

JISC DEVELOPMENT PROGRAMMES

WP4: D4.1 Report on L4All system architecture

Project

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1 Introduction

This report formulates the technical requirements of the L4All project and presents the L4All system architecture.

The document is organised as follows. Section 2 covers popular portal frameworks and derives a list of the most relevant frameworks for L4All. It then analyses them in detail in order to help us to make an informed decision on which one to adopt for the project. Next, in Section 3, a list of JISC funded tools that can be used in our system is presented. Section 4 provides a review of the existing e-Learning metadata standards. Finally, Section 5 focuses on the architecture of the pilot and provides a high level specification of it taking into account all the previously described technical requirements.

2 Portal Technologies

2.1 Portal Framework Requirements

The main requirements of the portal framework that will be used as the platform of the L4All project are listed below:

- **Open Source:** The chosen framework has to be an open source technology and be supported by the community; proven working in similar projects, popularity and low maintenance rates are also important factors.
- **Java-based:** Due to the popularity of Java and the high number of Java-based web technologies, the portal framework has to be implemented in Java.
- **Service and Portlet technologies:** The framework needs to support the latest web and portal technologies including:
 - Portlets technology complying with the JSR-168 Portlet API standard
 - Web Services technologies
 - Web interface customisation technologies, e.g. XSLT, CSS, Java Server Faces
- **Web server:** Working with popular Web Servers and Servlet engines like Apache Tomcat.
- **Security:** Standard-based security control mechanisms and Shibboleth (<http://shibboleth.internet2.edu/>). One part of the L4ALL project includes integration with Shibboleth, so a portal that would have been tested on Shibboleth will be an advantage.
- **Database connectivity:** the portal should support connection with popular open source databases such as MySQL and PostgreSQL and/or Name and Directory service standards such as LDAP.

2.2 Open Source Portal Frameworks

In the following paragraphs, we present popular portal framework implementations and we briefly describe their basic characteristics in the light of our requirements.

EXO Platform (<http://www.exoplatform.com>) The eXo platform is an Open Source, JSR 168 Portlet API compliant, enterprise portal built from several modules. It is based on popular enterprise Java tools, APIs and frameworks such as Java Server Faces, Pico Container, JbossMX and AspectJ.

Liferay (<http://www.liferay.com/home/index.jsp>) Liferay deploys portlets that adhere to the JSR-168 standard. Many useful portlets are bundled with the portal (Mail, Document Library, Calendar, Message Boards, to name a few) and can be used as examples for adding custom portlets.

Apache Jakarta JetSpeed (<http://jakarta.apache.org/jetspeed/site/index.html>) This is an Open Source implementation of an Enterprise Information Portal, using Java and XML. Jetspeed, appears to be one of the most popular and widely established portal frameworks. It implements a very rich set of characteristics and technologies including portlet standard, template-based layouts, XML content and RSS feeds, database connectivity and compatibility with all the popular Apache web technologies.

Nukes on JBoss (<http://www.jboss.org/developers/projects/nukes/index>) Nukes on JBoss is a Content Management System (CMS) with advanced user/group management, security rules and pluggable components. Nukes is built on enterprise Java components providing a set of advanced characteristics such as dynamic dependency resolve and runtime component deployment. It is all written in JBoss.

oPortal (<http://www.owasp.org/software/oportal.html>) This is one of the outcomes of the OWASP Portal project. It is a portal framework written entirely in Java having web application security as its main requirement. It is based on the Jakarta Struts framework but it lacks a lot of features the most important of which is the support of JSR-168 standard.

uPortal (<http://www.uportal.org>) uPortal is a free, sharable portal under development by a number of higher-education institutions worldwide. It includes a lot of collaborative community tools, such as chat, forums, survey, and so on. uPortal is an open-standard effort using Java, XML, JSP and J2EE technologies. Since recent versions of the system, portlet standards support has been included as an external, non-native, wrapper.

Gridsphere (<http://www.gridsphere.org/>) Gridsphere is JSR-168 compliant. A higher-level model for building complex portlets using visual beans and the GridSphere User Interface (UI) tag library is provided along with built-in support for a Role Based Access Control (RBAC) system that allow the separation of users into guests, users, admins and superusers. Persistence of data provided using Hibernate for RDBMS database support.

jPorta (<http://jporta.sourceforge.net/>) This is a portal engine built on top of the Jeenius Framework (<http://jeenius.sourceforge.net/>). It works with any 2.3 compliant servlet engine, like Apache Tomcat, and comes with a number of useful gadgets.

