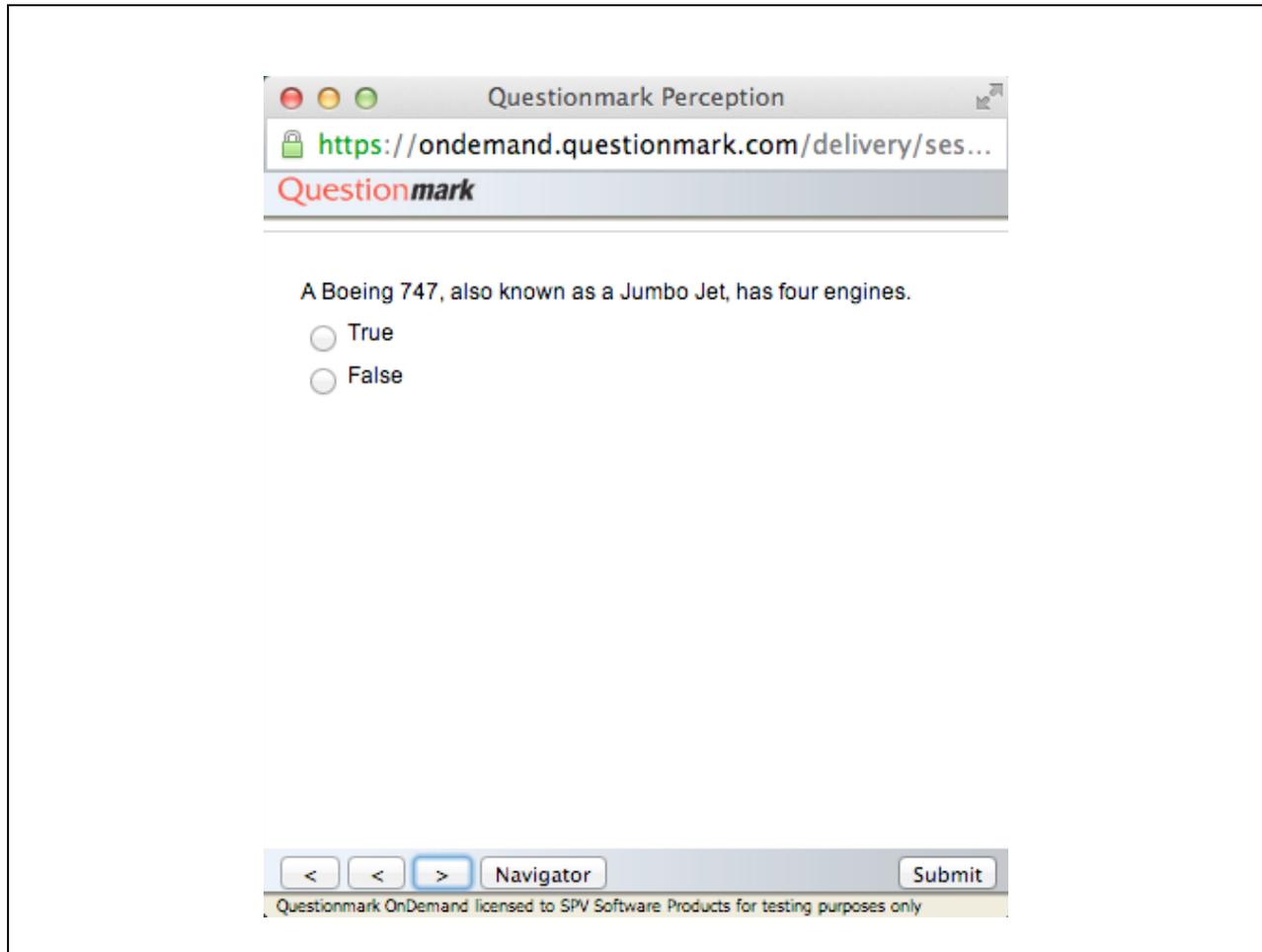
Figure B2.1 – The page displayed when launched into the Questionmark assessment system.

This is the first question of the quiz (it should be noted that Questionmak does not support QTIv2.1 and so the same set of questions were imported into Questionmark using the QTIv1.2.1 format. The context for the LTI Tool Consumer code within Readium is described in Subsection 3.3 and Appendix F2 i.e. the 'ltiLaunchTool()' method call.

B3   Launching the YouSeeU System

The code within the EPUB3 for the LTI-launch link (in the file 'qti_assessment.xhtml' with the OEBPS folder inside of the EPUB3 zip file) to the YouSeeU system is listed in Code B3.1.

Code B3.1 – Code to use LTI to launch the YouSeeU system.

```
0000
0001   <div class="qti-item" data-ng-hide="hideIntro">
0003       <div class="qti-item-header">Launch LTI Tool: YouSeeU</div>
0004       <div class="navigation">
0005           <h2>
0006               <a href=""
0007                   onclick="parent.ltiLaunchTool(this, 'youseeu',
0008                                                 'ysu1');"
0009                   title="YouSeeU">YouSeeU</a>
0010           </h2>
0011       </div>
0012   </div>
0013
```

Once the launch is completed the user is presented with the page shown in Figure B3.1.

Figure B3.1 – The page displayed when launched into the YouSeeU system.

Appendix C – Annotated Caliper/EDUPUB Examples

The Readium Caliper Sensor is used to instrument key events inside Readium, while the user is engaging with the EPUB3 content. Some typically examples follow, from the file `lib/EpubReader.js,` in Code C1.1:

Code C1.1 – Using the Sensor API in Readium.

```
0000
0001   var installReaderEventHandlers = function(){
0003          // Set handlers for click events
0004
0005          $("#previous-page-btn").unbind("click");
0006          $("#previous-page-btn").on("click", function () {
0007             readium.reader.openPageLeft();
0008             ReadiumSensor.measureActivity(ReadingActions.READ_PAGE,
0009                                             {'turnDirection' : 'LEFT'}
0010                                             );
0011             return false;
0012          });
0013
0014          $("#next-page-btn").unbind("click");
0015          $("#next-page-btn").on("click", function () {
0016
0017             readium.reader.openPageRight();
0018             ReadiumSensor.measureActivity(ReadingActions.READ_PAGE,
0019                                             {'turnDirection' : 'RIGHT'}
0020                                             );
0021             return false;
0022          });
0023          $('.icon-full-screen').on('click', toggleFullScreen);
0024          $('.icon-library').on('click', function(){
0025             $(window).trigger('loadlibrary');
0026             ReadiumSensor.measureActivity(ReadingActions.VIEW_LIBRARY,
0027                                             {});
0028             return false;
0029   });
```

As depicted in Appendix F, the ReadiumSensor establishes a common LearningContext for the LTI Session and uses it in all Caliper measure calls. It should be noted that the userId and courseId are made available to the Sensor by the LTI Provider module/code in the Readium EPUB3 Reader.

Code C1.2 – The ReadiumSensor learning context code.

```
0000
0001   var measureActivity = function(action, activityContextDetail) {
0003          var learningContext = {
0004             'personId': window.readiumSensor.context.userId,
0005             'courseId': window.readiumSensor.context.courseId
0006          };
0007          …
0008          measure(action, learningContext, activityContext, Date.now());
0009   };
```

Appendix D – Annotated Embedded QTI/EDUPUB Example

D1   Overview of the Example

The example used for the embedded quiz is based upon on the EPUB3 publication "INTENSE! Machines" from Carson Dellosa Publishing. The original EPUB3 eBook was supplied to IMS Global. This EPUB3 was then processed to add the LTI links and the embedded quiz. The extended EPUB3 was then made available through: i) the IMS Cloud and the hosted Moodle installation; and ii) as a standalone EPUB3.

When the user logs into the Moodle instance, the list of available EPUB3 resources is displayed as shown in Figure D1.1.

Figure D1.1 – Hosted Moodle-based access to the INTENSE! Machines publication.

When one of the icons for the 'INTENSE! Machines' eBook is clicked, the Readium Reader is activated (each EPUB3 resource is an LTI link to the Readium Reader which then opens the identified EPUB3 file) at the page shown in Figure D1.2.

Figure D1.2 – Page 1 of the INTENSE! Machines publication in Moodle/Readium.

If the TOC icon is pressed in Figure D1.2 then the view shown in Figure D1.4 is displayed.

Alternatively, the 'INTENSE! Machines' EPUB3 can be downloaded and opened using the Readium app plug-in for the Chrome browser. When this app is used your local library is displayed: an example is sown in Figure D1.3. When the 'INTENSE! Machines' EPUB3 is clicked and the eBook is opened in Table of Contents (TOC) mode the book is displayed as shown in Figure D1.4.

In the TOC, the link for the embedded quiz is shown fourth from the bottom i.e. 'QTI Assessment'. Interaction with the eBook is now through either the TOC or the next ('>') or previous ('<') page icons.
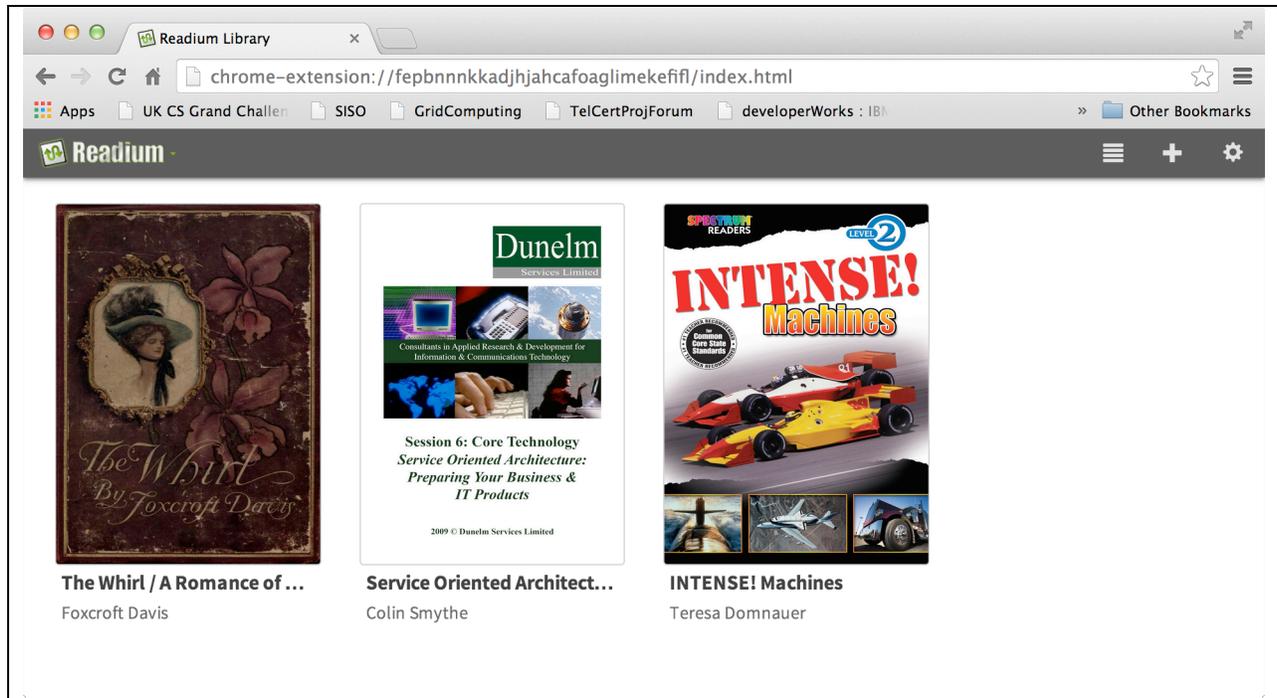
Figure D1.3 – Desktop Readium library view.
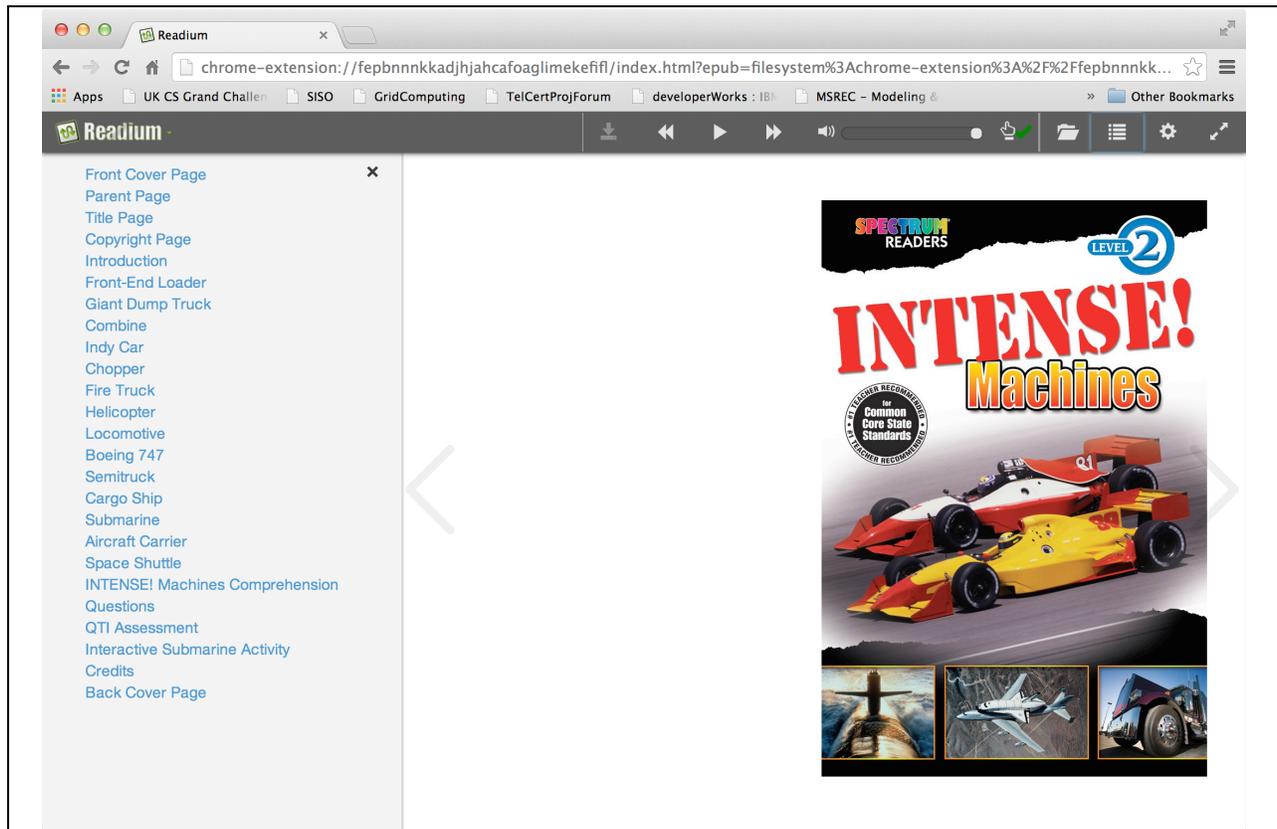
Figure D1.4 – Table of contents for the 'INTENSE! Machines' eBook.

When the original 'INTENSE! Machines' EPUB3 file is unzipped the contents structure is (italics denote a folder):

mimetype

META-INF
   container.xml

OEBPS
   audio
   bcover.xhtml
   config.js
   credit.xhtml
   css
   fcover.xhtml
   fonts
   images
   js
   license.xhtml
   nav.xhtml
   package.opf

page_000.xhtml	page_001.xhtml	page_002.xhtml	page_003.xhtml
page_004.xhtml	page_005.xhtml	page_006.xhtml	page_007.xhtml
page_008.xhtml	page_009.xhtml	page_010.xhtml	page_011.xhtml
page_012.xhtml	page_013.xhtml	page_014.xhtml	page_015.xhtml
page_016.xhtml	page_017.xhtml	page_018.xhtml	page_019.xhtml
page_020.xhtml	page_021.xhtml	page_022.xhtml	page_023.xhtml
page_024.xhtml	page_025.xhtml	page_026.xhtml	page_027.xhtml
page_028.xhtml	page_029.xhtml	page_030.xhtml	page_031.xhtml
page_032.xhtml	page_033.xhtml		

   smil
   submarine
   title.xhtml

D2   The User Experience for the Quiz

When the 'QTI Assessment' link is pressed, the page shown in Figure D2.1 is displayed.
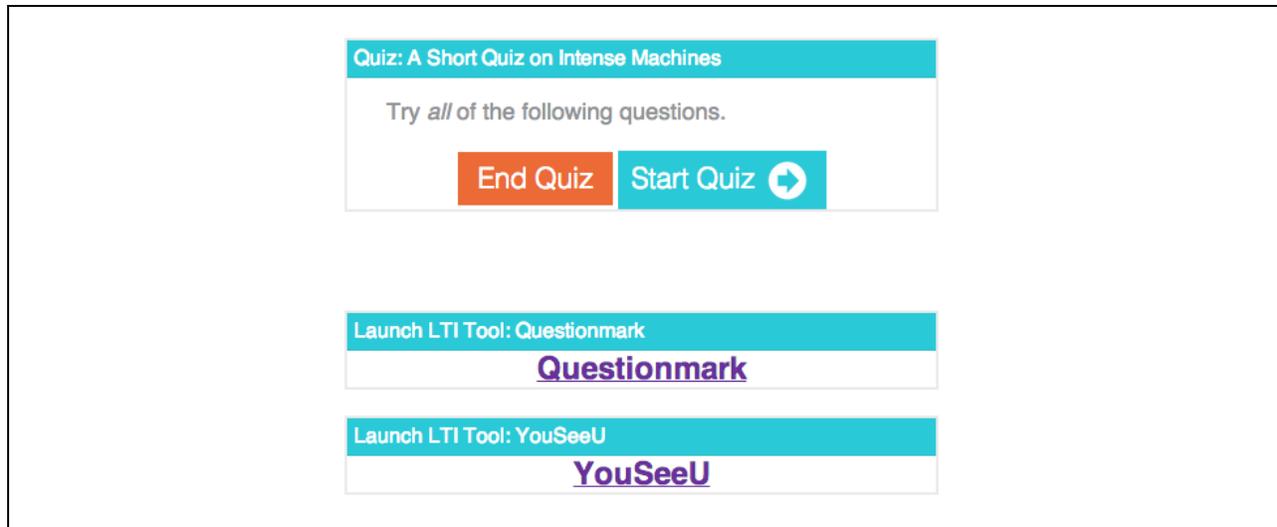
Figure D2.1 – The opening quiz page.

When the 'Start Quiz' button is pressed the first question as shown in Figure D2.2 is displayed. The initial question rendering for this True/False question is shown in Figure D2.2a. When the user selects the 'True' option and presses the 'Submit Answer' the display is changed to provide the feedback for the attempt as shown in Figure D2.2b.

| (a) Question 1 ready to be answered. | (b) Question 1 feedback for a correct answer. |
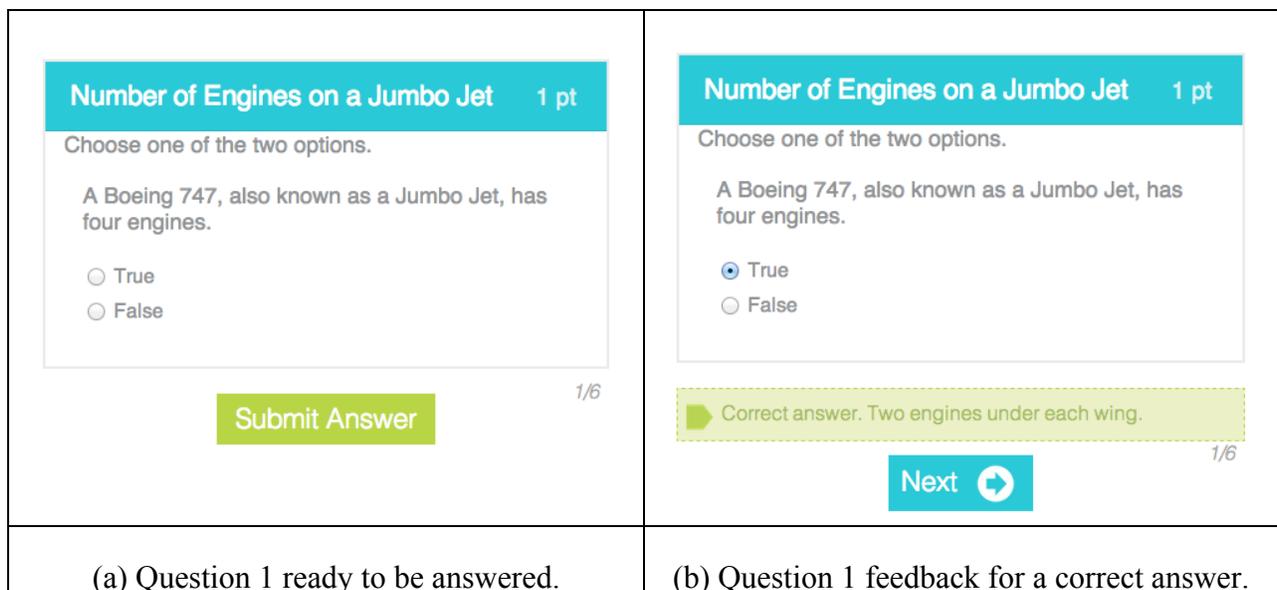
Figure D2.2 – Display of question 1 (True/False).

(a) Question 2 ready to be answered.   (b) Question 5 answered.

Figure D2.3 – Display of questions 2 and 5 (Multiple Choice-Single Response).