OpenPortal (<http://openportal.sourceforge.net/>) OpenPortal is a web portal framework that allows its users to personalise their web page on the site running this software. The user constructs his/her page by selecting between a set of portlets made available. A portlet can be a servlet or a JSP page.

MyPersonaliser (<http://www.tic.udc.es/%7Efbellas/mypersonalizer/>) This is a project that aims to produce a generic, adaptable J2EE-based framework for engineering personalised web portal pages that is, portals that let users create one or more personal pages (workspaces) composed of a number of personalisable services. MyPersonalizer is structured according to the Model-View-Controller and Layers architectural patterns, providing generic, adaptable model and controller layers that implement the typical use cases of a personalised portal. The controller layer is built upon Jakarta Struts. MyPersonalizer can be used with any standard J2EE web container (such as Jakarta Tomcat) and a number of databases (MySQL, PostgreSQL, and Oracle).

CHEF (<http://www.chefproject.org/index.htm>) CHEF stands for CompreHensive collaborativE Framework. It is a Java J2EE (Servlet) based application server using a version of Apache's Jetspeed as the main portal engine. CHEF contains a set of tools for controlling applications' user interface and services to provide information modeling, persistence, and application logic. The tools are a set of groupware applications (such as chat, schedule and resources). The services specifically support the tools (such as content hosting and messaging) and generally support the application environment (such as authentication, event tracking, security).

Stringbeans (<http://www.nabhinc.com/sb/index.html>) Stringbeans is a portal framework compatible with JSR-168 standard. String-beans offers JAAS based authentication, flexible portlet access control and monitoring, and support for mobile clients. It is bundled with portlets for displaying charts, reports, database tables, XML documents, RSS headlines, etc.

Jahia (<http://www.jahia.org/jahia/Jahia>) A Java-based integrated web content management and corporate portal server. Built-in support for standardized Java web applications and web services (default servlets supported as portlets). Full web-based

administration. Integrated with the Apache Lucene Search Engine. LDAP compliant. JSP and JSTL support for easy templates development. Integrated HTML cache engine. Dynamic XML export module.

Sakai (<http://sakaiproject.org/>) Sakai is a different set of tools. Its main goals include building and deploying a new Collaboration and Learning Environment for higher education, associated with CMS tools and components. It mainly consists of a refactored set of educational software tools blending the best of features from the University of Michigan, Indiana University, MIT, Stanford, and the uPortal consortium. The Sakai Project will include an Enterprise Services-based Portal, a complete Course Management System with sophisticated assessment tools, a Research Support Collaboration System, a Workflow Engine, and a Technology Portability Profile as a clear standard for writing future tools that can extend this core set of educational applications.

RedHat Portal Server Red Hat Portal Server is a open source Portal solution. Supports multiple languages in its user interface and pervasive devices such as WAP, XHTML, and VoiceXML in its rendering pipeline. Portals can be built and targeted for the individual, for work groups or teams, for people with a common set of interests, and for large corporations and organizations.

2.3 Main Portal Framework Comparison

Taking into account the requirements that are described in Section 2.1, we filter out the portal framework list given in the previous section in order to produce a short list of products from which we will make the final choice for the portal to be used as the platform for the L4All pilot.

So according to the requirements given above the list is narrowed down to the following platforms:

EXO Platform: The eXo platform code source is available for all our license types (GNU/GPL or commercial). EXO features a rich set of technical characteristics that are summarised as follows:

- *Services Container:* It provides an Inversion of Control (IoC) mechanism to allow efficient resolution of service dependencies. Each middleware component - such as a database or Enterprise JavaBean (EJB) access service - is then abstracted and separated from its implementation.
- *Content Management System (CMS):* It provides a hierarchy organization of binary objects that can be stored in any database or a file system with a small amount of code to implement for each storage system. In other words, to store XML documents, a native XML database can be used while objects can be stored either in a relational database or in an object database.
- *Portlet Container:* Implements the Portlet standard specification.