The formats for the two multiple choice-single response questions (2 and 5) are shown in Figure D2.3. Figure 2.3a shows the situation when question 2 has been displayed and the 'Submit Answer' button pressed without making a selection. Figure 2.3b shows the display for question 5 when one selection has been made.

(a) Question 3 feedback for a correct answer.   (b) Question 4 feedback for a wrong answer.

Figure D2.4 – Display of question 3 (Multiple Choice-Single Response) and question 4 (Fill-in-Blank).

The formats for questions 3 (multiple choice-multiple response) and 4 (fill-in-blank) are shown in Figure D2.4. Figure D2.4a shows the feedback when the user has submitted the correct answer. Figure D2.4b shows the feedback when the user has submitted the wrong answer to the fill-in-blank question.
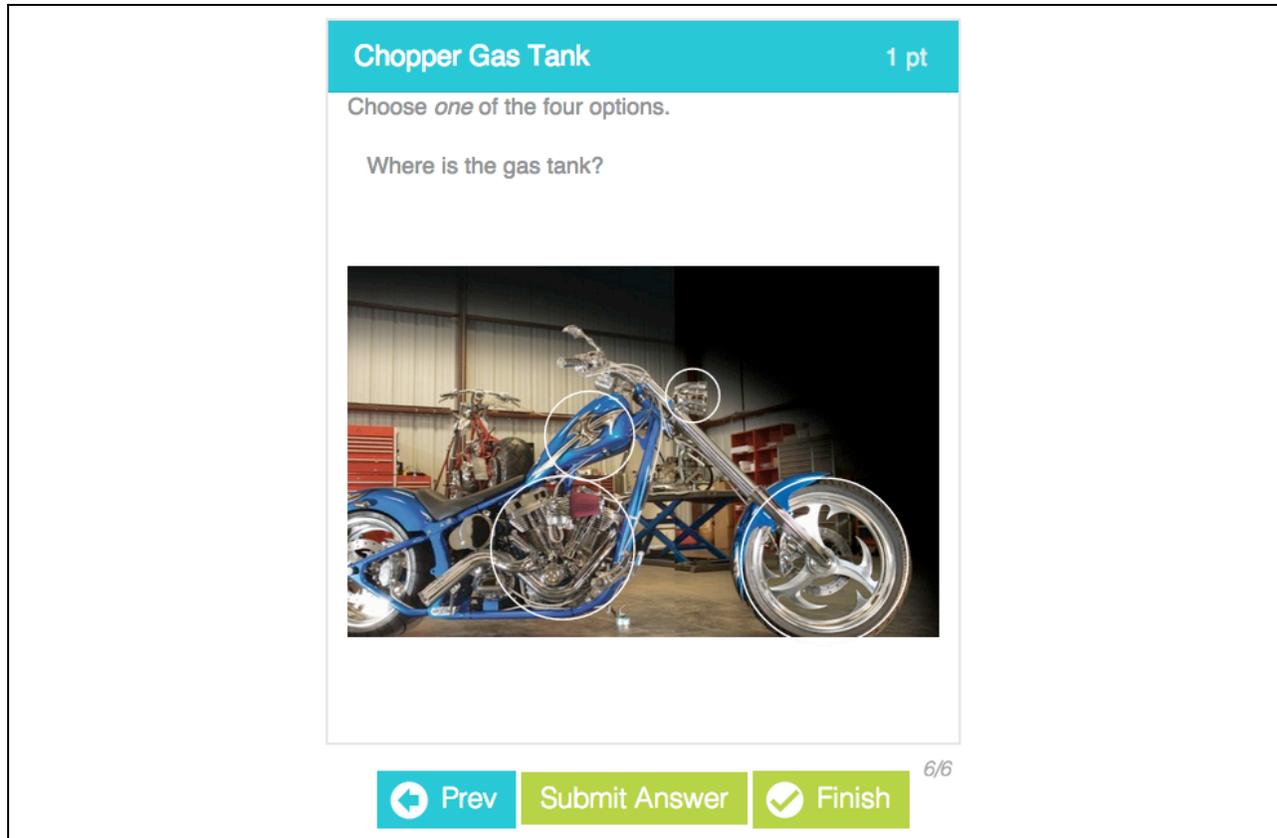
Figure D2.5 – Display of question 6 (Hotspot).

The display for the Question 6 (hotspot) is shown in Figure D2.5. When the 'Finish' button is pressed the final test summary page is displayed as shown in Figure D2.6.
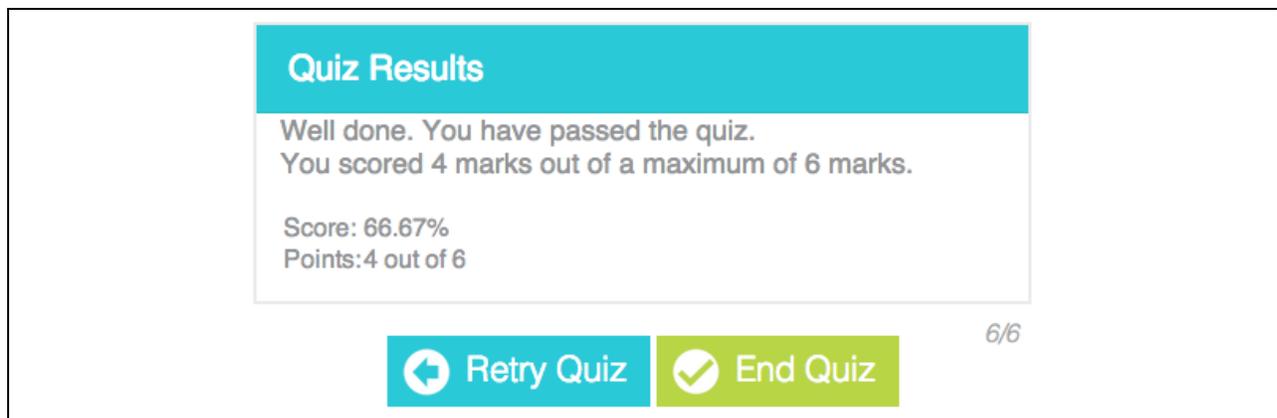
Figure D2.6 – Display of the completion page for the quiz.

The test summary page provides the overall percentage score for the quiz (expressed as the percentage of the number correct against total number of questions).

D3   The Definitive Source XML for the Quiz

The QTI-based quiz is supplied as an IMS Content Package. The required 'imsmanifest.xml' file explains the structure of the QTI package with the essential features being:

- Each QTI Item is contained within its own XML instance file;

- The Quiz QTI Test file is contained within its own XML instance file;

- Every file in the package has its own resource definition. The <dependency> element is used to define the dependencies between these resource e.g. the test resource has a dependency on each of the item resource.

Once the example file ('machinesepub3qyuiz01v1.zip') has been unzipped the following file structure is revealed:

Images
    Chopperv1.jpg

imsmanifest.xml

Items
    machinequiz01_item01.xml
    machinequiz01_item02.xml
    machinequiz01_item03.xml
    machinequiz01_item04.xml
    machinequiz01_item05.xml
    machinequiz01_item06.xml

Tests
    machineepub3quiz01_test01.xml

The key points about this structure are:

- A total of eight XML files and one image file are supplied;

- The required manifest file ("imsmanifest.xml") is present (this conforms to the IMS CP XML);

- Each of the six Item QTI-XML instance files are collected in the 'Items' folder;

- The singe Test QTI-XML instance file is collected in the 'Tests' folder;

- A single image file (used with the hotspot Item) is stored in the 'Images' folder.

D3.1   The Manifest CP-XML

The contents of the "imsmanifest.xml" file are listed in Code D3.1.

Code D3.1 – The CP manifest CP-XML.

```
0000
0001   <manifest identifier="Manifest_MACHINEEPUB3QUIZ01"
0003       xmlns="http://www.imsglobal.org/xsd/imscp_v1p1"
0004       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0005       xsi:schemaLocation="…">
0006     <metadata>
0007       <schema>QTIv2.1 Package</schema>
0008       <schemaversion>1.0.0</schemaversion>
0009       <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0010         <educational>
0011           <learningResourceType>
0012             <source>IMS</source>
0013             <value>QTI Package</value>
0014           </learningResourceType>
0015         </educational>
0016         <general>
0017           <identifier>
0018             <entry>Manifest_MACHINEEPUB3QUIZ01</entry>
0019           </identifier>
0020           <title>
0021             <string>EPUB3/QTI Quiz 1 Proof-of-Concept Example. This quiz
0022   is added to the Carson Dellosa Publishing eBook 'INTENSE!
0023   Machines'</string>
0024           </title>
0025         </general>
0026         <lifeCycle>
0027           <contribute/>
0028           <version>
0029             <string>Final 1.0</string>
0030           </version>
0031         </lifeCycle>
0032         <rights>
0033           <copyrightAndOtherRestrictions>
0034             <source>LOMv1.0</source>
0035             <value>yes</value>
0036           </copyrightAndOtherRestrictions>
0037           <description>
0038             <string>2014 IMS Global Learning Consortium Inc.</string>
0039           </description>
0040         </rights>
0041       </lom>
0042     </metadata>
0043
0044     <organizations/>
0045
0046     <resources>
0047
0048       <resource type="imsqti_test_xmlv2p1" identifier="ResourceTest01"
0049           href="Tests/machineepub3quiz01_test01v1.xml">
0050         <metadata>
0051           <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
```

```
0052                 <general>
0053                   <identifier>
0054                     <entry>MACHINE-QUIZ01</entry>
0055                   </identifier>
0056                   <title>
0057                     <string>A Short Quiz on Intense Machines</string>
0058                   </title>
0059                 </general>
0060                 <lifeCycle>
0061                   <contribute/>
0062                   <version>
0063                     <string>Final 1.0</string>
0064                   </version>
0065                 </lifeCycle>
0066                 <educational>
0067                   <description>
0068                     <string>EPUB3/QTI Example Quiz 1 </string>
0069                   </description>
0070                 </educational>
0071                 <qtiMetadata xmlns="…">
0072                   <feedbackType>nonadaptive</feedbackType>
0073                   <solutionAvailable>false</solutionAvailable>
0074                 </qtiMetadata>
0075               </lom>
0076             </metadata>
0077             <file href="Tests/machineepub3quiz01_test01v1.xml"/>
0078             <dependency identifierref="ResourceItem01"/>
0079             <dependency identifierref="ResourceItem02"/>
0080             <dependency identifierref="ResourceItem03"/>
0081             <dependency identifierref="ResourceItem04"/>
0082             <dependency identifierref="ResourceItem05"/>
0083             <dependency identifierref="ResourceItem06"/>
0084         </resource>
0085
0086         <resource type="imsqti_item_xmlv2p1" identifier="ResourceItem01"
0087             href="Items/machinequiz01_item01v1.xml">
0088             <metadata>
0089               <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0090                 <general>
0091                   <identifier>
0092                     <entry>MACHINE-ITEM01</entry>
0093                   </identifier>
0094                   <title></title>
0095                 </general>
0096                 <lifeCycle>
0097                   <contribute/>
0098                   <version>
0099                     <string>Final 1.0</string>
0100                   </version>
0101                 </lifeCycle>
0103                 <educational>
0104                   <description>
0105                     <string>True/False Question on Number of Engines on a
0106   Jumbo Jet.</string>
0107                   </description>
0108                 </educational>
0109                 <qtiMetadata xmlns="…">
0110                   <interactionType>choiceInteraction</interactionType>
```

```
0111                  <feedbackType>nonadaptive</feedbackType>
0112                  <solutionAvailable>false</solutionAvailable>
0113                </qtiMetadata>
0114              </lom>
0115            </metadata>
0116            <file href="Items/machinequiz01_item01v1.xml"/>
0117          </resource>
0118
0119        <resource type="imsqti_item_xmlv2p1" identifier="ResourceItem02"
0120            href="Items/machinequiz01_item02v1.xml">
0121          <metadata>
0122            <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0123              <general>
0124                <identifier>
0125                  <entry>MACHINE-ITEM02</entry>
0126                </identifier>
0127                <title>
0128                  <string>Machines Used to Collect Kernels of Corn
0129                  </string>
0130                </title>
0131              </general>
0132              <lifeCycle>
0133                <contribute/>
0134                <version>
0135                  <string>Final 1.0</string>
0136                </version>
0137              </lifeCycle>
0138              <educational>
0139                <description>
0140                  <string>"MC-SR question on machines used to collect
0141    kernels of corn.</string>
0142                </description>
0143              </educational>
0144              <qtiMetadata xmlns="…">
0145                <interactionType>choiceInteraction</interactionType>
0146                <feedbackType>nonadaptive</feedbackType>
0147                <solutionAvailable>false</solutionAvailable>
0148              </qtiMetadata>
0149            </lom>
0150          </metadata>
0151          <file href="Items/machinequiz01_item02v1.xml"/>
0152        </resource>
0153
0154        <resource type="imsqti_item_xmlv2p1" identifier="ResourceItem03"
0155            href="Items/machinequiz01_item03v1.xml">
0156          <metadata>
0157            <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0158              <general>
0159                <identifier>
0160                  <entry>MACHINE-ITEM03</entry>
0161                </identifier>
0162                <title>
0163                  <string>Machines Used to Fly</string>
0164                </title>
0165              </general>
0166              <lifeCycle>
0167                <contribute/>
0168                <version>
```

```
0169              <string>Final 1.0</string>
0170            </version>
0171          </lifeCycle>
0172          <educational>
0173            <description>
0174              <string>MC-MR question on machines used to fly.</string>
0175            </description>
0176          </educational>
0177          <qtiMetadata xmlns="…">
0178            <interactionType>choiceInteraction</interactionType>
0179            <feedbackType>nonadaptive</feedbackType>
0180            <solutionAvailable>false</solutionAvailable>
0181          </qtiMetadata>
0182        </lom>
0183      </metadata>
0184      <file href="Items/machinequiz01_item03v1.xml"/>
0185    </resource>
0186
0187    <resource type="imsqti_item_xmlv2p1" identifier="ResourceItem04"
0188      href="Items/machinequiz01_item04v1.xml">
0189      <metadata>
0190        <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0191          <general>
0192            <identifier>
0193              <entry>MACHINE-ITEM04</entry>
0194            </identifier>
0195            <title>
0196              <string>Chopper is a type of?</string>
0197            </title>
0198          </general>
0199          <lifeCycle>
0200            <contribute/>
0201            <version>
0203              <string>Final 1.0</string>
0204            </version>
0205          </lifeCycle>
0206          <educational>
0207            <description>
0208              <string>Fill-In Blank Question on a Chopper.</string>
0209            </description>
0210          </educational>
0211          <qtiMetadata xmlns="…">
0212            <interactionType>textEntryInteraction</interactionType>
0213            <feedbackType>nonadaptive</feedbackType>
0214            <solutionAvailable>false</solutionAvailable>
0215          </qtiMetadata>
0216        </lom>
0217      </metadata>
0218      <file href="Items/machinequiz01_item04v1.xml"/>
0219    </resource>
0220
0221    <resource type="imsqti_item_xmlv2p1" identifier="ResourceItem05"
0222      href="Items/machinequiz01_item05v1.xml">
0223      <metadata>
0224        <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0225          <general>
0226            <identifier>
0227              <entry>MACHINE-ITEM05</entry>
```

```
0228                </identifier>
0229                <title>
0230                  <string>Machines Using Railway Tracks</string>
0231                </title>
0232              </general>
0233              <lifeCycle>
0234                <contribute/>
0235                <version>
0236                  <string>Final 1.0</string>
0237                </version>
0238              </lifeCycle>
0239              <educational>
0240                <description>
0241                  <string>MC-SR question on machines using railway
0242   tracks.</string>
0243                </description>
0244              </educational>
0245              <qtiMetadata xmlns="…">
0246                <interactionType>choiceInteraction</interactionType>
0247                <feedbackType>nonadaptive</feedbackType>
0248                <solutionAvailable>false</solutionAvailable>
0249              </qtiMetadata>
0250            </lom>
0251          </metadata>
0252          <file href="Items/machinequiz01_item05v1.xml"/>
0253        </resource>
0254
0255        <resource type="imsqti_item_xmlv2p1" identifier="ResourceItem06"
0256           href="Items/machinequiz01_item06v1.xml">
0257          <metadata>
0258            <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0259              <general>
0260                <identifier>
0261                  <entry>MACHINE-ITEM06</entry>
0262                </identifier>
0263                <title>
0264                  <string>Chopper Gas Tank</string>
0265                </title>
0266              </general>
0267              <lifeCycle>
0268                <contribute/>
0269                <version>
0270                  <string>Final 1.0</string>
0271                </version>
0272              </lifeCycle>
0273              <educational>
0274                <description>
0275                  <string>Hotspot question on the Chopper.</string>
0276                </description>
0277              </educational>
0278              <qtiMetadata xmlns="…">
0279                <interactionType>hotspotInteraction</interactionType>
0280                <feedbackType>nonadaptive</feedbackType>
0281                <solutionAvailable>false</solutionAvailable>
0282              </qtiMetadata>
0283            </lom>
0284          </metadata>
0285          <file href="Items/machinequiz01_item06v1.xml"/>
```

```
0286            <dependency identifierref="ResourceItem06_Image"/>
0287        </resource>
0288
0289        <resource type="webcontent" identifier="ResourceItem06_Image"
0290          href="Images/Chopperv1.jpg">
0291          <metadata>
0292            <lom xmlns="http://ltsc.ieee.org/xsd/LOM">
0293              <general>
0294                <identifier>
0295                  <entry>MACHINE-ITEM06-IMAGE</entry>
0296                </identifier>
0297                <title>
0298                  <string>Chopper Bike</string>
0299                </title>
0300              </general>
0301              <lifeCycle>
0302                <contribute/>
0303                <version>
0304                  <string>Final 1.0</string>
0305                </version>
0306              </lifeCycle>
0307              <educational>
0308                <description>
0309                  <string>Hotspot question background image.</string>
0310                </description>
0311              </educational>
0312            </lom>
0313          </metadata>
0314          <file href="Images/Chopperv1.jpg"/>
0315        </resource>
0316      </resources>
0317
0318  </manifest>
0319
```

The key points are:

a) The manifest-level metadata is given in lines 0009-0042. This metadata is the learning resource type (lines 0011-0014), the manifest identifier (lines 0017-0019), the package title (00020-0023), the version number (0026-0031) and the copyright statement (0032-0040);

b) The test resource is given in lines 0048-0083. This includes the dependencies on the resources for the six Items (lines 0078-0083). The metadata for the resource is defined in lines (0050-0076) and includes the identifier for the Item (lines 0053-0055), the title (lines 0056-0058), the version (lines 0062-0064), the description (lines 0066-0070) and the QTI-specific information about feedback and solution availability (lines 0071-0074). Line 0077 defines the actual Test XML instance;

c) The resources for question 1 are given in lines 0086-0117. The associated resource metadata is defined in lines (0088-0115) and includes the identifier for the Item (lines 0091-0055), the title (line 0094), the version (lines 0098-0100), the description (lines 0103-0108) and the QTI-specific information about feedback and solution availability (lines 0109-0113). Line 0116 defines the actual Item XML instance;

d) The resources for question 2 are given in lines 0119-0152, for question 3 in lines 0154-0185, for question 4 in lines 0187-0219 and for question 5 in lines 0221-0253

e) There are two resources for question 6 (the Item XML instance and the background image). These resources are given in lines 0255-0316.

While the manifest is required to define the total composition of the QTI-package, none of the information is used in the generation of the rendered test i.e. none of the information in the manifest is displayed in Figures D2.2, D2.3, D2.4, D2.5 and D2.6.

D3.2   The Test QTI-XML

The contents of the *assessmentTest* XML file are listed in Code D3.2.

Code D3.2 – Test QTI-XML.

```
0000
0001   <assessmentTest xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004       xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_v2p1
0005       http://www.imsglobal.org/xsd/qti/qtiv2p1/imsqti_v2p1p1.xsd"
0006       identifier="MACHINE-QUIZ01"
0007       title="A Short Quiz on Intense Machines">
0008
0009       <outcomeDeclaration identifier="TOTAL_SCORE" cardinality="single"
0010           baseType="integer">
0011           <defaultValue>
0012               <value>0</value>
0013           </defaultValue>
0014       </outcomeDeclaration>
0015
0016       <outcomeDeclaration identifier="TOTAL_MAXSCORE"
0017           cardinality="single" baseType="integer">
0018           <defaultValue>
0019               <value>1</value>
0020           </defaultValue>
0021       </outcomeDeclaration>
0022
0023       <outcomeDeclaration identifier="TOTAL_MINSCORE"
0024           cardinality="single" baseType="integer">
0025           <defaultValue>
0026               <value>0</value>
0027           </defaultValue>
0028       </outcomeDeclaration>
0029
0030       <outcomeDeclaration identifier="MASTERY_SCORE"
0031           cardinality="single" baseType="integer">
0032           <defaultValue>
0033               <value>3</value>
0034           </defaultValue>
0035       </outcomeDeclaration>
0036
0037       <outcomeDeclaration identifier="TOTAL_NUMBERINCORRECT"
0038           cardinality="single" baseType="integer">
0039           <defaultValue>
0040               <value>0</value>
```

```
0041              </defaultValue>
0042          </outcomeDeclaration>
0043
0044          <outcomeDeclaration identifier="TOTAL_NUMBERCORRECT"
0045             cardinality="single" baseType="integer">
0046             <defaultValue>
0047                 <value>0</value>
0048             </defaultValue>
0049          </outcomeDeclaration>
0050
0051          <outcomeDeclaration identifier="TOTAL_NUMBERPRESENTED"
0052             cardinality="single" baseType="integer">
0053             <defaultValue>
0054                 <value>0</value>
0055             </defaultValue>
0056          </outcomeDeclaration>
0057
0058          <outcomeDeclaration identifier="TOTAL_NUMBERSELECTED"
0059             cardinality="single" baseType="integer">
0060             <defaultValue>
0061                 <value>0</value>
0062             </defaultValue>
0063          </outcomeDeclaration>
0064
0065          <outcomeDeclaration identifier="TOTAL_NUMBERRESPONDED"
0066             cardinality="single" baseType="integer">
0067             <defaultValue>
0068                  <value>0</value>
0069             </defaultValue>
0070          </outcomeDeclaration>
0071
0072          <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
0073             baseType="identifier"/>
0074
0075         <testPart identifier="MACHINE-QUIZ01-TP1" navigationMode="linear"
0076            submissionMode="individual">
0077            <assessmentSection identifier="MACHINE-QUIZ01-TP1-S1"
0078               title="Section 1" visible="true">
0079
0080               <rubricBlock view="candidate"><p>Try <em>all</em> of the
0081  following questions.</p>
0082               </rubricBlock>
0083
0084               <assessmentItemRef identifier="MACHINE-QUIZ01-ITEM01"
0085                  required="true" fixed="true"
0086                  href="../Items/machinequiz01-item01v1.xml"/>
0087               <assessmentItemRef identifier="MACHINE-QUIZ01-ITEM02"
0088                  required="true" fixed="true"
0089                  href="../Items/machinequiz01-item03v1.xml"/>
0090               <assessmentItemRef identifier="MACHINE-QUIZ01-ITEM03"
0091                  required="true" fixed="true"
0092                  href="../Items/machinequiz01-item03v1.xml"/>
0093               <assessmentItemRef identifier="MACHINE-QUIZ01-ITEM04"
0094                  required="true" fixed="true"
0095                  href="../Items/machinequiz01-item04v1.xml"/>
0096               <assessmentItemRef identifier="MACHINE-QUIZ01-ITEM05"
0097                  required="true" fixed="true"
0098                  href="../Items/machinequiz01-item05v1.xml"/>
```

```
0099              <assessmentItemRef identifier="MACHINE-QUIZ01-ITEM06"
0100                  required="true" fixed="true"
0101                  href="../Items/machinequiz01-item06v1.xml"/>
0103
0104          </assessmentSection>
0105      </testPart>
0106
0107      <outcomeProcessing>
0108          <setOutcomeValue identifier="TOTAL_SCORE">
0109              <sum>
0110                  <testVariables variableIdentifier="SCORE" />
0111              </sum>
0112          </setOutcomeValue>
0113
0114          <setOutcomeValue identifier="TOTAL_MAXSCORE">
0115              <sum>
0116                  <testVariables variableIdentifier="MAXSCORE" />
0117              </sum>
0118          </setOutcomeValue>
0119
0120          <setOutcomeValue identifier="TOTAL_MINSCORE">
0121              <sum>
0122                  <testVariables variableIdentifier="MINSCORE" />
0123              </sum>
0124          </setOutcomeValue>
0125
0126          <setOutcomeValue identifier="TOTAL_NUMBERINCORRECT">
0127              <numberIncorrect/>
0128          </setOutcomeValue>
0129
0130          <setOutcomeValue identifier="TOTAL_NUMBERCORRECT">
0131              <numberCorrect/>
0132          </setOutcomeValue>
0133
0134          <setOutcomeValue identifier="TOTAL_NUMBERRESPONDED">
0135              <numberResponded/>
0136          </setOutcomeValue>
0137
0138          <setOutcomeValue identifier="TOTAL_NUMBERSELECTED">
0139              <numberSelected/>
0140          </setOutcomeValue>
0141
0142          <setOutcomeValue identifier="TOTAL_NUMBERPRESENTED">
0143              <numberPresented/>
0144          </setOutcomeValue>
0145
0146      </outcomeProcessing>
0147
0148      <!-- Passed feedback given if the TOTAL_SCORE is greater
0149          than/equal to MASTERY_SCORE -->
0150      <testFeedback access="atEnd" outcomeIdentifier="FEEDBACK"
0151          showHide="show" identifier="Passed" title="Passed test
0152  feedback">
0153          <p>Well done. You have passed the quiz.</p>
0154          <p>You scored <printedVariable identifier="TOTAL_SCORE"/> marks
0155  out of a maximum of <printedVariable identifier="TOTAL_MAXSCORE"/>
0156  marks.</p>
0157      </testFeedback>
```

```
0158
0159        <!-- Failed feedback given if the TOTAL_SCORE is less than
0160        MASTERY_SCORE -->
0161        <testFeedback access="atEnd" outcomeIdentifier="FEEDBACK"
0162           showHide="show" identifier="Failed" title="Failed test
0163     feedback">
0164           <p>Try again and see if you can get more correct answers.</p>
0165           <p>You scored <printedVariable identifier="TOTAL_SCORE"/> marks
0166     out of a maximum of <printedVariable identifier="TOTAL_MAXSCORE"/>
0167     marks.</p>
0168        </testFeedback>
0169     </assessmentTest>
0170
```

The key points are:

a) The title for the test is given in line 0007. This is the information that is displayed as the 'Quiz Title' as shown in Figure D2.1;

b) A set of outcomes variables is defined for the test (see lines 0009-0073). This consists of 10 variables. The three variables 'TOTAL_SCORE' (lines 0009-0014), 'TOTAL_MAXSCORE' (lines 0016-0021 and 'TOTAL_MINSCORE' (lines 0023-0028) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The variable 'MASTERY_SCORE' (lines 0030-0035) is used to define the score at or above mastery is achieved. The five variables 'TOTAL_NUMBERINCORRECT' (lines 0037-0042), 'TOTAL_NUMBERCORRECT' (lines 0044-0049), 'TOTAL_NUMBERPRESENTED' (lines 0051-0056), 'TOTAL_NUMBERSELECTED' (lines 0058-0063) and 'TOTAL_NUMBERRESPONDED' (Lines 0065-0070) provide contextual information about the questions presented to the user. The final variable 'FEEDBACK' (lines 0072-0073) is used to determine the nature of the test-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any quiz and so do not need to be defined. They have been included in the QTI-XML for completeness;

c) The single *testPart* is defined in lines 0075-0105. This contains the single *assessmentSection* that is defined in lines 0078-0104;

d) The test-level *rubricBlock* is given in lines 0081-0083. This is the information that must be displayed in the test-level rubric block space on the opening page of the quiz as per Figure D2.1;

e) The test-level outcomes processing is presented in lines 0107-0146. This is the set of processing rules that must be used to populate the appropriate values in the set of outcomes variables. See the QTIv2.1 specification for the interpretation of the actual processing rules themselves. In the current version of EDUPUB these processing rules are assumed and are not parsed during the transformation. They have been included in the QTI-XML for completeness;

f) The test-level feedback is given in lines 0150-0168. If the test has been passed then the feedback given in lines 0150-0157 is presented. If the test has been failed the feedback given

in lines 0161-0168 is presented. This is the feedback that is presented in the final page displayed as shown in Figure D2.6.

D3.3   The Six Item QTI-XML

The contents of the *assessmentItem* for the question 1 XML file are listed in Code D3.3.

Code D3.3 – True/false Item QTI-XML (question 1).

```
0000
0001   <assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004       xsi:schemaLocation="…"
0005       identifier="MACHINE-ITEM01"
0006       title="Number of Engines on a Jumbo Jet"
0007       label="True/False Question on Number of Engines on a Jumbo Jet"
0008       xml:lang="en-US"
0009       timeDependent="true"
0010       adaptive="false">
0011
0012       <responseDeclaration identifier="RESPONSE" cardinality="single"
0013          baseType="identifier">
0014           <correctResponse>
0015               <value>true</value>
0016           </correctResponse>
0017       </responseDeclaration>
0018
0019       <outcomeDeclaration identifier="SCORE" cardinality="single"
0020          baseType="float" masteryValue="0.0">
0021           <defaultValue>
0022               <value>0.0</value>
0023           </defaultValue>
0024       </outcomeDeclaration>
0025
0026       <outcomeDeclaration identifier="MAXSCORE" cardinality="single"
0027          baseType="float">
0028           <defaultValue>
0029               <value>1.0</value>
0030           </defaultValue>
0031       </outcomeDeclaration>
0032
0033       <outcomeDeclaration identifier="MINSCORE" cardinality="single"
0034          baseType="float">
0035           <defaultValue>
0036               <value>-1.0</value>
0037           </defaultValue>
0038       </outcomeDeclaration>
0039
0040       <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
0041          baseType="identifier"/>
0042
0043       <itemBody>
0044           <rubricBlock view="candidate">
0045               <p>Choose <em>one</em> of the two options.</p>
0046           </rubricBlock>
0047
0048           <choiceInteraction responseIdentifier="RESPONSE" shuffle="false"
0049               maxChoices="1">
```

```
0050              <prompt>
0051                 <p>A Boeing 747, also known as a Jumbo Jet, has four
0052      engines.</p>
0053              </prompt>
0054
0055              <simpleChoice identifier="true" fixed="true">True
0056              </simpleChoice>
0057              <simpleChoice identifier="false" fixed="true">False
0058              </simpleChoice>
0059
0060          </choiceInteraction>
0061
0062      </itemBody>
0063
0064      <responseProcessing template="truefalse-epub3rptemplate01" />
0065
0066      <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0067         identifier="Correct" title="Correct Answer Feedback">
0068          <p>Correct answer. Two engines under each wing.</p>
0069      </modalFeedback>
0070
0071      <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0072         identifier="Incorrect" title="Incorrect Answer Feedback">
0073          <p>No, wrong answer. A Jumbo Jet does have four engines.  Two
0074      under each wing.</p>
0075      </modalFeedback>
0076
0077  </assessmentItem>
0078
```

The key points are:

a) The title of the Item is given in line 0006;

b) The response processing variable, 'RESPONSE' is defined in lines 0012-0017. The
    associated correct answer is defined a 'true';

c) Four outcomes variables are defined for the Item (see lines 0019-0041). The three variables
    'SCORE' (lines 0019-0024), 'MAXSCORE' (lines 0026-0031 and 'MINSCORE' (lines
    0033-0038) are used to store the user's score, the maximum possible score and the minimum
    possible score respectively. The final variable 'FEEDBACK' (lines 0040-0041) is used to
    determine the nature of the Item-level feedback to be presented. In the current version of
    EDUPUB these variables are assumed as the default set for any Item and so do not need to be
    defined. They have been included in the QTI-XML for completeness;

d) The actual question is defined in lines 0043-0063. This consists of the Item-level rubric
    (lines 0044-0046), the choice interaction (lines 0048-0060) with the prompt given in lines
    0051-0054 and the two choices in lines 0052-0055;

e) The response-processing template to be used for this Item is given in line 0064. This
    template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of
    0.0 when not answered;

f) The Item-level feedback is given in lines 0066-0076. If the Item has been answered correctly, the feedback given in lines 0066-0069 is presented otherwise the feedback given in lines 0071-0075 is presented.

The contents of the *assessmentItem* for the question 2 XML file are listed in Code D3.4.

Code D3.4 – Multiple choice-single response Item QTI-XML (question 2).

```
0000
0001   <assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004       xsi:schemaLocation="…"
0005       identifier="MACHINE-ITEM02"
0006       title="Machines Used to Collect Kernels of Corn"
0007       label="MC-SR question on machines used to collect kernels of corn."
0008       xml:lang="en-US"
0009       timeDependent="true"
0010       adaptive="false">
0011
0012       <responseDeclaration identifier="RESPONSE" cardinality="single"
0013          baseType="identifier">
0014              <correctResponse>
0015                  <value>B</value>
0016              </correctResponse>
0017       </responseDeclaration>
0018
0019       <outcomeDeclaration identifier="SCORE" cardinality="single"
0020          baseType="float" masteryValue="0.0">
0021              <defaultValue>
0022                  <value>0.0</value>
0023              </defaultValue>
0024       </outcomeDeclaration>
0025
0026       <outcomeDeclaration identifier="MAXSCORE" cardinality="single"
0027          baseType="float">
0028              <defaultValue>
0029                  <value>1.0</value>
0030              </defaultValue>
0031       </outcomeDeclaration>
0032
0033       <outcomeDeclaration identifier="MINSCORE" cardinality="single"
0034          baseType="float">
0035              <defaultValue>
0036                  <value>-1.0</value>
0037              </defaultValue>
0038       </outcomeDeclaration>
0039
0040       <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
0041          baseType="identifier"/>
0042
0043       <itemBody>
0044           <rubricBlock view="candidate">
0045               <p>Choose <em>one</em> of the five options.</p>
0046           </rubricBlock>
0047
0048           <choiceInteraction responseIdentifier="RESPONSE"
0049             shuffle="false" maxChoices="1">
0050               <prompt>
```

```
0051                    <p>Which machine is used to collect the kernels of
0052    corn in a field?</p>
0053                 </prompt>
0054
0055                  <simpleChoice identifier="A" fixed="true">Submarine.
0056              </simpleChoice>
0057                  <simpleChoice identifier="B" fixed="true">Combine.
0058              </simpleChoice>
0059                  <simpleChoice identifier="C" fixed="true">Chopper.
0060              </simpleChoice>
0061                  <simpleChoice identifier="D" fixed="true">Locomotive.
0062              </simpleChoice>
0063                  <simpleChoice identifier="E" fixed="true">Helicopter.
0064              </simpleChoice>
0065
0066          </choiceInteraction>
0067
0068        </itemBody>
0069
0070        <responseProcessing template="mcsr-epub3rptemplate01" />
0071
0072        <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0073           identifier="Correct" title="Correct Answer Feedback">
0074             <p>Correct answer. Well done.</p>
0075        </modalFeedback>
0076
0077        <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0078           identifier="Incorrect" title="Incorrect Answer Feedback">
0079             <p>No, wrong answer. A <em>Combine</em> is used to collect the
0080    kernels of corn.</p>
0081        </modalFeedback>
0082
0083    </assessmentItem>
0084
```

The key points are:

a) The title of the Item is given in line 0006;

b) The response processing variable, 'RESPONSE' is defined in lines 0012-0017. The associated correct answer is defined as 'B';

c) Four outcomes variables are defined for the Item (see lines 0019-0041). The three variables 'SCORE' (lines 0019-0024), 'MAXSCORE' (lines 0026-0031 and 'MINSCORE' (lines 0033-0038) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0040-0041) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

d) The actual question is defined in lines 0043-0068. This consists of the Item-level rubric (lines 0044-0046), the choice interaction (lines 0048-0066) with the prompt given in lines 0050-0053 and the five choices in lines 0055-0064;

e) The response-processing template to be used for this Item is given in line 0070. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

f) The Item-level feedback is given in lines 0072-0080. If the Item has been answered correctly, the feedback given in lines 0072-0075 is presented otherwise the feedback given in lines 0077-0081 is presented.

The contents of the *assessmentItem* for question 3 XML file are listed in Code D3.5.

Code D3.5 – Multiple choice-multiple response Item QTI-XML (question 3).

```
0000
0001    <assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004        xsi:schemaLocation="…"
0005        identifier="MACHINE-ITEM03"
0006        title="Machines Used to Fly"
0007        label="MC-MR question on machines used to fly."
0008        xml:lang="en-US"
0009        timeDependent="true"
0010        adaptive="false">
0011
0012        <responseDeclaration identifier="RESPONSE" cardinality="single"
0013           baseType="identifier">
0014              <correctResponse>
0015                  <value>B</value>
0016                  <value>E</value>
0017              </correctResponse>
0018        </responseDeclaration>
0019
0020        <outcomeDeclaration identifier="SCORE" cardinality="single"
0021           baseType="float" masteryValue="0.0">
0022              <defaultValue>
0023                  <value>0.0</value>
0024              </defaultValue>
0025        </outcomeDeclaration>
0026
0027        <outcomeDeclaration identifier="MAXSCORE" cardinality="single"
0028           baseType="float">
0029              <defaultValue>
0030                  <value>1.0</value>
0031              </defaultValue>
0032        </outcomeDeclaration>
0033
0034        <outcomeDeclaration identifier="MINSCORE" cardinality="single"
0035           baseType="float">
0036              <defaultValue>
0037                  <value>-1.0</value>
0038              </defaultValue>
0039        </outcomeDeclaration>
0040
0041        <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
0042           baseType="identifier"/>
0043
0044        <itemBody>
0045
```

```
0046            <rubricBlock view="candidate">
0047                <p>Choose as many of the options as you think are
0048    correct.</p>
0049            </rubricBlock>
0050
0051            <choiceInteraction responseIdentifier="RESPONSE"
0052                shuffle="false" maxChoices="5">
0053                <prompt>
0054                    <p>Which machines can <em>fly</em>?</p>
0055                </prompt>
0056                <simpleChoice identifier="A" fixed="true">Submarine.
0057                 </simpleChoice>
0058                <simpleChoice identifier="B" fixed="true">Boeing 747.
0059                 </simpleChoice>
0060                <simpleChoice identifier="C" fixed="true">Chopper.
0061                 </simpleChoice>
0062                <simpleChoice identifier="D" fixed="true">Locomotive.
0063                 </simpleChoice>
0064                <simpleChoice identifier="E" fixed="true">Helicopter.
0065                 </simpleChoice>
0066
0067            </choiceInteraction>
0068
0069        </itemBody>
0070
0071        <responseProcessing template="mcmr-epub3rptemplate01" />
0072
0073        <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0074           identifier="Correct" title="Correct Answer Feedback">
0075            <p>Correct answer. Well done.</p>
0076        </modalFeedback>
0077
0078        <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0079           identifier="Incorrect" title="Incorrect Answer Feedback">
0080            <p>No, wrong answer. Only the <em>Boeing 747</em> and
0081    <em>Helicopter</em> can fly.</p>
0082        </modalFeedback>
0083
0084    </assessmentItem>
0085
```

The key points are:

a) The title of the Item is given in line 0006;

b) The response processing variable, 'RESPONSE' is defined in lines 0012-0018. The associated correct answer is defined as 'B' and 'E';

c) Four outcomes variables are defined for the Item (see lines 0019-0041). The three variables 'SCORE' (lines 0020-0025), 'MAXSCORE' (lines 0027-0032 and 'MINSCORE' (lines 0034-0039) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0041-0042) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

d) The actual question is defined in lines 0044-0069. This consists of the Item-level rubric (lines 0046-0049), the choice interaction (lines 0051-0067) with the prompt given in lines 0053-0055 and the five choices in lines 0056-0065;

e) The response-processing template to be used for this Item is given in line 0071. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

f) The Item-level feedback is given in lines 0073-0082. If the Item has been answered correctly, the feedback given in lines 0073-0076 is presented otherwise the feedback given in lines 0078-0082 is presented.

The contents of the *assessmentItem* for question 4 XML file are listed in Code D3.6.

Code D3.6 – Fill-in-Blank Item QTI-XML (question 4).

```
0000
0001   <assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004       xsi:schemaLocation="…"
0005       identifier="MACHINE-ITEM04"
0006       title="Chopper is a type of?"
0007       label="Fill-In Blank Question on a Chopper"
0008       xml:lang="en-US"
0009       timeDependent="true"
0010       adaptive="false">
0011
0012       <responseDeclaration identifier="RESPONSE" cardinality="single"
0013          baseType="identifier">
0014             <correctResponse>
0015                 <value>motorcycle</value>
0016             </correctResponse>
0017       </responseDeclaration>
0018
0019       <outcomeDeclaration identifier="SCORE" cardinality="single"
0020          baseType="float" masteryValue="0.0">
0021             <defaultValue>
0022                 <value>0.0</value>
0023             </defaultValue>
0024       </outcomeDeclaration>
0025
0026       <outcomeDeclaration identifier="MAXSCORE" cardinality="single"
0027          baseType="float">
0028             <defaultValue>
0029                 <value>1.0</value>
0030             </defaultValue>
0031       </outcomeDeclaration>
0032
0033       <outcomeDeclaration identifier="MINSCORE" cardinality="single"
0034          baseType="float">
0035             <defaultValue>
0036                 <value>-1.0</value>
0037             </defaultValue>
0038       </outcomeDeclaration>
0039
0040       <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
```

```
0041            baseType="identifier"/>
0042
0043       <itemBody>
0044
0045          <rubricBlock view="candidate">
0046             <p>Make sure you spell your answer correctly.</p>
0047          </rubricBlock>
0048
0049          <p>Fill in the <em>missing</em> word.</p>
0050          <p>A chopper is a specially built <textEntryInteraction
0051          responseIdentifier="RESPONSE" expectedLength="10"/>.</p>
0052
0053       </itemBody>
0054
0055       <responseProcessing template="fib-epub3rptemplate01" />
0056
0057       <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0058          identifier="Correct" title="Correct Answer Feedback">
0059             <p>Correct answer. Yes, a motorcycle.</p>
0060       </modalFeedback>
0061
0062       <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0063          identifier="Incorrect" title="Incorrect Answer Feedback">
0064             <p>No, wrong answer. A chopper is a specially built
0065   <em>motorcycle</em>.</p>
0066       </modalFeedback>
0067
0068   </assessmentItem>
0069
```

The key points are:

a) The title of the Item is given in line 0006;

b) The response processing variable, 'RESPONSE' is defined in lines 0012-0017. The associated correct answer is defined as 'motorcycle';

c) Four outcomes variables are defined for the Item (see lines 0019-0041). The three variables 'SCORE' (lines 0019-0024), 'MAXSCORE' (lines 0026-0031 and 'MINSCORE' (lines 0033-0038) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0040-0041) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

d) The actual question, FIB, is defined in lines 0043-0053. This consists of the Item-level rubric (lines 0045-0047), the text entry interaction (lines 0049-0051);

e) The response-processing template to be used for this Item is given in line 0055. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

f) The Item-level feedback is given in lines 0057-0066. If the Item has been answered correctly, the feedback given in lines 0057-0060 is presented otherwise the feedback given in lines 0062-0066 is presented.