- *Web Interface*: Supports Java Server Faces (JSR-127) for portal interface customisation.
- *Web Application Container*: Supports Tomcat web application container

Apache Jetspeed: Jetspeed comes in two versions; version 1.x and the upcoming version 2. The data presented via Jetspeed is independent of content type, This means that content from for example XML,RSS or SMTP can be integrated with Jetspeed. The actual presentation of the data is handled via XSL and delivered to the user for example via the combination of Java Server Pages (JSPs) and HTML.

The main goal of Jetspeed is to create a tool for both portal development as well as web interface design using Java and XML-related technologies. In particular Jetspeed, uses the Velocity (<http://jakarta.apache.org/velocity>) Java-based template engine for Web Page design. Velocity provides a viable alternative to JSP and PHP technologies.

Jetspeed-2 is the next-generation enterprise portal from Apache. Jetspeed-2 offers several architectural enhancements and improvements over Jetspeed 1.0. First, Jetspeed-2 is conformant to the Java Portlet Standard and will provide a standard mechanism for the deployment of portlets. Second, Jetspeed-2 has matured to a more scalable architecture featuring multi-threaded functionality. Third, Jetspeed-2 is decoupled from several legacy open source projects. Fourth, Jetspeed-2 is based on a component architecture. However, Jetspeed 2 is still work in progress without any final and stable product yet available.

uPortal: Well-suited to educational portals, it is widely used for creating campus portals. As mentioned above, uPortal is a well established product among the academic community. It is an evolving platform with a quite rich set of characteristics, adaptor to educational needs compared to the rest of the platforms that are targeted more towards business enterprises. uPortal is also one of the early adopters of the *Sakai* project technology standards.

The key technical characteristics of uPortal are:

- Portlet standard support through a software adapter over the uPortal engine. Full native support within the platform is envisaged in the on-going version 3.x.
- Interface creation is performed by creating on the fly the appropriate style-sheets using XML/XSLT and JSP.
- Supports WSRP standard and web service integration.

2.4 The portal platform for L4All

Taking into account the L4All requirements and the above comparison of existing portal framework technologies, we have concluded that *uPortal* is the most appropriate product to fulfill L4All's needs.

The uPortal toolkit appears to be more dedicated to educational portals making it more easy to customise and to integrate educational information. Although it lacks a

number of technical features compared to the rest, it has been used with success in similar projects, including JISC-funded projects such as the NIIMLE portal. Moreover, other projects, such as the PERSEUS project (<http://www.angel.ac.uk/PERSEUS/>), have demonstrated the suitability of uPortal as a platform for integrating Shibboleth authentication and authorisation services, which is an important requirement for L4All as an early adopter of Shibboleth. Finally, it is expected that the popularity of uPortal and the adoption of Sakai technologies will increase the degree of compatibility between the L4All system and other portals that use the same set of technologies in the future.

3 Relevant JISC eTools and Services

As part of the L4All project we will exploit the functionality provided by some of the other JISC-funded projects. Each project conforms to the E-Learning Framework (ELF) architecture, implementing one or more of the indicated architectural components/services.

Below, we provide a list of relevant JISC-funded projects examining where each one may facilitate implementation of the L4All portal pilot.

3.1 ASSIS (Assessment and Simple Sequencing Integration Services)

ASSIS implements, according to the ELF architecture, a *Sequencing* service.

ASSIS aims to provide tools for a teacher to browse, search, preview and select assessment objects from question banks which can then be incorporated into packages of content which may also include sequencing instructions. The assessment objects in the content package contain pointers to an external rendering service, developed by Assis, removing the requirement for teachers to have any knowledge of the technical details of how the object is presented to the learner or how the learner's responses are captured. For learners, a player is produced that presents material from content packages and integrates with the Assis external services for presenting assessment objects and the processing of sequencing rules.

The sequencing service of ASSIS can be exploited in L4All to develop a mechanism for sequencing of digital objects that will generate recommended learning pathways.

Project URL: http://www.hull.ac.uk/esig/assis_deliverables.html

3.2 e-Learning Annotation Web Service

e-Learning Annotation Web Service provides a web service that allows the users to annotate a learning content and share these annotations with other users throughout the system. Annotations can take the form of text, rollover notes, images or links. Reports can be obtained by learners showing their own annotations to a specific web page.

The tool can be used within L4All by both content providers and users in order to annotate some particular areas or objects of interest; especially for contents that users wish to share with others.