The contents of the *assessmentItem* for question 5 XML file are listed in Code D3.7.

Code D3.7 – Multiple choice-single response Item QTI-XML (question 5).

```
0000
0001   <assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004       xsi:schemaLocation="…"
0005       identifier="MACHINE-ITEM05"
0006       title="Machines Using Railway Tracks"
0007       label="MC-SR question on machines using railway tracks."
0008       xml:lang="en-US"
0009       timeDependent="true"
0010       adaptive="false">
0011
0012       <responseDeclaration identifier="RESPONSE" cardinality="single"
0013          baseType="identifier">
0014            <correctResponse>
0015                <value>C</value>
0016            </correctResponse>
0017       </responseDeclaration>
0018
0019       <outcomeDeclaration identifier="SCORE" cardinality="single"
0020          baseType="float" masteryValue="0.0">
0021            <defaultValue>
0022                <value>0.0</value>
0023            </defaultValue>
0024       </outcomeDeclaration>
0025
0026       <outcomeDeclaration identifier="MAXSCORE" cardinality="single"
0027          baseType="float">
0028            <defaultValue>
0029                <value>1.0</value>
0030            </defaultValue>
0031       </outcomeDeclaration>
0032
0033       <outcomeDeclaration identifier="MINSCORE" cardinality="single"
0034          baseType="float">
0035            <defaultValue>
0036                <value>-1.0</value>
0037            </defaultValue>
0038       </outcomeDeclaration>
0039
0040       <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
0041          baseType="identifier"/>
0042
0043       <itemBody>
0044           <rubricBlock view="candidate">
0045                <p>Choose <em>one</em> of the five options.</p>
0046           </rubricBlock>
0047
0048           <choiceInteraction responseIdentifier="RESPONSE"
0049             shuffle="false" maxChoices="1">
0050                <prompt>
```

```
0051                         <p>Which machine moves on a railway track?</p>
0052                     </prompt>
0053
0054                     <simpleChoice identifier="A" fixed="true">Indy Car.
0055                      </simpleChoice>
0056                     <simpleChoice identifier="B" fixed="true">Combine.
0057                      </simpleChoice>
0058                     <simpleChoice identifier="C" fixed="true">Locomotive.
0059                      </simpleChoice>
0060                     <simpleChoice identifier="D" fixed="true">Chopper.
0061                      </simpleChoice>
0062                     <simpleChoice identifier="E" fixed="true">Front-End
0063   Loader.</simpleChoice>
0064
0065             </choiceInteraction>
0066
0067       </itemBody>
0068
0069       <responseProcessing template="mcsr-epub3rptemplate01" />
0070
0071       <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0072          identifier="Correct" title="Correct Answer Feedback">
0073            <p>Correct answer. Well done.</p>
0074       </modalFeedback>
0075
0076       <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0077          identifier="Incorrect" title="Incorrect Answer Feedback">
0078            <p>No, wrong answer. A <em>Locomotive</em> uses railway
0079   tracks.</p>
0080       </modalFeedback>
0081
0082   </assessmentItem>
0083
```

The key points are:

a) The title of the Item is given in line 0006;

b) The response processing variable, 'RESPONSE' is defined in lines 0012-0017. The associated correct answer is defined as 'C';

c) Four outcomes variables are defined for the Item (see lines 0019-0041). The three variables 'SCORE' (lines 0019-0024), 'MAXSCORE' (lines 0026-0031 and 'MINSCORE' (lines 0033-0038) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0040-0041) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

d) The actual question is defined in lines 0043-0067. This consists of the Item-level rubric (lines 0044-0046), the choice interaction (lines 0048-0065) with the prompt given in lines 0050-0052 and the five choices in lines 0054-0063;

e) The response-processing template to be used for this Item is given in line 0069. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

f) The Item-level feedback is given in lines 0071-0080. If the Item has been answered correctly, the feedback given in lines 0071-0074 is presented otherwise the feedback given in lines 0076-0080 is presented.

The contents of the *assessmentItem* for question 6 XML file are listed in Code D3.8.

Code D3.8 – Hotspot Item QTI-XML (question 6).

```
0000
0001   <assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p1"
0003       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0004       xsi:schemaLocation="…"
0005       identifier="MACHINE-ITEM06"
0006       title="Chopper Gas Tank"
0007       label="Hotspot question on the Chopper."
0008       xml:lang="en-US"
0009       timeDependent="true"
0010       adaptive="false">
0011
0012       <responseDeclaration identifier="RESPONSE" cardinality="single"
0013          baseType="identifier">
0014            <correctResponse>
0015                <value>A</value>
0016            </correctResponse>
0017       </responseDeclaration>
0018
0019       <outcomeDeclaration identifier="SCORE" cardinality="single"
0020          baseType="float" masteryValue="0.0">
0021            <defaultValue>
0022                <value>0.0</value>
0023            </defaultValue>
0024       </outcomeDeclaration>
0025
0026       <outcomeDeclaration identifier="MAXSCORE" cardinality="single"
0027          baseType="float">
0028            <defaultValue>
0029                <value>1.0</value>
0030            </defaultValue>
0031       </outcomeDeclaration>
0032
0033       <outcomeDeclaration identifier="MINSCORE" cardinality="single"
0034          baseType="float">
0035            <defaultValue>
0036                <value>-1.0</value>
0037            </defaultValue>
0038       </outcomeDeclaration>
0039
0040       <outcomeDeclaration identifier="FEEDBACK" cardinality="single"
0041          baseType="identifier"/>
0042
0043       <itemBody>
0044
0045           <rubricBlock view="candidate">
```

```
0046              <p>Choose <em>one</em> of the four options.</p>
0047          </rubricBlock>
0048
0049          <hotspotInteraction responseIdentifier="RESPONSE"
0050           maxChoices="1">
0051
0052              <prompt>Where is the gas tank?</prompt>
0053              <object type="image/jpeg" width="720" height="495"
0054                 data="Chopperv1.jpg">Chopper</object>
0055
0056              <hotspotChoice identifier="A" shape="circle"
0057                 coords="300, 250, 25" label="gastank"/>
0058              <hotspotChoice identifier="B" shape="circle"
0059                 coords="600, 100, 25" label="frontwheel"/>
0060              <hotspotChoice identifier="C" shape="circle"
0061                 coords="400, 100, 25" label="engine"/>
0062              <hotspotChoice identifier="D" shape="circle"
0063                 coords="500, 270, 25" label="light"/>
0064
0065          </hotspotInteraction>
0066
0067      </itemBody>
0068
0069      <responseProcessing template="hssr-epub3rptemplate01" />
0070
0071      <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0072         identifier="Correct" title="Correct Answer Feedback">
0073          <p>Correct answer. Well done.</p>
0074      </modalFeedback>
0075
0076      <modalFeedback outcomeIdentifier="FEEDBACK" showHide="show"
0077         identifier="Incorrect" title="Incorrect Answer Feedback">
0078          <p>No, wrong answer.</p>
0079      </modalFeedback>
0080
0081  </assessmentItem>
0082
```

The key points are:

a) The title of the Item is given in line 0006;

b) The response processing variable, 'RESPONSE' is defined in lines 0012-0017. The associated correct answer is defined as 'A';

c) Four outcomes variables are defined for the Item (see lines 0019-0041). The three variables 'SCORE' (lines 0019-0024), 'MAXSCORE' (lines 0026-0031 and 'MINSCORE' (lines 0033-0038) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0040-0041) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

d) The actual question, hotspot, is defined in lines 0043-0067. This consists of the Item-level rubric (lines 0045-0047), the hotspot interaction (lines 0049-0065) with the prompt given in line 0052, the four choices in lines 0056-0063 and the background image in lines 0053-0054;

e) The response-processing template to be used for this Item is given in line 0069. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

f) The Item-level feedback is given in lines 0071-0079. If the Item has been answered correctly, the feedback given in lines 0071-0074 is presented otherwise the feedback given in lines 0076-0079 is presented.

D3.4 The Response Processing Templates

[[ED NOTE: To be completed in a later draft.]]

D4   The Embedded XHTML File (s)

The contents of the quiz XHTML embedded in the EPUB3 file are listed in Code D4.1.

Code D4.1 – The embedded XHTML file for the quiz.

```
0000
0001   <html xmlns="http://www.w3.org/1999/xhtml" data-ng-app="myApp">
0003   <head>
0004       <title>Intense Machines Quiz</title>
0005       <meta name="viewport" content="width=1100, height=1650"/>
0006       <link href="uvu_dgm/css/assessment.css" rel="stylesheet"
0007         type="text/css"/>
0008       <link rel="stylesheet" type="text/css"
0009         href="../../../../lib/thirdparty/thickbox.css"/>
0010       <script src="uvu_dgm/js/lib/angular/angular.js"></script>
0011       <script src="uvu_dgm/js/lib/angular/angular-sanitize.js"></script>
0012       <script src="uvu_dgm/js/lib/angular/angular-resource.js"></script>
0013       <script src="uvu_dgm/js/lib/angular/pouchdb-1.1.0.min.js"></script>
0014       <script src="uvu_dgm/js/lib/angular/angular-pouchdb.js"></script>
0015       <script src="uvu_dgm/js/app.js"></script>
0016       <script src="uvu_dgm/js/controllers.js"></script>
0017       <script src="uvu_dgm/js/services.js"></script>
0018       <script src="uvu_dgm/js/directives.js"></script>
0019       <script src="uvu_dgm/js/lib/jquery-1.11.0.js"></script>
0020       <script src="uvu_dgm/js/lib/intellisense.min.js"></script>
0021       <script src="../../../lib/thirdparty/lti.js"
0022         type="text/javascript"></script>
0023       <script src="../../../lib/thirdparty/jquery-migrate-1.2.1.min.js"
0024         type="text/javascript"></script>
0025       <script src="../../../lib/thirdparty/thickbox-compressed.js"
0026         type="text/javascript"></script>
0027
0028   </head>
0029   <body id="quiz_body">
0030   <div class="Basic-Text-Frame" data-ng-controller="MainCtrl">
0031       <div class="qti-item" data-ng-hide="hideIntro">
0032           <div class="qti-item-header"
0033             data-ng-model="qti.assessmentTest.title">Quiz:
0034   {{qti.assessmentTest.title}}</div>
0035           <div class="item-content">
0036               <div class="qti-item-prompt"
0037                   data-ng-bind-html=
0038   "qti.assessmentTest.testPart.assessmentSection.rubricBlock.__text">
0039               </div>
0040           </div>
0041           <div class="navigation">
0042               <button class="btn-warning"
0043                 data-ng-click="endQuiz()">End Quiz
0044               </button>
0045               <button class="btn-primary btn-next"
0046                 data-ng-click="startQuiz()">Start Quiz</button>
0047           </div>
0048
0049       </div>    <br/><br/>
0050       <div class="qti-item" data-ng-hide="hideIntro">
0051           <div class="qti-item-header">Launch LTI Tool:
```

```
0052 | Questionmark</div>
0053 |         <div class="navigation">
0054 |             <h2>
0055 |             <a href="" onclick="parent.ltiLaunchTool('qm', 'qm001');"
0056 |                 title="Questionmark">Questionmark</a>
0057 |             </h2>
0058 |         </div>
0059 |     </div>
0060 |     <div class="qti-item" data-ng-hide="hideIntro">
0061 |         <div class="qti-item-header">Launch LTI Tool: YouSeeU</div>
0062 |         <div class="navigation">
0063 |             <h2>
0064 |             <a href="" onclick="parent.ltiLaunchTool('youseeu',
0065 | 'ysu1');"
0066 |                 title="YouSeeU">YouSeeU</a>
0067 |             </h2>
0068 |         </div>
0069 |     </div>
0070 |     <!-- this is the title for the Item -->
0071 |
0072 |     <div id="wrapper" data-ng-hide="hideQuiz">
0073 |         <div class="qti-item" data-ng-hide="showResponsePage">
0074 |             <div class="qti-item-header">
0075 |                 <div data-ng-model="qti.currItem.assessmentItem.title"
0076 |                     class="title">
0077 |                     {{qti.currItem.assessmentItem.title}}
0078 |                 </div>
0079 |                 <div class="points">1 pt</div>
0080 |             </div>
0081 |
0082 |             <div class="qti-item-rubric">
0083 |                 <div class="qti-item-prompt"
0084 |                     data-ng-bind-
0085 | html="qti.currItem.assessmentItem.itemBody.rubricBlock.__text"></div>
0086 |             </div>
0087 |
0088 |             <div class="item-content">
0089 |
0090 |                 <!-- True/False, MultiChoice Single Response -->
0091 |                 <div data-ng-if="qti.currItem.quizType=='choiceSingle'
0092 | || qti.currItem.quizType=='truefalse'">
0093 |                     <div class="qti-item-prompt"
0094 |                         data-ng-bind-
0095 | html="qti.currItem.assessmentItem.itemBody.choiceInteraction.prompt"></
0096 | div>
0097 |                     <ul class="qti-item-choices">
0098 |                         <li data-ng-repeat="choice in
0099 | qti.currItem.assessmentItem.itemBody.choiceInteraction.simpleChoice"
0100 |                             data-ng-class="{correct:
0101 | choice.correctResponse}">
0103 |                             <label>
0104 |                                 <input type="radio" name="choice"
0105 |                                     data-ng-model="qti.userSelection"
0106 |                                     value="{{choice.identifier}}"/>
0107 |                                 <span
0108 |                     data-ng-model="choice.identifier">{{choice.__text}}
0109 |                                 </span>
0110 |                             </label>
```

```
0111                           </li>
0112                         </ul>
0113                     </div>
0114
0115
0116                   <!-- MultiChoice Multi Response -->
0117                   <div data-ng-if="qti.currItem.quizType=='choiceMulti'">
0118                       <div class="qti-item-prompt"
0119                           data-ng-bind-
0120    html="qti.currItem.assessmentItem.itemBody.choiceInteraction.prompt"></
0121    div>
0122                       <ul class="qti-item-choices">
0123                           <li data-ng-repeat="choice in
0124    qti.currItem.assessmentItem.itemBody.choiceInteraction.simpleChoice"
0125                               data-ng-class="{correct:
0126    choice.correctResponse}">
0127                               <label>
0128                                   <input type="checkbox"
0129                                       value="{{choice.identifier}}"
0130                                       check-list='checked_choices'/>
0131                                   {{choice.__text}}
0132                               </label>
0133                           </li>
0134                       </ul>
0135                   </div>
0136
0137                   <!-- Fill In The Blank -->
0138                   <div data-ng-if="qti.currItem.quizType=='fillInBlank'">
0139                       <div class="qti-item-prompt" data-ng-bind-
0140    html="qti.currItem.assessmentItem.itemBody.__text"></div>
0141                       <input type="text"
0142                         data-ng-model="qti.fib_userTyped"/>
0143                   </div>
0144
0145                   <!-- Hot Spot questions -->
0146                   <div data-ng-if="qti.currItem.quizType=='hotSpot'">
0147                       <div class="qti-item-prompt" data-ng-bind-
0148    html="qti.currItem.assessmentItem.itemBody.__text"></div>
0149                       <div class="qti-item-prompt"
0150                           data-ng-bind-
0151    html="qti.currItem.assessmentItem.itemBody.hotspotInteraction.prompt"><
0152    /div>
0153                       <svg width="660" height="415" viewBox="0 0 660 415"
0154                           xmlns="http://www.w3.org/2000/svg"
0155                           xmlns:xlink="http://www.w3.org/1999/xlink"
0156                           data-ng-click="chopperClick($event)">
0157                           <image
0158                               xlink:href="uvu_dgm/images/Chopperv1.jpg"
0159                               height="415px" width="660px"/>
0160                           <circle cx="270" cy="190" r="50" fill="none"
0161                               stroke="white" stroke-width="2"/>
0162                           <circle cx="532" cy="330" r="93" fill="none"
0163                               stroke="white" stroke-width="2"/>
0164                           <circle cx="240" cy="315" r="80" fill="none"
0165                               stroke="white" stroke-width="2"/>
0166                           <circle cx="385" cy="145" r="30" fill="none"
0167                               stroke="white" stroke-width="2"/>
0168                       </svg>
```

```
0169                        </div>
0170                    </div>
0171             </div>
0172
0173             <div class="qti-item-feedback"
0174               data-ng-class="{correct: correctFeedbackAvailable,
0175             incorrect: incorrectFeedbackAvailable}"
0176               data-ng-show="itemFeedback"
0177               data-ng-bind-html="itemFeedback">
0178             </div>
0179
0180             <div data-ng-show="showResponsePage" class="wrapper">
0181                 <div class="qti-item">
0182                     <div class="qti-item-header">
0183                         <div class="title">Quiz Results</div>
0184                     </div>
0185                     <div class="assessmentTest-feedback"
0186                        data-ng-show="testPassed">
0187                        <div class="qti-item-prompt">
0188                             <p>Well done. You have passed the quiz.</p>
0189
0190                             <p>You scored {{qti.finalScore}} marks out of a
0191     maximum of {{qti.MAX_ITEMS}} marks.</p>
0192                        </div>
0193                     </div>
0194                     <div class="assessmentTest-feedback"
0195                        data-ng-hide="testPassed">
0196                        <div class="qti-item-prompt">
0197                             <p>Try again and see if you can get more
0198     correct answers.</p>
0199
0200                             <p>You scored {{qti.finalScore}} marks out of a
0201     maximum of {{qti.MAX_ITEMS}} marks.</p>
0203                        </div>
0204                     </div>
0205                     <div class="item-content">
0206                         <table class="qti-item-resultsOverview">
0207                             <tr>
0208                                 <td>Score:</td>
0209                                 <td>{{(qti.finalScore / qti.MAX_ITEMS) *
0210     100 | number:2}}%</td>
0211                             </tr>
0212                             <tr>
0213                                 <td>Points:</td>
0214                                 <td>{{qti.finalScore}} out of
0215     {{qti.MAX_ITEMS}}</td>
0216                             </tr>
0217                         </table>
0218                     </div>
0219                 </div>
0220             </div>
0221
0222             <div class="navigation">
0223                 <div data-ng-hide="showResponsePage">
0224                     <button class="btn-primary btn-previous"
0225                        data-ng-click="prevItem()"
0226                        data-ng-hide="qti.currItemIndex===0">Prev
0227                     </button>
```

```
0228                    <button class="btn-approve"
0229                        data-ng-disabled="submitAnswerDisabled"
0230                        data-ng-click="submitAnswer()"
0231                        data-ng-
0232    hide="qti.currItem.assessmentItem.isSubmitted">
0233    Submit Answer
0234                    </button>
0235                    <button class="btn-primary btn-next"
0236                        data-ng-click="nextItem()"
0237                        data-ng-show="showNextBtn()">
0238    Next
0239                    </button>
0240                    <button class="btn-approve btn-save"
0241                        data-ng-click="submitQuiz()"
0242                        data-ng-show="(qti.currItemIndex +
0243    1)===qti.MAX_ITEMS">
0244    Finish
0245                    </button>
0246                </div>
0247                <div data-ng-show="showResponsePage">
0248                    <button class="btn-primary btn-previous"
0249                        data-ng-click="startQuiz()">Retry Quiz</button>
0250                    <button class="btn-approve btn-save"
0251                        data-ng-click="endQuiz()">End Quiz</button>
0252                </div>
0253                <div class="quiz-indicator">{{(qti.currItemIndex + 1) + '/'
0254    + qti.MAX_ITEMS}}</div>
0255            </div>
0256        </div>
0257    </div>
0258
0259    <script type="text/javascript">
0260
0261        $(window).bind("load", function () { // Wait until window load is
0262    complete
0263
0264            var LTI = window.parent.LTI;
0265
0266            var host = LTI.session.caliper.serviceurl;
0267            var apiKey = LTI.session.caliper.apikey;
0268            var server = "http://" + host;
0269
0270            var options = {
0271                'apiKey': apiKey,
0272                'server': server,
0273                'sensor_id': 'com.testorg.thorTek1'
0274            };
0275
0276            intellisense.initialize({'intellisense': options}, {});
0277
0278            console.log(LTI);
0279
0280            console.log("init complete..");
0281        });
0282    </script>
0283    </body>
0284    </html>
0285
```

The key points are:

a) This XHTML file has been hand-created using the QTI-XML files from the content package as the source material. A number of classes have been defined for the layout of the quiz and questions. A set of AngularJS actions have been defined and these are identified using the attribute 'data-ng-***' e.g. 'data-ng-model', 'data-ng-hide', etc;

b) The links to the external JavaSCript libraries are supplied in lines 0010-0026 (these include the libraries for LTI, the Sensor API and the AngularJS framework;

c) The scaffolding for the quiz (the quiz title, buttons, etc.) is provided in lines 0031-0049;

d) The links to the two external systems, launched using LTI, are given in lines 0050-0069 (to Questionmark in lines 0050-0059 and to YouSeeU in lines 0060-0069);

e) The code for the set of questions is shown in lines 0072-0171 with True/False and Multiple Choice-Single Response in lines 0090-113, Multiple Choice-Multiple Response in lines 0116-0135, FIB in lines 0137-0143 and Hotspot in lines 0145-0169. The title for the questions is given in lines 0076-0078;

f) Control of the Item level-feedback is supplied in lines 0173-0178;

g) Control of the Test level feedback is supplied in lines 0180-0220;

h) The set of navigation buttons for the questions is supplied in lines 0222-0255;

i) The JavaScript that is used to initialise the SensorAPI is supplied in lines 0259-0282.

D4.1   The Embedded Caliper Calls

The declaration and initialization of the LTI global variable and the Sensor API 'person' and 'course' describe learning events are sent as listed in Code D4.2.

Code D4.2 – LTI global used in the initial person and course 'describe' events.

```
0000
0001   var LTI = $window.parent.LTI;
0003
0004   intellisense.describe('person', LTI.session.user.id,
0005       {"firstName" : LTI.session.user.firstname,
0006          "lastName" : LTI.session.user.lastname,
0007          "emailAddress": LTI.session.user.email}, Date.now());
0008
0009   intellisense.describe('course', LTI.session.context.id,
0010       {"title": $scope.qti.assessmentTest.title}, Date.now());
0011
```

When an *assessmentTest* is begun, there may be Sensor API learning events sent using the measure method that will indicate the precise beginning of a test attempt, a test part attempt, and a section attempt as listed in Code D4.1.2.

Code D4.3 – Learning events sent for test, testPart and section attempts.

```
0000
0001   intellisense.measure('ATTEMPT_TEST', {
0003          "courseId": LTI.session.context.id,
0004          "personId": LTI.session.user.firstname},
0005       {"activityId": "quiz-22321"}
0006   );
0007
0008   intellisense.measure('ATTEMPT_TESTPART', {
0009          "courseId": LTI.session.context.id,
0010          "personId": LTI.session.user.firstname},
0011       {"activityId": "quiz-22321"}
0012   );
0013
0014   intellisense.measure('ATTEMPT_SECTION', {
0015          "courseId": LTI.session.context.id,
0016          "personId": LTI.session.user.firstname},
0017       {"activityId": "quiz-22321"}
0018   );
0019
```

As each *assessmentItem* is encountered by the learner within the *assessmentTest*, *testPart*, or *assessmentSection*, there may be Sensor API learning events sent using the measure method that will indicate the precise beginning of an *assessmentItem* attempt as listed in Code D4.3.

Code D4.3 – Learning event posted for each attempted quiz item.

```
0000
0001   intellisense.measure('ATTEMPT_ITEM', {
0003          "courseId": LTI.session.context.id,
0004          "personId": LTI.session.user.firstname},
0005       {"activityId": "quiz-22321"}
0006   );
0007
```

Upon submission of the quiz by the learner for grading and results reporting, there may be a Sensor API measure event sent that will convey the appropriate context, person, and activity information as well as provide scoring and results information as listed in Code D4.4.

Code D4.4 – Learning event posted upon quiz submission.

```
0000
0001   intellisense.measure('SUBMIT_QUIZ', {
0003                      "courseId": LTI.session.context.id,
0004                      "personId": LTI.session.user.firstname},
0005                  {"activityId": "quiz-22321",
0006                      "percentageScore": ($scope.qti.finalScore /
0007   $scope.qti.MAX_ITEMS) * 100,
0008                      "achievedScore": $scope.qti.finalScore},
0009                  Date.now()
0010              );
0011
```

D5   The Embedded JSON File(s)

The contents of the quiz JSON file embedded in the EPUB3 are listed in Code D5.1.

Code D5.1– The test/quiz JSON file.

```
0000   {
0001       "assessmentTest": {
0003           "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004           "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005           "xsi:schemaLocation": "…",
0006           "identifier": "MACHINE-QUIZ01",
0007           "title": "A Short Quiz on Intense Machines",
0008           "outcomeDeclaration": [
0009               {
0010                   "identifier": "TOTAL_SCORE",
0011                   "cardinality": "single",
0012                   "baseType": "integer",
0013                   "defaultValue": {
0014                       "value": "0"
0015                   }
0016               },
0017               {
0018                   "identifier": "TOTAL_MAXSCORE",
0019                   "cardinality": "single",
0020                   "baseType": "integer",
0021                   "defaultValue": {
0022                       "value": "1"
0023                   }
0024               },
0025               {
0026                   "identifier": "TOTAL_MINSCORE",
0027                   "cardinality": "single",
0028                   "baseType": "integer",
0029                   "defaultValue": {
0030                       "value": "0"
0031                   }
0032               },
0033               {
0034                   "identifier": "MASTERY_SCORE",
0035                   "cardinality": "single",
0036                   "baseType": "integer",
0037                   "defaultValue": {
0038                       "value": "4"
0039                   }
0040               },
0041               {
0042                   "identifier": "TOTAL_NUMBERINCORRECT",
0043                   "cardinality": "single",
0044                   "baseType": "integer",
0045                   "defaultValue": {
0046                       "value": "0"
0047                   }
0048               },
0049               {
0050                   "identifier": "TOTAL_NUMBERCORRECT",
0051                   "cardinality": "single",
```

```
0052                      "baseType": "integer",
0053                      "defaultValue": {
0054                          "value": "0"
0055                      }
0056                  },
0057                  {
0058                      "identifier": "TOTAL_NUMBERPRESENTED",
0059                      "cardinality": "single",
0060                      "baseType": "integer",
0061                      "defaultValue": {
0062                          "value": "0"
0063                      }
0064                  },
0065                  {
0066                      "identifier": "TOTAL_NUMBERSELECTED",
0067                      "cardinality": "single",
0068                      "baseType": "integer",
0069                      "defaultValue": {
0070                          "value": "0"
0071                      }
0072                  },
0073                  {
0074                      "identifier": "TOTAL_NUMBERRESPONDED",
0075                      "cardinality": "single",
0076                      "baseType": "integer",
0077                      "defaultValue": {
0078                          "value": "0"
0079                      }
0080                  },
0081                  {
0082                      "identifier": "FEEDBACK",
0083                      "cardinality": "single",
0084                      "baseType": "identifier"
0085                  }
0086              ],
0087              "testPart": {
0088                  "identifier": "MACHINE-QUIZ01-TP1",
0089                  "navigationMode": "linear",
0090                  "submissionMode": "individual",
0091                  "assessmentSection": {
0092                      "identifier": "MACHINE-QUIZ01-TP1-S1",
0093                      "title": "Section 1",
0094                      "visible": "true",
0095                      "rubricBlock": {
0096                          "__text": "<p>Try <em>all</em> of the following
0097      questions.</p>",
0098                          "view": "candidate"
0099                      },
0100                      "assessmentItemRef": [
0101                          {
0103                              "identifier": "MACHINE-QUIZ01-ITEM01",
0104                              "required": "true",
0105                              "fixed": "true",
0106                              "href": "../Items/machinequiz01-item01v1.xml"
0107                          },
0108                          {
0109                              "identifier": "MACHINE-QUIZ01-ITEM02",
0110                              "required": "true",
```

```
0111                              "fixed": "true",
0112                              "href": "../Items/machinequiz01-item03v1.xml"
0113                          },
0114                          {
0115                              "identifier": "MACHINE-QUIZ01-ITEM03",
0116                              "required": "true",
0117                              "fixed": "true",
0118                              "href": "../Items/machinequiz01-item03v1.xml"
0119                          },
0120                          {
0121                              "identifier": "MACHINE-QUIZ01-ITEM04",
0122                              "required": "true",
0123                              "fixed": "true",
0124                              "href": "../Items/machinequiz01-item04v1.xml"
0125                          },
0126                          {
0127                              "identifier": "MACHINE-QUIZ01-ITEM05",
0128                              "required": "true",
0129                              "fixed": "true",
0130                              "href": "../Items/machinequiz01-item05v1.xml"
0131                          },
0132                          {
0133                              "identifier": "MACHINE-QUIZ01-ITEM06",
0134                              "required": "true",
0135                              "fixed": "true",
0136                              "href": "../Items/machinequiz01-item06v1.xml"
0137                          }
0138                      ]
0139                  }
0140          },
0141          "outcomeProcessing": {
0142              "setOutcomeValue": [
0143                  {
0144                      "identifier": "TOTAL_SCORE",
0145                      "sum": {
0146                          "testVariables": {
0147                              "variableIdentifier": "SCORE"
0148                          }
0149                      }
0150                  },
0151                  {
0152                      "identifier": "TOTAL_MAXSCORE",
0153                      "sum": {
0154                          "testVariables": {
0155                              "variableIdentifier": "MAXSCORE"
0156                          }
0157                      }
0158                  },
0159                  {
0160                      "identifier": "TOTAL_MINSCORE",
0161                      "sum": {
0162                          "testVariables": {
0163                              "variableIdentifier": "MINSCORE"
0164                          }
0165                      }
0166                  },
0167                  {
0168                      "identifier": "TOTAL_NUMBERINCORRECT",
```

```
0169                            "numberIncorrect": ""
0170                     },
0171                     {
0172                            "identifier": "TOTAL_NUMBERCORRECT",
0173                            "numberCorrect": ""
0174                     },
0175                     {
0176                            "identifier": "TOTAL_NUMBERRESPONDED",
0177                            "numberResponded": ""
0178                     },
0179                     {
0180                            "identifier": "TOTAL_NUMBERSELECTED",
0181                            "numberSelected": ""
0182                     },
0183                     {
0184                            "identifier": "TOTAL_NUMBERPRESENTED",
0185                            "numberPresented": ""
0186                     }
0187                 ]
0188             },
0189             "testFeedback": [
0190                 {
0191                        "__text": "<p>Well done. You have passed the quiz.</p>
0192    <p>You scored marks out of a maximum of marks.</p>",
0193                        "access": "atEnd",
0194                        "outcomeIdentifier": "FEEDBACK",
0195                        "showHide": "show",
0196                        "identifier": "Passed",
0197                        "title": "Passed test feedback",
0198                        "printedVariable": [
0199                            { "identifier": "TOTAL_SCORE" },
0200                            { "identifier": "TOTAL_MAXSCORE" }
0201                        ]
0203                 },
0204                 {
0205                        "__text": "<p>Try again and see if you can get more
0206    correct answers.</p> <p>You scored marks out of a maximum of
0207    marks.</p>",
0208                        "access": "atEnd",
0209                        "outcomeIdentifier": "FEEDBACK",
0210                        "showHide": "show",
0211                        "identifier": "Failed",
0212                        "title": "Failed test feedback",
0213                        "printedVariable": [
0214                            { "identifier": "TOTAL_SCORE" },
0215                            { "identifier": "TOTAL_MAXSCORE" }
0216                        ]
0217                 }
0218             ]
0219         }
0220  }
```

The key points are:

a) The JSON in Code 5.1 is produced by transforming the equivalent QTI-XML for the quiz (see Code D3.2);

b) The title for the test is given in line 0007. This is the information that is displayed as the 'Quiz Title' as shown in Figure D2.1;

c) A set of outcomes variables is defined for the test (see lines 0008-0086). This consists of 10 variables. The three variables 'TOTAL_SCORE' (lines 0009-0016), 'TOTAL_MAXSCORE' (lines 0017-0024 and 'TOTAL_MINSCORE' (lines 0025-0032) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The variable 'MASTERY_SCORE' (lines 0033-0040) is used to define the score at or above mastery is achieved. The five variables 'TOTAL_NUMBERINCORRECT' (lines 0041-0048), 'TOTAL_NUMBERCORRECT' (lines 0044-0049), 'TOTAL_NUMBERPRESENTED' (lines 0049-0064), 'TOTAL_NUMBERSELECTED' (lines 0065-0072) and 'TOTAL_NUMBERRESPONDED' (Lines 0073-0080) provide contextual information about the questions presented to the user. The final variable 'FEEDBACK' (lines 0081-0085) is used to determine the nature of the test-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any quiz and so do not need to be defined. They have been included in the QTI-XML for completeness;

d) The single *testPart* is defined in lines 0087-0140. This contains the single *assessmentSection* that is defined in lines 0091-0139 and the associated set of Item references are given in lines 0100-0138;

e) The test-level *rubricBlock* is given in lines 0095-0099. This is the information that must be displayed in the test-level rubric block space on the opening page of the quiz as per Figure D2.1;

f) The test-level outcomes processing is presented in lines 0141-0188. This is the set of processing rules that must be used to populate the appropriate values in the set of outcomes variables. See the QTIv2.1 specification for the interpretation of the actual processing rules themselves. In the current version of EDUPUB these processing rules are assumed and are not parsed during the transformation. They have been included in the QTI-XML for completeness;

g) The test-level feedback is given in lines 0189-0218. If the test has been passed then the feedback given in lines 0190-0203 is presented. If the test has been failed the feedback given in lines 0204-0217 is presented. This is the feedback that is presented in the final page displayed as shown in Figure D2.6.

The contents of the question 1 JSON file embedded in the EPUB3 are listed in Code D5.2.

Code D5.2 – The question 1 JSON file.

```
0000   {
0001        "assessmentItem": {
0003            "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004            "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005            "xsi:schemaLocation": "…",
0006            "identifier": "MACHINE-ITEM01",
0007            "title": "Number of Engines on a Jumbo Jet",
0008            "label": "True/False Question on Number of Engines on a Jumbo
0009   Jet",
0010            "xml:lang": "en-US",
0011            "timeDependent": "true",
0012            "adaptive": "false",
0013            "responseDeclaration": {
0014                "identifier": "RESPONSE",
0015                "cardinality": "single",
0016                "baseType": "identifier",
0017                "correctResponse": {
0018                    "value": "true"
0019                }
0020            },
0021            "outcomeDeclaration": [
0022                {
0023                    "identifier": "SCORE",
0024                    "cardinality": "single",
0025                    "baseType": "float",
0026                    "masteryValue": "0.0",
0027                    "defaultValue": {
0028                        "value": "0.0"
0029                    }
0030                },
0031                {
0032                    "identifier": "MAXSCORE",
0033                    "cardinality": "single",
0034                    "baseType": "float",
0035                    "defaultValue": {
0036                        "value": "1.0"
0037                    }
0038                },
0039                {
0040                    "identifier": "MINSCORE",
0041                    "cardinality": "single",
0042                    "baseType": "float",
0043                    "defaultValue": {
0044                        "value": "-1.0"
0045                    }
0046                },
0047                {
0048                    "identifier": "FEEDBACK",
0049                    "cardinality": "single",
0050                    "baseType": "identifier"
0051                }
0052            ],
0053            "itemBody": {
0054                "rubricBlock": {
```

```
0055                           "__text": "<p>Choose one of the two options.</p>",
0056                           "view": "candidate"
0057                       },
0058                       "choiceInteraction": {
0059                           "responseIdentifier": "RESPONSE",
0060                           "shuffle": "false",
0061                           "maxChoices": "1",
0062                           "prompt": "<p>A Boeing 747, also known as a Jumbo Jet,
0063  has four engines.</p>",
0064                           "simpleChoice": [
0065                               {
0066                                   "__text": "True",
0067                                   "identifier": "true",
0068                                   "fixed": "true"
0069                               },
0070                               {
0071                                   "__text": "False",
0072                                   "identifier": "false",
0073                                   "fixed": "true"
0074                               }
0075                           ]
0076                       }
0077                   },
0078               "responseProcessing": {
0079                   "template": "truefalse-epub3rptemplate01"
0080               },
0081               "modalFeedback": [
0082                   {
0083                       "__text": "<p>Correct answer. Two engines under each
0084  wing.</p>",
0085                       "outcomeIdentifier": "FEEDBACK",
0086                       "showHide": "show",
0087                       "identifier": "Correct",
0088                       "title": "Correct Answer Feedback"
0089                   },
0090                   {
0091                       "__text": "<p>No, wrong answer. A Jumbo Jet does have
0092  four engines. Two under each wing.</p>",
0093                       "outcomeIdentifier": "FEEDBACK",
0094                       "showHide": "show",
0095                       "identifier": "Incorrect",
0096                       "title": "Incorrect Answer Feedback"
0097                   }
0098               ]
0099           }
0100  }
```

The key points are:

a) The JSON in Code 5.2 is produced by transforming the equivalent QTI-XML for the
    question 1 (see Code D3.3);

b) The title of the Item is given in line 0007;

c) The response processing variable, 'RESPONSE' is defined in lines 0013-0020. The
    associated correct answer is defined a 'true';

d) Four outcomes variables are defined for the Item (see lines 0021-0052). The three variables 'SCORE' (lines 0022-0030), 'MAXSCORE' (lines 0031-0038 and 'MINSCORE' (lines 0039-0046) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0047-0051) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

e) The actual question is defined in lines 0053-0077. This consists of the Item-level rubric (lines 0054-0057), the choice interaction (lines 0058-0076) with the prompt given in lines 0062-0063 and the two choices in lines 0064-0075;

f) The response-processing template to be used for this Item is given in lines 0078-0080. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

g) The Item-level feedback is given in lines 0081-0098. If the Item has been answered correctly, the feedback given in lines 0082-0089 is presented otherwise the feedback given in lines 0090-0097 is presented.

The contents of the question 2 JSON file embedded in the EPUB3 are listed in Code D5.3.

Code D5.3 – The question 2 JSON file.

```
0000  {
0001      "assessmentItem": {
0003          "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004          "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005          "xsi:schemaLocation": "… ",
0006          "identifier": "MACHINE-ITEM02",
0007          "title": "Machines Used to Collect Kernels of Corn",
0008          "label": "MC-SR question on machines used to collect kernels
0009  of corn.",
0010          "xml:lang": "en-US",
0011          "timeDependent": "true",
0012          "adaptive": "false",
0013          "responseDeclaration": {
0014              "identifier": "RESPONSE",
0015              "cardinality": "single",
0016              "baseType": "identifier",
0017              "correctResponse": {
0018                  "value": "B"
0019              }
0020          },
0021          "outcomeDeclaration": [
0022              {
0023                  "identifier": "SCORE",
0024                  "cardinality": "single",
0025                  "baseType": "float",
0026                  "masteryValue": "0.0",
0027                  "defaultValue": {
0028                      "value": "0.0"
0029                  }
0030              },
```

```
0031                {
0032                    "identifier": "MAXSCORE",
0033                    "cardinality": "single",
0034                    "baseType": "float",
0035                    "defaultValue": {
0036                        "value": "1.0"
0037                    }
0038                },
0039                {
0040                    "identifier": "MINSCORE",
0041                    "cardinality": "single",
0042                    "baseType": "float",
0043                    "defaultValue": {
0044                        "value": "-1.0"
0045                    }
0046                },
0047                {
0048                    "identifier": "FEEDBACK",
0049                    "cardinality": "single",
0050                    "baseType": "identifier"
0051                }
0052            ],
0053            "itemBody": {
0054                "rubricBlock": {
0055                    "__text": "<p>Choose <em>one</em> of the five
0056    options.</p>",
0057                    "view": "candidate"
0058                },
0059                "choiceInteraction": {
0060                    "responseIdentifier": "RESPONSE",
0061                    "shuffle": "false",
0062                    "maxChoices": "1",
0063                    "prompt": "<p>Which machine is used to collect the
0064    kernels of corn in a field?</p>",
0065                    "simpleChoice": [
0066                        {
0067                            "__text": "Submarine.",
0068                            "identifier": "A",
0069                            "fixed": "true"
0070                        },
0071                        {
0072                            "__text": "Combine.",
0073                            "identifier": "B",
0074                            "fixed": "true"
0075                        },
0076                        {
0077                            "__text": "Chopper.",
0078                            "identifier": "C",
0079                            "fixed": "true"
0080                        },
0081                        {
0082                            "__text": "Locomotive.",
0083                            "identifier": "D",
0084                            "fixed": "true"
0085                        },
0086                        {
0087                            "__text": "Helicopter.",
0088                            "identifier": "E",
```

```
0089                            "fixed": "true"
0090                        }
0091                    ]
0092                }
0093            },
0094            "responseProcessing": {
0095                "template": "mcsr-epub3rptemplate01"
0096            },
0097            "modalFeedback": [
0098                {
0099                    "__text": "<p>Correct answer. Well done.</p>",
0100                    "outcomeIdentifier": "FEEDBACK",
0101                    "showHide": "show",
0103                    "identifier": "Correct",
0104                    "title": "Correct Answer Feedback"
0105                },
0106                {
0107                    "__text": "<p>No, wrong answer. A <em>Combine</em> is
0108   used to collect the kernels of corn.</p>",
0109                    "outcomeIdentifier": "FEEDBACK",
0110                    "showHide": "show",
0111                    "identifier": "Incorrect",
0112                    "title": "Incorrect Answer Feedback"
0113                }
0114            ]
0115        }
0116  }
```

The key points are:

a) The JSON in Code 5.3 is produced by transforming the equivalent QTI-XML for the question 2 (see Code D3.4);

b) The title of the Item is given in line 0007;

c) The response processing variable, 'RESPONSE' is defined in lines 0013-0020. The associated correct answer is defined as 'B';

d) Four outcomes variables are defined for the Item (see lines 0021-0052). The three variables 'SCORE' (lines 0022-0030), 'MAXSCORE' (lines 0031-0038 and 'MINSCORE' (lines 0039-0046) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0047-0051) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

e) The actual question is defined in lines 0053-0093. This consists of the Item-level rubric (lines 0054-0058), the choice interaction (lines 0059-0092) with the prompt given in lines 0063-0064 and the five choices in lines 0065-0091;

f) The response-processing template to be used for this Item is given in lines 0094-0096. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

g) The Item-level feedback is given in lines 0097-00114. If the Item has been answered correctly, the feedback given in lines 0098-0105 is presented otherwise the feedback given in lines 0106-0113 is presented.

The contents of the question 3 JSON file embedded in the EPUB3 are listed in Code D5.4.

Code D5.4 – The question 3 JSON file.

```
0000   {
0001       "assessmentItem": {
0003           "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004           "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005           "xsi:schemaLocation": "…",
0006           "identifier": "MACHINE-ITEM03",
0007           "title": "Machines Used to Fly",
0008           "label": "MC-MR question on machines used to fly.",
0009           "xml:lang": "en-US",
0010           "timeDependent": "true",
0011           "adaptive": "false",
0012           "responseDeclaration": {
0013               "identifier": "RESPONSE",
0014               "cardinality": "single",
0015               "baseType": "identifier",
0016               "correctResponse": {
0017                   "value": [
0018                       "B",
0019                       "E"
0020                   ]
0021               }
0022           },
0023           "outcomeDeclaration": [
0024               {
0025                   "identifier": "SCORE",
0026                   "cardinality": "single",
0027                   "baseType": "float",
0028                   "masteryValue": "0.0",
0029                   "defaultValue": {
0030                       "value": "0.0"
0031                   }
0032               },
0033               {
0034                   "identifier": "MAXSCORE",
0035                   "cardinality": "single",
0036                   "baseType": "float",
0037                   "defaultValue": {
0038                       "value": "1.0"
0039                   }
0040               },
0041               {
0042                   "identifier": "MINSCORE",
0043                   "cardinality": "single",
0044                   "baseType": "float",
0045                   "defaultValue": {
0046                       "value": "-1.0"
0047                   }
0048               },
0049               {
0050                   "identifier": "FEEDBACK",
```

```
0051                    "cardinality": "single",
0052                    "baseType": "identifier"
0053                }
0054            ],
0055        "itemBody": {
0056            "rubricBlock": {
0057                "__text": "<p>Choose as many of the options as you
0058    think are correct.</p>",
0059                "view": "candidate"
0060            },
0061            "choiceInteraction": {
0062                "responseIdentifier": "RESPONSE",
0063                "shuffle": "false",
0064                "maxChoices": "5",
0065                "prompt": "<p>Which machines can <em>fly</em>?</p>",
0066                "simpleChoice": [
0067                    {
0068                        "__text": "Submarine.",
0069                        "identifier": "A",
0070                        "fixed": "true"
0071                    },
0072                    {
0073                        "__text": "Boeing 747.",
0074                        "identifier": "B",
0075                        "fixed": "true"
0076                    },
0077                    {
0078                        "__text": "Chopper.",
0079                        "identifier": "C",
0080                        "fixed": "true"
0081                    },
0082                    {
0083                        "__text": "Locomotive.",
0084                        "identifier": "D",
0085                        "fixed": "true"
0086                    },
0087                    {
0088                        "__text": "Helicopter.",
0089                        "identifier": "E",
0090                        "fixed": "true"
0091                    }
0092                ]
0093            }
0094        },
0095        "responseProcessing": {
0096            "template": "mcmr-epub3rptemplate01"
0097        },
0098        "modalFeedback": [
0099            {
0100                "__text": "<p>Correct answer. Well done.</p>",
0101                "outcomeIdentifier": "FEEDBACK",
0103                "showHide": "show",
0104                "identifier": "Correct",
0105                "title": "Correct Answer Feedback"
0106            },
0107            {
0108                "__text": "<p>No, wrong answer. Only the <em>Boeing
0109    747</em> and <em>Helicopter</em> can fly.</p>",
```

```
0110                    "outcomeIdentifier": "FEEDBACK",
0111                    "showHide": "show",
0112                    "identifier": "Incorrect",
0113                    "title": "Incorrect Answer Feedback"
0114                }
0115            ]
0116        }
0117  }
```

The key points are:

a) The JSON in Code 5.4 is produced by transforming the equivalent QTI-XML for the question 2 (see Code D3.5);

b) The title of the Item is given in line 0007;

c) The response processing variable, 'RESPONSE' is defined in lines 0012-0022. The associated correct answer is defined as 'B' and 'E';

d) Four outcomes variables are defined for the Item (see lines 0023-0054). The three variables 'SCORE' (lines 0024-0032), 'MAXSCORE' (lines 0033-0040 and 'MINSCORE' (lines 0041-0048) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0049-0053) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

e) The actual question is defined in lines 0055-0094. This consists of the Item-level rubric (lines 0046-0049), the choice interaction (lines 0051-0067) with the prompt given in line 0065 and the five choices in lines 0066-0092;

f) The response-processing template to be used for this Item is given in lines 0095-96. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

g) The Item-level feedback is given in lines 0098-0115. If the Item has been answered correctly, the feedback given in lines 0099-0106 is presented otherwise the feedback given in lines 0107-0114 is presented.

The contents of the question 4 JSON file embedded in the EPUB3 are listed in Code D5.5.

Code D5.5 – The question 4 JSON file.

```
0000  {
0001      "assessmentItem": {
0003          "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004          "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005          "xsi:schemaLocation": "…",
0006          "identifier": "MACHINE-ITEM04",
0007          "title": "Chopper is a type of?",
0008          "label": "Fill-In Blank Question on a Chopper",
0009          "xml:lang": "en-US",
0010          "timeDependent": "true",
0011          "adaptive": "false",
0012          "responseDeclaration": {
0013              "identifier": "RESPONSE",
0014              "cardinality": "single",
0015              "baseType": "identifier",
0016              "correctResponse": {
0017                  "value": "motorcycle"
0018              }
0019          },
0020          "outcomeDeclaration": [
0021              {
0022                  "identifier": "SCORE",
0023                  "cardinality": "single",
0024                  "baseType": "float",
0025                  "masteryValue": "0.0",
0026                  "defaultValue": {
0027                      "value": "0.0"
0028                  }
0029              },
0030              {
0031                  "identifier": "MAXSCORE",
0032                  "cardinality": "single",
0033                  "baseType": "float",
0034                  "defaultValue": {
0035                      "value": "1.0"
0036                  }
0037              },
0038              {
0039                  "identifier": "MINSCORE",
0040                  "cardinality": "single",
0041                  "baseType": "float",
0042                  "defaultValue": {
0043                      "value": "-1.0"
0044                  }
0045              },
0046              {
0047                  "identifier": "FEEDBACK",
0048                  "cardinality": "single",
0049                  "baseType": "identifier"
0050              }
0051          ],
0052          "itemBody": {
0053              "rubricBlock": {
0054                  "view": "candidate",
```

```
0055                       "__text": "<p>Make sure you spell your answer
0056    correctly.</p>"
0057                   },
0058                   "__text": "<p>Fill in the <em>missing</em> word.</p><p>A
0059    chopper is a specially built .</p>",
0060                   "textEntryInteraction": {
0061                           "responseIdentifier": "RESPONSE",
0062                           "expectedLength": "10"
0063                   }
0064           },
0065           "responseProcessing": {
0066                   "template": "fib-epub3rptemplate01"
0067           },
0068           "modalFeedback": [
0069                   {
0070                           "outcomeIdentifier": "FEEDBACK",
0071                           "showHide": "show",
0072                           "identifier": "Correct",
0073                           "title": "Correct Answer Feedback",
0074                           "__text": "<p>Correct answer. Yes, a motorcycle.</p>"
0075                   },
0076                   {
0077                           "outcomeIdentifier": "FEEDBACK",
0078                           "showHide": "show",
0079                           "identifier": "Incorrect",
0080                           "title": "Incorrect Answer Feedback",
0081                           "__text": "<p>No, wrong answer. A chopper is a
0082    specially built <em>motorcycle</em></p>"
0083                   }
0084           ]
0085       }
0086    }
```

The key points are:

a) The JSON in Code 5.5 is produced by transforming the equivalent QTI-XML for the question 2 (see Code D3.6);

b) The title of the Item is given in line 0007;

c) The response processing variable, 'RESPONSE' is defined in lines 0012-0019. The associated correct answer is defined as 'motorcycle';

d) Four outcomes variables are defined for the Item (see lines 0020-0051). The three variables 'SCORE' (lines 0021-0029), 'MAXSCORE' (lines 0030-0037 and 'MINSCORE' (lines 0038-0045) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0046-0050) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

e) The actual question, FIB, is defined in lines 0052-0064. This consists of the Item-level rubric (lines 0053-0057), the text entry interaction (lines 0058-0063);

f) The response-processing template to be used for this Item is given in lines 0065-0066. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

g) The Item-level feedback is given in lines 0068-0084. If the Item has been answered correctly, the feedback given in lines 0069-0075 is presented otherwise the feedback given in lines 0076-0083 is presented.

The contents of the question 5 JSON file embedded in the EPUB3 are listed in Code D5.6.

Code D5.6– The question 5 JSON file.

```
0000  {
0001      "assessmentItem": {
0003          "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004          "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005          "xsi:schemaLocation": "…",
0006          "identifier": "MACHINE-ITEM05",
0007          "title": "Machines Using Railway Tracks",
0008          "label": "MC-SR question on machines using railway tracks.",
0009          "xml:lang": "en-US",
0010          "timeDependent": "true",
0011          "adaptive": "false",
0012          "responseDeclaration": {
0013              "identifier": "RESPONSE",
0014              "cardinality": "single",
0015              "baseType": "identifier",
0016              "correctResponse": {
0017                  "value": "C"
0018              }
0019          },
0020          "outcomeDeclaration": [
0021              {
0022                  "identifier": "SCORE",
0023                  "cardinality": "single",
0024                  "baseType": "float",
0025                  "masteryValue": "0.0",
0026                  "defaultValue": {
0027                      "value": "0.0"
0028                  }
0029              },
0030              {
0031                  "identifier": "MAXSCORE",
0032                  "cardinality": "single",
0033                  "baseType": "float",
0034                  "defaultValue": {
0035                      "value": "1.0"
0036                  }
0037              },
0038              {
0039                  "identifier": "MINSCORE",
0040                  "cardinality": "single",
0041                  "baseType": "float",
0042                  "defaultValue": {
0043                      "value": "-1.0"
0044                  }
0045              },
```

```
0046                    {
0047                          "identifier": "FEEDBACK",
0048                          "cardinality": "single",
0049                          "baseType": "identifier"
0050                    }
0051              ],
0052              "itemBody": {
0053                    "rubricBlock": {
0054                          "__text": "<p>Choose <em>one</em> of the five
0055    options.</p>",
0056                          "view": "candidate"
0057                    },
0058                    "choiceInteraction": {
0059                          "responseIdentifier": "RESPONSE",
0060                          "shuffle": "false",
0061                          "maxChoices": "1",
0062                          "prompt": "<p>Which machine moves on a railway
0063    track?</p>",
0064                          "simpleChoice": [
0065                                {
0066                                      "__text": "Indy Car.",
0067                                      "identifier": "A",
0068                                      "fixed": "true"
0069                                },
0070                                {
0071                                      "__text": "Combine.",
0072                                      "identifier": "B",
0073                                      "fixed": "true"
0074                                },
0075                                {
0076                                      "__text": "Locomotive.",
0077                                      "identifier": "C",
0078                                      "fixed": "true"
0079                                },
0080                                {
0081                                      "__text": "Chopper.",
0082                                      "identifier": "D",
0083                                      "fixed": "true"
0084                                },
0085                                {
0086                                      "__text": "Front-End Loader.",
0087                                      "identifier": "E",
0088                                      "fixed": "true"
0089                                }
0090                          ]
0091                    }
0092              },
0093              "responseProcessing": {
0094                    "template": "mcsr-epub3rptemplate01"
0095              },
0096              "modalFeedback": [
0097                    {
0098                          "__text": "<p>Correct answer. Well done.</p>",
0099                          "outcomeIdentifier": "FEEDBACK",
0100                          "showHide": "show",
0101                          "identifier": "Correct",
0103                          "title": "Correct Answer Feedback"
0104                    },
```

```
0105                   {
0106                       "__text": "<p>No, wrong answer. A <em>Locomotive</em>
0107    uses railway tracks.</p>",
0108                       "outcomeIdentifier": "FEEDBACK",
0109                       "showHide": "show",
0110                       "identifier": "Incorrect",
0111                       "title": "Incorrect Answer Feedback"
0112                   }
0113               ]
0114           }
0115    }
```

The key points are:

a) The JSON in Code 5.6 is produced by transforming the equivalent QTI-XML for the
    question 2 (see Code D3.7);

b) The title of the Item is given in line 0007;

c) The response processing variable, 'RESPONSE' is defined in lines 0012-0019. The
    associated correct answer is defined as 'C';

d) Four outcomes variables are defined for the Item (see lines 0020-0051). The three variables
    'SCORE' (lines 0021-0029), 'MAXSCORE' (lines 0030-0037 and 'MINSCORE' (lines
    0038-0045) are used to store the user's score, the maximum possible score and the minimum
    possible score respectively. The final variable 'FEEDBACK' (lines 0046-0050) is used to
    determine the nature of the Item-level feedback to be presented. In the current version of
    EDUPUB these variables are assumed as the default set for any Item and so do not need to be
    defined. They have been included in the QTI-XML for completeness;

e) The actual question is defined in lines 0052-0092. This consists of the Item-level rubric
    (lines 0053-0057), the choice interaction (lines 0058-0091) with the prompt given in lines
    0062-0063 and the five choices in lines 0064-0090;

f) The response-processing template to be used for this Item is given in lines 0093-0094. This
    template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of
    0.0 when not answered;

g) The Item-level feedback is given in lines 0096-0113. If the Item has been answered correctly,
    the feedback given in lines 0097-0104 is presented otherwise the feedback given in lines
    0105-0112 is presented.

The contents of the question 6 JSON file embedded in the EPUB3 are listed in Code D5.7.

Code D5.7 – The question 6 JSON file.

```
0000  {
0001      "assessmentItem": {
0003          "xmlns": "http://www.imsglobal.org/xsd/imsqti_v2p1",
0004          "xmlns:xsi": "http://www.w3.org/2001/XMLSchema-instance",
0005          "xsi:schemaLocation": "…",
0006          "identifier": "MACHINE-ITEM06",
0007          "title": "Chopper Gas Tank",
0008          "label": "Hotspot question on the Chopper.",
0009          "xml:lang": "en-US",
0010          "timeDependent": "true",
0011          "adaptive": "false",
0012          "responseDeclaration": {
0013              "identifier": "RESPONSE",
0014              "cardinality": "single",
0015              "baseType": "identifier",
0016              "correctResponse": {
0017                  "value": "A"
0018              }
0019          },
0020          "outcomeDeclaration": [
0021              {
0022                  "identifier": "SCORE",
0023                  "cardinality": "single",
0024                  "baseType": "float",
0025                  "masteryValue": "0.0",
0026                  "defaultValue": {
0027                      "value": "0.0"
0028                  }
0029              },
0030              {
0031                  "identifier": "MAXSCORE",
0032                  "cardinality": "single",
0033                  "baseType": "float",
0034                  "defaultValue": {
0035                      "value": "1.0"
0036                  }
0037              },
0038              {
0039                  "identifier": "MINSCORE",
0040                  "cardinality": "single",
0041                  "baseType": "float",
0042                  "defaultValue": {
0043                      "value": "-1.0"
0044                  }
0045              },
0046              {
0047                  "identifier": "FEEDBACK",
0048                  "cardinality": "single",
0049                  "baseType": "identifier"
0050              }
0051          ],
0052          "itemBody": {
0053              "rubricBlock": {
0054                  "__text": "<p>Choose <em>one</em> of the four
```

```
0055   options.</p>",
0056                       "view": "candidate"
0057                   },
0058                   "hotspotInteraction": {
0059                       "responseIdentifier": "RESPONSE",
0060                       "maxChoices": "1",
0061                       "prompt": "Where is the gas tank?",
0062                       "object": {
0063                           "__text": "Chopper",
0064                           "type": "image/jpeg",
0065                           "width": "720",
0066                           "height": "495",
0067                           "data": "Chopperv1.jpg"
0068                       },
0069                       "hotspotChoice": [
0070                           {
0071                               "identifier": "A",
0072                               "shape": "circle",
0073                               "coords": "300, 250, 25",
0074                               "label": "gastank"
0075                           },
0076                           {
0077                               "identifier": "B",
0078                               "shape": "circle",
0079                               "coords": "600, 100, 25",
0080                               "label": "frontwheel"
0081                           },
0082                           {
0083                               "identifier": "C",
0084                               "shape": "circle",
0085                               "coords": "400, 100, 25",
0086                               "label": "engine"
0087                           },
0088                           {
0089                               "identifier": "D",
0090                               "shape": "circle",
0091                               "coords": "500, 270, 25",
0092                               "label": "light"
0093                           }
0094                       ]
0095                   }
0096               },
0097               "responseProcessing": {
0098                   "template": "hssr-epub3rptemplate01"
0099               },
0100               "modalFeedback": [
0101                   {
0103                       "__text": "<p>Correct answer. Well done.</p>",
0104                       "outcomeIdentifier": "FEEDBACK",
0105                       "showHide": "show",
0106                       "identifier": "Correct",
0107                       "title": "Correct Answer Feedback"
0108                   },
0109                   {
0110                       "__text": "<p>No, wrong answer.</p>",
0111                       "outcomeIdentifier": "FEEDBACK",
0112                       "showHide": "show",
0113                       "identifier": "Incorrect",
```

```
0114                       "title": "Incorrect Answer Feedback"
0115                   }
0116               ]
0117           }
0118  }
```

The key points are:

a) The JSON in Code 5.7 is produced by transforming the equivalent QTI-XML for the question 2 (see Code D3.8);

b) The title of the Item is given in line 0007;

c) The response processing variable, 'RESPONSE' is defined in lines 0012-0019. The associated correct answer is defined as 'A';

d) Four outcomes variables are defined for the Item (see lines 0020-0051). The three variables 'SCORE' (lines 0021-0029), 'MAXSCORE' (lines 0030-0037 and 'MINSCORE' (lines 0038-0045) are used to store the user's score, the maximum possible score and the minimum possible score respectively. The final variable 'FEEDBACK' (lines 0046-0050) is used to determine the nature of the Item-level feedback to be presented. In the current version of EDUPUB these variables are assumed as the default set for any Item and so do not need to be defined. They have been included in the QTI-XML for completeness;

e) The actual question, hotspot, is defined in lines 0052-0096. This consists of the Item-level rubric (lines 0053-0057), the hotspot interaction (lines 0058-0095) with the prompt given in line 0061, the four choices in lines 0069-0094 and the background image in lines 0062-0068;

f) The response-processing template to be used for this Item is given in lines 0097-0098. This template provides a score of 1.0 when correct, a score of -1.0 when incorrect and a score of 0.0 when not answered;

g) The Item-level feedback is given in lines 0100-0116. If the Item has been answered correctly, the feedback given in lines 0101-0108 is presented otherwise the feedback given in lines 0109-0115 is presented.

D6   Other Files Changes in the EPUB3

D6.1   The Navigation File

The navigation file is amended to include the reference to the new QTI Quiz as shown in listing Code 5.8.

Code D5.8 – The EPUB3 'nav.html' file.

```
0000
0001   <html xmlns="http://www.w3.org/1999/xhtml"
0003      xmlns:epub="http://www.idpf.org/2007/ops" lang="en" xml:lang="en">
0004      <head>
0005          <title>INTENSE! Machines</title>
0006          <meta charset="utf-8" />
0007      </head>
0008      <body>
0009          <section class="frontmatter TableOfContents"
0010              epub:type="frontmatter toc">
0011              <header>
0012                  <h1>Table of Contents</h1>
0013              </header>
0014              <nav xmlns:epub="http://www.idpf.org/2007/ops"
0015                  epub:type="toc" id="toc">
0016                  <ol>
0017                      <li><a href="fcover.xhtml">Front Cover Page</a></li>
0018                      <li><a href="page_000.xhtml">Parent Page</a></li>
0019                      <li><a href="title.xhtml">Title Page</a></li>
0020                      <li><a href="page_001.xhtml">Copyright Page</a></li>
0021                      <li><a href="page_002.xhtml">Introduction</a></li>
0022                      <li><a href="page_004.xhtml">Front-End Loader</a></li>
0023                      <li><a href="page_006.xhtml">Giant Dump Truck</a></li>
0024                      <li><a href="page_008.xhtml">Combine</a></li>
0025                      <li><a href="page_010.xhtml">Indy Car</a></li>
0026                      <li><a href="page_012.xhtml">Chopper</a></li>
0027                      <li><a href="page_014.xhtml">Fire Truck</a></li>
0028                      <li><a href="page_016.xhtml">Helicopter</a></li>
0029                      <li><a href="page_018.xhtml">Locomotive</a></li>
0030                      <li><a href="page_020.xhtml">Boeing 747</a></li>
0031                      <li><a href="page_022.xhtml">Semitruck</a></li>
0032                      <li><a href="page_024.xhtml">Cargo Ship</a></li>
0033                      <li><a href="page_026.xhtml">Submarine</a></li>
0034                      <li><a href="page_028.xhtml">Aircraft Carrier</a></li>
0035                      <li><a href="page_030.xhtml">Space Shuttle</a></li>
0036                      <li><a href="page_031.xhtml">INTENSE! Machines
0037   Comprehension Questions</a></li>
0038                      <li>
0039                          <a href="qti_assessment.xhtml">QTI Assessment</a>
0040                      </li>
0041                      <li><a href="page_033.xhtml">Interactive Submarine
0042   Activity</a></li>
0043                      <li><a href="credit.xhtml">Credits</a></li>
0044                      <li><a href="bcover.xhtml">Back Cover Page</a></li>
0045                  </ol>
0046              </nav>
0047          </section>
0048      </body>
```

```
0049  </html>
0050
```

The new entry into the EPUB3 table of contents is shown in lines 0038-0040 (see Figure D1.3).

D6.2   The OPF File

The amendments required in the OPF file are shown in listing Code 5.8.

<div align="center">Code D5.8 – The EPUB3 'package.opf' file.</div>

```
0000
0001  <package xmlns="http://www.idpf.org/2007/opf" version="3.0">
0003      <metadata>
0004          …
0005      </metadata>
0006      <manifest>
0007          …
0008          <!--QTI-->
0009          <item id="qti_01" href="qti_assessment.xhtml"
0010              media-type="application/xhtml+xml" properties="scripted"/>
0011          <item id="qtijs_01" href="uvu_dgm/js/lib/angular/angular.js"
0012              media-type="text/javascript" />
0013          <item id="qtijs_02"
0014              href="uvu_dgm/js/lib/angular/angular-pouchdb.js"
0015              media-type="text/javascript" />
0016          <item id="qtijs_03"
0017              href="uvu_dgm/js/lib/angular/angular-resource.js"
0018              media-type="text/javascript" />
0019          <item id="qtijs_04"
0020              href="uvu_dgm/js/lib/angular/angular-sanitize.js"
0021              media-type="text/javascript" />
0022          <item id="qtijs_05"
0023              href="uvu_dgm/js/lib/angular/pouchdb-1.1.0.min.js"
0024              media-type="text/javascript" />
0025          <item id="qtijs_06" href="uvu_dgm/js/lib/intellisense.min.js"
0026              media-type="text/javascript" />
0027          <item id="qtijs_07" href="uvu_dgm/js/lib/jquery-1.11.0.js"
0028              media-type="text/javascript" />
0029
0030          <item id="qtijs_08" href="uvu_dgm/js/app.js"
0031              media-type="text/javascript" />
0032          <item id="qtijs_09" href="uvu_dgm/js/controllers.js"
0033              media-type="text/javascript" />
0034          <item id="qtijs_10" href="uvu_dgm/js/services.js"
0035              media-type="text/javascript" />
0036          <item id="qtijs_11" href="uvu_dgm/js/directives.js"
0037              media-type="text/javascript" />
0038
0039          <item id="qti_css01" href="uvu_dgm/css/assessment.css"
0040              media-type="text/css" />
0041
0042          <item id="qti_test01"
0043              href="uvu_dgm/quiz_items/machineepub3quiz01_test01v1.json"
0044              media-type="application/json" />
0045
0046          <item id="qti_item01"
0047              href="uvu_dgm/quiz_items/machinequiz01_item01v1.json"
```

```
0048              media-type="application/json" />
0049          <item id="qti_item02"
0050              href="uvu_dgm/quiz_items/machinequiz01_item02v1.json"
0051              media-type="application/json" />
0052          <item id="qti_item03"
0053              href="uvu_dgm/quiz_items/machinequiz01_item03v1.json"
0054              media-type="application/json" />
0055          <item id="qti_item04"
0056              href="uvu_dgm/quiz_items/machinequiz01_item04v1.json"
0057              media-type="application/json" />
0058          <item id="qti_item05"
0059              href="uvu_dgm/quiz_items/machinequiz01_item05v1.json"
0060              media-type="application/json" />
0061          <item id="qti_item06"
0062              href="uvu_dgm/quiz_items/machinequiz01_item06v1.json"
0063              media-type="application/json" />
0064
0065          <item id="qti_image01" href="uvu_dgm/images/Chopperv1.jpg"
0066              media-type="image/jpeg" />
0067          <item id="qti_icon01" href="uvu_dgm/images/icons/icon_add.png"
0068              media-type="image/png" />
0069          <item id="qti_icon02"
0070              href="uvu_dgm/images/icons/icon_approve.png"
0071              media-type="image/png" />
0072          <item id="qti_icon03"
0073              href="uvu_dgm/images/icons/icon_checkmark.png"
0074              media-type="image/png" />
0075          <item id="qti_icon04"
0076              href="uvu_dgm/images/icons/icon_checkmark_blue.png"
0077              media-type="image/png" />
0078          <item id="qti_icon05" href="uvu_dgm/images/icons/icon_close.png"
0079              media-type="image/png" />
0080          <item id="qti_icon06"
0081              href="uvu_dgm/images/icons/icon_closeWht.png"
0082              media-type="image/png" />
0083          <item id="qti_icon07"
0084              href="uvu_dgm/images/icons/icon_discard.png"
0085              media-type="image/png" />
0086          <item id="qti_icon08"
0087              href="uvu_dgm/images/icons/icon_download.png"
0088              media-type="image/png" />
0089          <item id="qti_icon09"
0090              href="uvu_dgm/images/icons/icon_selector_correct.png"
0091              media-type="image/png" />
0092          <item id="qti_icon10"
0093              href="uvu_dgm/images/icons/icon_selector_incorrect.png"
0094              media-type="image/png" />
0095          <item id="qti_icon11"
0096              href="uvu_dgm/images/icons/icon_selector_neutral.png"
0097              media-type="image/png" />
0098          <item id="qti_icon12"
0099              href="uvu_dgm/images/icons/icon_upload.png"
0100              media-type="image/png" />
0101          <item id="qti_icon13" href="uvu_dgm/images/icons/icon_next.png"
0103              media-type="image/png" />
0104          <item id="qti_icon14"
0105              href="uvu_dgm/images/icons/icon_previous.png"
0106              media-type="image/png" />
```

```
0107
0108      </manifest>
0109      <spine page-progression-direction="ltr">
0110         <itemref idref="fcover" properties="page-spread-right"/>
0111         <itemref idref="page_000" properties="page-spread-left"/>
0112         …
0113         <itemref idref="qti_01" properties="rendition:layout-
0114            reflowable"/>
0115         …
0116         <itemref idref="page_032" properties="page-spread-left"/>
0117         <itemref idref="bcover" properties="page-spread-left"/>
0118      </spine>
0119   </package>
0120
```

The changes to the <manifest> are shown in lines 0009-0106 i.e. the listing of all the new files that have been added due to the inclusion of the quiz. The changes to the <spine> are shown in lines 0113-0114 i.e. the pointer to the actual quiz XHTML <item> in the <manifest>.

D7   The Support Java Script Files

[[ED NOTE: To be completed in a later draft.]]

D8   The New EPUB3/EDUPUB Content Structure

When the new EDUPUB/EPUB3 file is unzipped the new contents structure is (italics denote a folder, shaded lines denote the new folders/files and bold denotes original files that have been amended):

mimetype

META-INF
    container.xml

OEBPS
    audio
    bcover.xhtml
    config.js
    credit.xhtml
    css
    fcover.xhtml
    fonts
    images
    js
    license.xhtml
    nav.xhtml
    package.opf

page_000.xhtml	page_001.xhtml	page_002.xhtml	page_003.xhtml
page_004.xhtml	page_005.xhtml	page_006.xhtml	page_007.xhtml
page_008.xhtml	page_009.xhtml	page_010.xhtml	page_011.xhtml

page_012.xhtml	page_013.xhtml	page_014.xhtml	page_015.xhtml
page_016.xhtml	page_017.xhtml	page_018.xhtml	page_019.xhtml
page_020.xhtml	page_021.xhtml	page_022.xhtml	page_023.xhtml
page_024.xhtml	page_025.xhtml	page_026.xhtml	page_027.xhtml
page_028.xhtml	page_029.xhtml	page_030.xhtml	page_031.xhtml
page_032.xhtml	page_033.xhtml		

qti_assessment.xhtml

smil

submarine

title.xhtml

uvu
   css
      assessment.css
   images
      Chopperv1.jpg
      icons
         icon_add.png   icon_approve.png
         icon_checkmark_blue.png   icon_checkmark.png
         icon_close.png   icon_closeWht.png
         icon_discard.png   icon_download.png
         icon_next.png   icon_previous.png
         icon_selector_correct.png   icon_selector_incorrect.png
         icon_selector_neutral.png   icon_upload.png
   js
      app.js
      controllers.js
      directives.js
      lib
         angular
            angular-pouchdb.js   angular-resource.js
            angular-sanitize.js   angular.js
            pouchdb-1.1.0.min.js

         intellisense.min.js
         jquery-1.11.0.js

      services.js
   quiz_items
      machineepub3quiz01_test01v1.json
      machinequiz01_item01.json
      machinequiz01_item02.json
      machinequiz01_item03.json
      machinequiz01_item04.json
      machinequiz01_item05.json
      machinequiz01_item06.json

Appendix E – Metadata in EDUPUB

E1   Metadata Information Model

The metadata fields available for use in EDUPUB are listed in Table E1.1. The key to Table E1.1 is:

- Name – the name of the field. The term enclosed in the accompanying square brackets denote the equivalent Dublin Core term;
- Type –the data type for the field;
- Mult – indicates the multiplicity of the field with values of '1' or many ('*');
- Description – a short description of how the field is to be used;
- '*' – denotes use in the context of a QTI-based assessment.

No attempt has been made to define whether or not an entry should/must be supplied. Instead, the aim is to provide mappings between the various binding form and to leave each sector to determine what metadata should be supplied.

Table E1.1 – The set of logical metadata fields supported in EDUPUB.

Name	Type	Mult	Description
GUID [dc:identifier]	String.	1	This field is the globally unique identifier of the object from the originator. This will be used to determine if the object already exists in the system in order to avoid duplicates. It will allow the owner of the object to update the metadata or URL when necessary. Systems can also allow direct access to the object within their system by allowing the field to be searched.
Version	String	1	The version of the object.
LTI URL	String (URL).	1	This field is the IMS Global Learning Tools Interoperability launch URL to access the tool within the tool provider. It contains either the direct URL to the tool or the authorization service of LTI while the actual tool or resource is at the Resource URL location.
Resource URL	String (URL).	1	This field is used as a parameter with LTI. It contains the redirect URL that the LTI tool provider requires to access the tool. The LTI URL authorizes and sets up the tool session while the resource URL accesses the specific tool or resource within the tool provider.
Language [dc:language]	Enumeration as per RFC3066/ISO639.	1	This is the primary language of the content of the resource. This takes the form of two- and three-letter primary language tags with optional sub-tags.

Name	Type	Mult	Description
Title [dc:title]	String.	1	This field contains the metadata title of the object.
Description [dc:description]	String.	1	This field contains the metadata description of the object.
Creator/Author [dc:creator]	String	1	An entity primarily responsible for making the content of the resource. Examples of a Creator include a person, an organization, or a service. Typically the name of the Creator should be used to indicate the entity.
Publisher [dc: publisher]	String	1	The entity responsible for making the resource available. Examples of a Publisher include a person, an organization, or a service. Typically, the name of a Publisher should be used to indicate the entity.
Date Created [dc:date]	Date (YYYY-MM-DD)	1	The date of the creation of the resource itself as a complete entity.
Date Modified [dc:date]	Date (YYYY-MM-DD)	1	The date at which the resource was modified.
Educational Role	Enumeration: { teacher | author | learner | manager }	1	The role that describes the target audience of the content.
Typical Learning Time	Duration (PTHH:MM:SS)	1	Approximate or typical time it takes to work with or through this learning resource for the typical intended target audience.
Interactivity Type	Enumeration: { active | expositive | mixed }	1	The predominant mode of learning supported by the learning resource.
Interactivity Level	Enumeration: { very low | low | medium | high | very high }	1	A qualitative statement of the amount/extent of the interaction available to the user when using the content.
Source [dc:source]	String	1	A Reference to a resource from which the present resource is derived. The present resource may be derived from the Source resource in whole or part. Recommended best practice is to reference the resource by means of a string or number conforming to a formal identification system.
Keywords [dc:subject]	String (space delimited).	1	This field contains the single words separated by spaces related to the object. This helps organize the object within the system for easier searching and identification.
Typical Age Range	String	1	A free format field to provide the typical age range for which the content is suitable i.e. 'From Grade' – 'To Grade'. Typical values are "k-12", "7-9", "0-5", etc. Each range component is enumerated by: { p | k | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

Name	Type	Mult	Description
			| 10 | 11 | 12 | a }.
Copyright [dc:date]	Year (4 digit string).	1	This field contains the year in which the object was created. It represents when the copyright of the object was first introduced.
Use Rights	URL	1	The URL where the owner specifies permissions for using the resource.
Context	Enumeration: { school | higher education | training | other }	*	Information about the principal environment within which the learning and use of this learning object is intended to take place.
Difficulty	Enumeration: { very easy | easy | medium | difficult | very difficult }	1	A qualitative statement about how hard it is to work with or through this learning object for the typical intended target audience.
ISBN [dc:identifier]	String.	1	This field contains the ISBN (International Standard Book Number) of the object. This allows quick access to the object during a search.
Learning Resource Type [dc:type]	Enumeration: { video | audio, image | interactive | game | weblink | ebook | exercise | simulation | questionnaire | diagram | figure | graph | index | slide | table | narrative text | exam | experiment | problem statement | self assessment | lecture }.	1	This field contains a descriptor string of what the object is. This is a simpler form of the MIME type (Multipurpose Internet Email Extensions) of an object. The field is used to categorize the object for easier searching and organization.
AccessPermission	Enumeration: { parent | student | teacher | teacher/uploader | school admin | principal | curriculum admin | admin }.	*	This field contains the permission level needed to access the object. Any user type below the threshold should be denied access to the object and may not be visible to the user.
UseType	Enumeration: { primary | secondary | teacher | assessment | question | concept | assignment }.	*	This field contains the use type of the object. It allows the object to be organized based on the purpose of the object. For example, if the object was a LTI link to resource for homework purposes, it would be set to "assignment". That means the object would be available to a student during an assignment. The values can be: • Primary: within a lesson it would be part of the primary lesson. • Secondary: within a lesson it would be a secondary object and not necessarily used and isn't the main focus of the lesson. • Teacher: within a lesson it would be viewable only to a teacher. • Assessment: within a lesson it would be an

Name	Type	Mult	Description
			object that would aid in the assessment.
			• Question: within a lesson it would be a reference or the main part of a specific question.
			• Concept: within a lesson it would be part of the concept review.
			• Assignment: within a lesson it would be part of the assignment.
Visibility	Enumeration: { private | shared | public }.	1	This field pertains to the visibility of the object. On initial load, who has the ability to see it. The values can be: • Private: Only the person who imported the object has the right to view the object. • Shared: Users within the school can view it. • Public: Everyone in the district can view it.
Thumbnail	String.	1	This field contains the URL to the location of a thumbnail of the object. This would be used in previewing the object while searching or viewing the object. Since the object is a URL and the tool provider may change the object at any time, the thumbnail would be located on the tool provider's servers. Updated when the object is updated and accessible without an LTI launch.
Mapping to Curriculum Standards	List of GUIDs (strings).	*	This field (set of fields) contains each state standard or common core standard for the object. In this case the term GUID is uses in the sense of any globally unique identifier form e.g. number, URI, etc.
Item Template*	Boolean.	1	A Boolean to indicate it the Item is actually an Item template.
Time Dependent*	Boolean.	1	Whether or not the Item is time dependent.
Composite*	Boolean.	1	A composite contains more than one interaction. Set as 'true' if the Item is a composite.
Interaction Type*	Enumeration: { associateInteraction | choiceInteraction | customInteraction | drawingInteraction | endAttemptInteraction | extendedTextInteraction, | gapMatchInteaction | graphicAssociateInteraction |graphicGapMatchInteraction | graphicOrderInteraction | hotspotInteraction |	*	The type of interaction(s) used to construct the Item.

Name	Type	Mult	Description
	hotextInteraction | inlineChoiceInteraction | matchInteraction | orderInteraction | positionObjectInteraction | selectPointInteraction | sliderInteraction | textEntryInteraction | uploadInteraction }		
Feedback Type*	Enumeration: { adaptive | nonadaptive | none }	1	Describes the type of feedback, if any, availale.
Solution Available*	Boolean.	1	A statement of whether or not the Item includes the solution.
Scoring Mode*	Enumeration: { human | externalmachine | responseprocessing }	*	Indicates the type of response processing that is required.
Tool Name*	String	1	The name of the tool used to cerate the quiz, test, question, etc.
Tool Version*	String	1	The version of the tool used to cerate the quiz, test, question, etc.
Tool Vendor*	String.	1	The vendor of the tool used to cerate the quiz, test, question, etc.
Extension	N/A	*	Support for an extension mechanism.

E2   Binding Mappings in IEEE LOM and Schema.Org

The metadata binding mappings are defined in Table E2.1. The columns in Table E2.1 denote:

- Name – the name of the field. The term enclosed in the accompanying square brackets denote the equivalent Dublin Core term;

- XML Mapping – XML mapping when used with IMS specifications directly e.g. in Common Cartridge, APIP, etc. The actual binding formats are:-

  - 'lom.' – mapping to the IEEE LOM using the IMS Metadata v1.3.2 XSD binding

  - 'csm' – mapping to the IMS Curriculum Standards Metadata v1.0 XSD binding but contained within the LOM context

  - 'qti' – mapping to the IMS QTI Metadata v2.2 XSD binding but contained within the LOM context;

- Micro Data Mapping – mapping to the Schema.Org micro data format (including the LRMI support). In this column the value <object> denotes a creative work of: { Article | Blog |

Book | Clip | Code | Comment | DataCatalog | Dataset | Diet | Episode | ExercisePlan | ItemList | Map | MediaObject | Movie | MusicPlaylist | MusicRecording | Painting | Photograph | Recipe | Review | Sculpture | Season | Series | SoftwareApplication | TVSeason | TVSeries | WebPage | WebPageElement }. If an explicit creative work is identified then the property is restricted to that creative work.

Table E2.1 – The metadata binding mappings.

Name	IMS XML Mappings	Schema.Org Micro Data Mapping

GUID	lom.general.identifier
	    .catalog=GUID
	     .entry
		– No mapping available –

Version	lom.lifeCycle
	    .version
	      .sring
		itemtype="http://schema.org/<object>"
		    version="???"

LTI URL	lom.technical.installationRemarks	itemtype="http://schema.org/<object>" sameAs="???"
Resource URL	lom.technical.location	itemtype="http://schema.org/<object>" url="???"
Language	lom.general.language	itemtype="http://schema.org/<object>" inLanguage="???"
Title	lom.general.title	itemtype="http://schema.org/<object>" name="???"
Description	lom.general.description	itemtype="http://schema.org/<object>" description="???"

Creator	lom.lifeCycle
	    .contribute
	      .role
	        .value=creator
	      .entity
		itemtype="http://schema.org/<object>"
		    creator="???"
		
		or
		
		itemtype="http://schema.org/<object>"
		    author="???"

Publisher	lom.lifeCycle
	    .contribute
	      .role
	        .value=publisher
	      .entity
		itemtype="http://schema.org/<object>"
		    publisher="???

Date Created	lom.lifeCycle
	    .contribute
	      .role
	        .value=creator
	      .date
	        .dateTime
		itemtype="http://schema.org/<object>"
		    dateCreated="???

Name	IMS XML Mappings	Schema.Org Micro Data Mapping

Data Modified	lom.lifeCycle
	   .contribute
	     .role
	       .value=contributor
	    . date
	       .dateTime
		itemtype="http://schema.org/<object>"
		   dateModified="???"

Educational Role	lom.educational.intendedEndUserRole
	   .value
		itemtype="http://schema.org/<object>"
		   educationalRole="???"

Typical Learning Time	lom.educational.itypicalLearningTime
	   .duration
		itemtype="http://schema.org/<object>"
		   timeRequired="???"

Interactivity Type	lom.educational.interactivityType
	   .value
		itemtype="http://schema.org/<object>"
		   interactivityType="???"

Interactivity Level	lom.educational.interactivtyLevel .value	– N/A –

Source	lom.relation
	   .kind
	      .value=isbasedon
	   .resource
	     .identifier
	       .catalog=GUID
	       .entry
		itemtype="http://schema.org/<object>"
		   isBasedOnUrl="???"

Keywords	lom.general.keyword	itemtype="http://schema.org/<object>" keywords="???"
Typical Age Range	lom.educational.typicalAgeRange	itemtype="http://schema.org/<object>" typicalAgeRange="???"

Copyright	lom.lifeCycle.contribute
	   .role
	     .value = copyright
	   .date
	     .dateTime
		itemtype="http://schema.org/<object>"
		   copyrightYear="???"

Use Rights	lom.rights
	   .copyrightAndOtherRestrictions
	     .value=yes
	   .description
	     .string
		– N/A –

Context	lom.educational.context .value	– N/A –
Difficulty	lom.educational.difficulty .value	– N/A –

Name	IMS XML Mappings	Schema.Org Micro Data Mapping

ISBN	lom.general.identifier
	    .catalog=ISBN
	    .entry
		itemtype="http://schema.org/Book"
		    isbn="???"

Learning Resource Type	lom.educational.learningresourcetype
	    .type
		itemtype="http://schema.org/<object>"
		    learningResourceType="???"

AccessPermission	lom.educational.intendedEndUserRole
	    .source=AccessPermissionVocab
	    .value
		itemtype="http://schema.org/EducationalAudience"
		    educationRole="???"

UseType	lom.educational.intendedEndUserRole
	    .source=UseTypeVocab
	    .value
		itemtype="http://schema.org/<object>"
		    educationalUse="???"

Visibility	lom.educational.intendedEndUserRole
	    .source=VisibilityVocab
	    .value
		– No mapping available –

Thumbnail	lom.annotation.description	itemtype="http://schema.org/<object>" thumbnailUrl="???"

Mapping to Curriculum Standards	curriculumStandardsMetadataSet
	    @resourceLabel
	    @resourcePartId
	    .curriculumStandardsMetadata
	        @providerId
	        .setOfGUIDs
	            @region
	            @version
	            .labelledGUID
	                .label
	                .GUID
	
	            …
	
	            .labelledGUID
	                .label
	                .GUID
		itemtype="http://schema.org/<object>"
		    educationalAlignment="item1"
		
		item1
		itemtype="http://schema.org/AlignmentObject"
		    alignmentType="???"
		    educationalFramework="???"
		    targetUrl="???"
		    targetDescription="???"
		    targetName="???"

Item Template	qtiMetadata.itemTemplate	– N/A –
Time Dependent	qtiMetadata.timeDependent	– N/A –
Composite	qtiMetadata.composite	– N/A –
Interaction Type	qtiMetadata.interactionType	– N/A –
Feedback Type	qtiMetadata.feedbackType	– N/A –
Solution	qtiMetadata.solutionAvailable	– N/A –

Name	IMS XML Mappings	Schema.Org Micro Data Mapping
Available		
Scoring Mode	qtiMetada.scoringMode	– N/A –
Tool Name	qtiMetadata.toolName	– N/A –
Tool Version	qtiMetadata.toolVersion	– N/A –
Tool Vendor	qtiMetadata.toolVendor	– N/A –
Extension	Require namespace approach as per IMS Metadata v1.3.2 requirements.	Use Schema.Org approach for extension.

E3   Examples of the Bindings

When using IMS-based content is typically supplied in the form of a content package and so the metadata is encoded in the "imsmanifest.xml" file using the IMS Metadata V1.3 binding of the IEEE LOM information model. An example of the full mapping of the IMS objects to their XML form is shown in Code E3.1.

Code E3.1 – XML-based metadata binding for the IMS objects.

```
0000   …
0001   <metadata>
0003     <lom xmlns="http://ltsc.ieee.org/xsd/LOM"
0004       xmlns:csm="http://www.imsglobal.org/xsd/imsccv1p3/imscsmd_v1p0"
0005       xmlns:qti="http://www.imsglobal.org/xsd/imsqti_metadata_v2p2"
0006       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
0007       xsi:schemaLocation="http://ltsc.ieee.org/xsd/LOM
0008       http://www.imsglobal.org/xsd/imsmd_loose_v1p3p2.xsd
0009       http://www.imsglobal.org/xsd/imsccv1p3/imscsmd_v1p0
0010       http://www.imsglobal.org/profile/cc/ccv1p3/ccv1p3_imscsmd_v1p0.xsd
0011       http://www.imsglobal.org/xsd/imsqti_metadata_v2p2
0012       http://www.imsglobal.org/xsd/qti/qtiv2p2/imsqti_metadata_v2p2.xsd">
0013
0014   <!-- ************************************************************* -->
0015   <!-- GUID, TITLE, DESCRIPTION, KEYWORDS, ISBN, LANGUAGE ************ -->
0016     <general>
0017       <identifier>
0018         <catalog>GUID</catalog>
0019         <entry>ABCDEFG...123456789...XYZ</entry>
0020       </identifier>
0021       <title>
0022         <string>...Title...</string>
0023       </title>
0024       <description>
0025         <string>...The description...</string>
0026       </description>
0027       <keyword>
0028         <string>Value1 Value2 Value 2</string>
0029       </keyword>
0030       <identifier>
0031         <catalog>ISBN</catalog>
```

```
0032              <entry>...ISBN Value...</entry>
0033          </identifier>
0034          <language>en-US</language>
0035      </general>
0036 <!-- ************************************************************ -->
0037 <!-- LTI URL, RESOURCE URL ************************************** -->
0038      <technical>
0039          <installationRemarks>
0040              <string>http://...lti authentication URL ...</string>
0041          </installationRemarks>
0042          <location>http://...lti launch URL...</location>
0043      </technical>
0044 <!-- ************************************************************ -->
0045 <!-- TYPICICALAGERANGE, LEARNING RES-TYPE, ACCESS PERMISSION, USE-TYPE,
0046 VISIBILITY, ED ROLE, INTERACTIVITY TYPE, INTERACTIVITY LEVEL, CONTEXT,
0047 DIFFICULTY, TYPICALLEARNINGTIME ********************************* -->
0048      <educational>
0049          <typicalAgeRange>
0050              <string>k-a</string>
0051          </typicalAgeRange>
0052          <learningResourceType>
0053              <source>...Vocab Source...</source>
0054              <value>..Type of Resource...</value>
0055          </learningResourceType>
0056          <intendedEndUserRole>
0057              <source>Access Permission Vocab</source>
0058              <value>...Access Permission...</value>
0059          </intendedEndUserRole>
0060          <intendedEndUserRole>
0061              <source>UseType Vocab</source>
0062              <value>...Usetype...</value>
0063          </intendedEndUserRole>
0064          <intendedEndUserRole>
0065              <source>Visibility Vocab</source>
0066              <value>...Visibility...</value>
0067          </intendedEndUserRole>
0068          <intendedEndUserRole>
0069              <source>Educational Role Vocab</source>
0070              <value>learner</value>
0071          </intendedEndUserRole>
0072          <interactivityType>
0073              <value>active</value>
0074          </interactivityType>
0075          <interactivityLevel>
0076              <value>medium</value>
0077          </interactivityLevel>
0078          <context>
0079              <source>LOMv1.0</source>
0080              <value>school</value>
0081          </context>
0082          <difficulty>
0083              <source>LOMv1.0</source>
0084              <value>medium</value>
0085          </difficulty>
0086          <typicalLearningTime>
0087            <duration>pT30M</duration>
0088          </typicalLearningTime>
0089      </educational>
```

```
0090   <!-- ******************************************************************* -->
0091   <!—VERSION, CREATOR, DATE CREATED, PUBLISHER, DATE MODIFIED, COPYRIGHT
0092   ******************************************************************* -->
0093       <lifeCycle>
0094           <version>
0095             <string>Final 1.0</string>
0096           </version>
0097           <contribute>
0098               <role>
0099                   <value>creator</value>
0100               </role>
0101               <entity>...Name of Author...</entity>
0103               <date>
0104                   <dateTime>20140527</dateTime>
0105               </date>
0106           </contribute>
0107           <contribute>
0108               <role>
0109                   <value>publisher</value>
0110               </role>
0111               <entity>...Name of Publisher...</entity>
0112           </contribute>
0113           <contribute>
0114               <role>
0115                   <value>contributor</value>
0116               </role>
0117               <date>
0118                   <dateTime>20140528</dateTime>
0119               </date>
0120           </contribute>
0121           <contribute>
0122               <role>
0123                   <value>copyright</value>
0124               </role>
0125               <date>
0126                   <dateTime>2014</dateTime>
0127               </date>
0128           </contribute>
0129       </lifeCycle>
0130   <!-- ******************************************************************* -->
0131   <!-- SOURCE ******************************************************** -->
0132       <relation>
0133           <kind>
0134               <source>LOMv1.0</source>
0135               <value>isbasedon</value>
0136           </kind>
0137           <resource>
0138               <identifier>
0139                   <catalog>GUID</catalog>
0140                   <entry>XYZ...123</entry>
0141               </identifier>
0142           </resource>
0143       </relation>
0144   <!-- ******************************************************************* -->
0145   <!-- USE RIGHTS ******************************************************** -->
0146       <rights>
0147           <copyrightAndOtherRestrictions>
0148               <source>LOMv1.0</source>
```

```
0149                  <value>yes</value>
0150              </copyrightAndOtherRestrictions>
0151              <description>
0152                  <string>...Use Rights URL...</string>
0153              </description>
0154          </rights>
0155  <!-- *********************************************************** -->
0156  <!-- THUMBNAIL ************************************************* -->
0157          <annotation>
0158              <description>
0159                  <string>...URL for the Thumbnail...</string>
0160              </description>
0161          </annotation>
0162  <!-- *********************************************************** -->
0163  <!-- CURRICULUM STANDARDS METADATA ***************************** -->
0164          <csm:curriculumStandardsMetadataSet
0165              resourceLabel="...Human readable label..."
0166              resourcePartId="...Pointer to Associated Resource-Part...">
0167              <csm:curriculumStandardsMetadata
0168                  providerId="...The originator of the GUID scheme...">
0169                  <csm:setOfGUIDs region="Florida" version="1.0">
0170                      <csm:labelledGUID>
0171                          <csm:label>...Human readable string ...</csm:label>
0172                          <csm:GUID>GUID for Standard/Standard-part</csm:GUID>
0173                      </csm:labelledGUID>
0174                      <csm:labelledGUID>
0175                          <csm:label>...Human readable string ...</csm:label>
0176                          <csm:GUID>GUID for Standard/Standard-part</csm:GUID>
0177                      </csm:labelledGUID>
0178                  </csm:setOfGUIDs>
0179              </csm:curriculumStandardsMetadata>
0180          </csm:curriculumStandardsMetadataSet>
0181  <!-- *********************************************************** -->
0182  <!-- QTI METADATA ********************************************** -->
0183          <qti:qtiMetadata>
0184              <qti:itemTemplate>false</qti:itemTemplate>
0185              <qti:timeDependent>false</qti:timeDependent>
0186              <qti:composite>false</qti:composite>
0187              <qti:interactionType>choiceInteraction</qti:interactionType>
0188              <qti:feedbackType>nonadaptive</qti:feedbackType>
0189              <qti:solutionAvailable>false</qti:solutionAvailable>
0190              <qti:scoringMode>responseprocessing</qti:scoringMode>
0191              <qti:toolName>Oxygen XML Editor</qti:toolName>
0192              <qti:toolVersion>16.0</qti:toolVersion>
0193              <qti:toolVendor>Syncro SOft SRL</qti:toolVendor>
0194          </qti:qtiMetadata>
0195  <!-- *********************************************************** -->
0196
0197  </lom>
0198  </metadata>
0199  …
```

An example of the full mapping of the IMS objects to their microdata form is shown in Code E3.2.

Code E3.2 – Microdata-based metadata binding for the IMS objects.

```
0000
0001
0003
0004
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0009
0010
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0019
0020
0021
0022
0023
0024
0025
0026
0027
0028
0029
```

NOTE: The code mappings of the IMS objects to the XML-based and Microdata-based bindings shown in Code E3.1 and E3.2 are for discussion. These are the current mapping recommendations but feedback to IMS on these is welcome.

[[ED NOTE: To be completed in a later draft.]]

Appendix F – Readium Support for EDUPUB

F1   Source Code Additions to Support LTIv1.x Tool Provider Functionality

The `server/main.js` file defines an endpoint of `/ltilaunch` which represents the launch URL for use by tool consumers. Any key and secret issued to a tool consumer should be recorded in the `LTI_CONSUMERS` array variable (see Subsection 3.1.1 for an example). The processing of a launch request depends upon the `oauth-signature` module that should be installed on the Readium server. The process of handling an LTI launch request is described in Subsection 3.1.2. A successful launch causes the `views/lti.jade` to be rendered. If an invalid launch request is received then the user is redirected to the URL provided in the `launch_presentation_return_url` parameter with an `lti_errormsg` query parameter or, if this parameter is not available, then the `views/lti-error.jade` file is rendered. The `lib/thirdparty/lti_lib.js` file provides supporting functions for accessing tool consumer declarations and the request URL.

F2   Source Code Additions to Support LTIv1.x Tool Consumer Functionality

The `server/main.js` file defines an endpoint of `/ltitool` which represents the URL to call when launching a tool provider. The tools available for launch are defined in the `LTI_PROVIDERS` array variable (see Subsection 3.2.1 for an example). The launch parameters included in a tool launch request are identified in Subsection 3.2.2. The location where the tool is opened is determined by the value of the `presentation_document_target` attribute in its declaration; a value of "popup" will cause the tool to be opened in a sized new window, whilst a value of "window" will open the tool in a new full-sized window (or tab). The size of the popup window will be 400 by 400 unless otherwise specified via the `displayWidth` and `displayHeight` attributes in the tool declaration. The `oauth-signature` module is used to generate the signature for the launch request data. The launch process requires 3 query parameters passed to the endpoint; if any of these is missing, or if the `session` parameter value does not represent a current session, or if the `id` parameter does not represent a current tool declaration, then the `views/lti-error.jade` file is rendered. Otherwise an attempt is made to launch the selected tool provider using the `views/lti-launch.jade` file. The `lib/thirdparty/lti_lib.js` file provides supporting functions for accessing tool provider declarations and for generating GUID values.

F3   Source Code Additions to Support IMS Sensor API Functionality

The `lib/thirdPary/ReadiumSensor.js` file provides an implementation of the Readium Caliper Sensor. The Readium Caliper Sensor is defined as a self-contained Asynchronous Module Definition (AMD) module that in turn leverages the IMS Base JavaScript Caliper Sensor.

Note that the code below is elided to remove some utility functions, leaving in place the key API calls that the sensor typically makes.

Code F3.1 – The IMS Base JavaScript Caliper Sensor API.

```
0000
0001    define(['jquery', 'caliper'], function($, caliper) {
0003
0004        // Initialize with the Caliper API key (one time)
0005        …
0006
0007        // initialize context
0008        var context = {
0009            'metadata': ''
0010        };
0011
0012        var ReadingInfo = {
0013            'ID': 'readingId',
0014            'ISBN': 'isbn',
0015            'TYPE': 'reading',
0016            'LABEL': 'label',
0017            'TITLE': 'title',
0018            'DESCRIPTION': 'description'
0019        };
0020
0021        var ReadingActions = {
0022            'LOAD_BOOK': 'LOAD_BOOK',
0023            'VIEW_TOC': 'VIEW_TOC',
0024            'SWITCH_CHAPTER': 'SWITCH_CHAPTER',
0025            'READ_PAGE': 'READ',
0026            'BOOKMARK_PAGE': 'BOOK_MARK',
0027            'VIEW_LIBRARY': 'VIEW_LIBRARY',
0028            'SWITCH_VIEWMODE': 'SWITCH_VIEWMODE'
0029        };
0030
0031        var describe = function(type, entityId, properties, timestamp) {
0032            caliper.describe(type, entityId, properties, timestamp);
0033        };
0034
0035        var describeCurrentBook = function() {
0036            var type = ReadingInfo.TYPE;
0037            var entityId = window.readiumSensor.context.metadata.id;
0038            var properties = window.readiumSensor.context.metadata.
0039                             attributes;
0040            describe(type, entityId, properties, Date.now());
0041        };
0042
0043        var measure = function(action, learningContext, activityContext,
0044                               timestamp) {
0045            caliper.measure(action, learningContext, activityContext,
0046                        timestamp);
0047        };
0048         …
0049        var measureActivity = function(action, activityContextDetail) {
0050            var learningContext = {
0051                'personId': window.readiumSensor.context.userId,
0052                'courseId': window.readiumSensor.context.courseId
0053            };
0054            var activityContext = merge({
0055                    'activityId': window.readiumSensor.context.metadata.
0056                                  id,
```

```
0057                     'itemId': window.readiumSensor.context.
0058                              currentSpineItem
0059              },
0060              activityContextDetail);
0061
0062         measure(action, learningContext, activityContext, Date.now());
0063     };
0064
0065     var init = function(apiKey, host, courseId, userId,
0066                        packageMetadata) {
0067
0068         var server = 'http://' + host;
0069         var options = {
0070             'apiKey': apiKey,
0071             'server': server,
0072             'sensor_id': 'com.testorg.readium1'
0073         };
0074
0075         caliper.initialize({
0076             'caliper': options
0077         }, {});
0078
0079         console.log("initializing Readium Caliper Sensor context...");
0080         …
0081     };
0082
0083     return {
0084             initSensor: init,
0085             describe: describe,
0086             describeCurrentBook: describeCurrentBook,
0087             measure: measure,
0088             measureActivity: measureActivity,
0089             ReadingInfo: ReadingInfo,
0090             ReadingActions: ReadingActions
0091     };
0092 });
```

F4   The Readium Source Code Distribution

The set of source code files distributed for Readium are shown below. Note that italics denote a folder, shaded lines denote the new folders/files and bold denotes original files that have been amended.

chrome-app
css
epub_content
    IntenseMachines
extend_require_config.js
Gruntfile.js
i18n
images

index.html
lib
    Dialog.js
    EpubLibrary.js
    EpubReader.js
    ReaderSettings.js
    Readium.js
    ReadiumViewer.js
    ReadiumViewer.Lite
    Require.js
    storage
    thirdparty

       …
       intellisense.min.js

       …
       jquery-1.11.0.min.js

       …
       lti_lib.js
       lti.js
       ReadiumsSensor.js

       …
    workers
package.json
readium.sublime-project
readium.sub,ime-workspace
README.md
require_config.js
server
    main.js
simpleviewer.html
templates
views
    lti-error.jade
    lti-launch.jade
    lti.jade

Appendix G – Best Practices Checklist

G1   EDUPUB Content

G1.1   General Recommendations

The general best practice recommendations for EDUPUB content are:

- A design/implementation decision has to be made regarding the extent to which the eBook relies upon features available in the eReader against the provision of the sae features within the eBook itself. If the eReader permits external Web service access then the eBook could be self sufficient wit regard to LTI and Sensor support;

[[ED NOTE: To be completed in a later draft.]]

G1.2   LTI-Specific Recommendations

The LTI-specific best practice recommendations for EDUPUB content are:

- If the eBook is to make use of other resources using LTI, the user should receive an informative error message if the LTI launch fails. In general, the user will be unaware of the nature of LTI and its usage but even so this message should help the user locate and correct the problem.

G1.3   Caliper-Specific Recommendations

The Caliper-specific best practice recommendations for EDUPUB content are:

- Calls to the Sensor API should be used to report the appropriate measurements for the metric profiles as the eBook is used. Calls should be made to the Sensor API for every user action on the eBook;

- The user should be able to disable the sensor API so that measurements reporting is completely disabled for a particular eBook;

- The user should be able to define the target analytics repository (for both real-time and offline synchronisation modes).

G1.4   QTI-Specific Recommendations

The QTI-specific best practice recommendations for EDUPUB content are:

- In the QTI-XML for an Item the value of the assessmentItem/@identifier should be the same as the identifier value in the metadata for the QTI-Item's resource in the manifest file. This should be globally unique;

- In the QTI-XML for the Test the value of the assessmentTest/@identifier should be the same as the identifier value in the metadata for the QTI-Item's resource in the manifest file. This should be globally unique.

[[ED NOTE: To be completed in a later draft.]]

G1.5   Metadata Recommendations

[[ED NOTE: To be completed in a later draft.]]

G2   EDUPUB Readers

G2.1   General Recommendations

The general best practice recommendations for an EDUPUB reader are:

- The reader must be LTIv1.x compliant both as a Tool Provider and as a Tool Consumer. Tool Provider compliance means the player can be launched by any LTI compliant Tool Consumer e.g. an LMS. Tool Consumer compliance means that the reader can launch other LTI compliant Tool Providers e.g. third party quizzing systems;

- The reader must be Caliper compliant both in terms of real-time data reporting and also using local caching and data synchronisation when the reader is not connected to a network;

- The reader must be EDUPUB/QTI compliant for the provision of formative assessments within the EPUB3 file. This provides the support for formative assessments that are embedded within the EPUB3 file. This compliance includes support for Caliper within the context of the formative assessment;

- If an eBook requires certain features of the eReader, e.g. LTI launch capability, analytics reporting, etc. and these are unavailable, then an appropriate warning/error message should be displayed to the user. If the eBook is still used, its behaviour is undefined when using the unavailable features.

G2.2   LTI-Specific Recommendations

The LTI-specific best practice recommendations for an EDUPUB reader are:

- All of the supported Tools must be registered Tool Providers within the reader i.e. it must have the required authentication information. Therefore, the eReader must provide a simple interface (this could be a part of the normal eBook management software) through which such tool registrations can be established;

G2.3   Caliper-Specific Recommendations

The Caliper-specific best practice recommendations for an EDUPUB reader are:

- The user should be able to disable the sensor API so that measurements reporting is completely disabled;

G2.4   QTI-Specific Recommendations

[[ED NOTE: To be completed in a later draft.]]

G2.5   Metadata Recommendations

[[ED NOTE: To be completed in a later draft.]]

G3   EDUPUB Authoring Systems, Tools & Applications

G3.1   General Recommendations

The general best practice recommendations for an EDUPUB authoring system, etc. are:

- The tool must allow the eBook to return the appropriate information when invoked using an LTI launch;

- The tool must allow LTI-enabled launch links to be inserted into the EPUB3 file. This includes the insertion of the required code libraries;

- The tool must enable the use of the Sensor API to report the appropriate measures. This includes the insertion of the required code libraries.

G3.2   LTI-Specific Recommendations

[[ED NOTE: To be completed in a later draft.]]

G3.3   Caliper-Specific Recommendations

[[ED NOTE: To be completed in a later draft.]]

G3.4   QTI-Specific Recommendations

[[ED NOTE: To be completed in a later draft.]]

G3.5   Metadata Recommendations

[[ED NOTE: To be completed in a later draft.]]

Appendix H – LTI/Caliper/QTI EDUPUB Conformance

At the time of publication the EDUPUB Conformance Program has not been finalised. This Section will be completed in later versions of this document.