Project URL: <http://eel.hud.ac.uk/>

3.3 DELTA

DELTA develops a content management tool. The fundamental aim is to provide an architecture to allow teacher and learner-controlled materials to be shared, and to 'grow context' with sharing. The tool also provides the ability of distributed resources to be created, submitted, searched and retrieved, based on standardised metadata, making also possible for new resource types to be added and shared among the teachers and the learners via widely available metadata repositories.

DELTA can be used in the L4All portal in order to facilitate performing search operations over the User and Learning Object Metadata that will be accessible via the portal.

Project URL: <https://sourceforge.net/projects/delta-jisc>

3.4 ePET (ePortfolio Extension Toolkit)

ePet is an ePortfolio project that has mainly been developed in order to provide the learner with functionality for personal management including: (i) meeting planning and recording; (ii) CV creation and editing; (iii) Learning action planning and recording in a learning diary.

ePet allows learners to share individual aspects of the portfolio (e.g. the CV) with others, create a hierarchical skill or learning outcome map for a course and record evidence against each of these. It can make this information available in various forms including ready-to-be-browsed HTML or fully customisable XML.

In L4All, ePet's functionality can facilitate the provision of services such as those above but integrated in the portal rather than stand-alone.

Project URL: <http://www.eportfolios.ac.uk/FDTL4>

3.5 GroupLog

The GroupLog project provides a Forum service in the form of a 'collaborative' weblog with multiple authors. The tool gives the opportunity to both teachers and learners to create discussion threads that can be customised so as to make some posting accessible or not.

GroupLog can be potentially used in L4All in order to extend the portal functionality with a collaborative forum tool.

Project URL: <http://www.bath.ac.uk/e-learning/grouplog/>

3.6 d+

The d+ project is developing a set of pilot web services and a toolkit that will allow searching over various resources and transforming the search results to reusable and standardised schemas for e-learning purposes. The output schemas are Learning Object Metadata (LOM), IMS Content Packaging and Resource Lists Specifications.

This set of tools can be exploited in L4All in order to provide search functionality over the provided learning metadata.

Project URL: <http://devil.lib.ed.ac.uk:8080/dplus/resources.jsp>

3.7 Open Mentor

OpenMentor is a ELF Tracking service that consists of two major parts: (i) a learning system, that acquires feedback rules through a training set, and (ii) a web interface that uses these rules to provide feedback to teachers.

The OpenMentor system will be available as a toolkit which can either be a standalone service or part of a larger service oriented architecture such as the e-learning framework. It will specifically make use the Rating/Annotation service within ELF to gather information on the level and quality of tutorial support.

In L4All the functionalities of Open Mentor can be exploited in the context of providing feedback to learners about their own pathways and facilitate their improvement.

Project URL: <http://kn.open.ac.uk/public/index.cfm?wpid=3817>

3.8 PETAL

PETAL aims to produce a general e-portfolio tool for lifelong learning based on the Open Source Portfolio Initiative and the Certified Member of ALT scheme. An e-portfolio can help learners reflect on their learning, help people move and progress from school to college to university and into work, help workers to learn on the job, and help increase participation in education and lifelong learning. Such a tool allows users to update and refine their personal information and provides profile management facilities.

PETAL can be used in L4All in order to facilitate, through the provided tools, a learner's personal information management.

Project URL: http://www.brookes.ac.uk/research/odl/petal/petal_home.html

L4All will explore possible synergies with e-portfolio tools by embedding relevant functionalities into the L4All portal in order to facilitate learners interaction with portfolio tools.

3.9 NIIMLE (Northern Ireland Integrated Managed Learning Environment)

This project aims to create an inter-institutional managed learning environment. NIIMLE will be implemented as a web portal, that will allow personalisation by each individual user. Through the portal, users will be given access to information about courses offered by FE and HE institutions in Northern Ireland, including various details about each university and college.

An online 'mentoring' service will also be available, through the portal, helping students to make guided decisions. A parallel mentoring forum will also facilitate user guidance. A personal development plan and careers service will also be available from the NIIMLE portal as an attempt to provide a complete range of services to the user.

NIIMLE is a project with a lot of similarities to L4All. Exploiting the functionalities by various of e-learning tools, it is building an inter-institutional portal with various features, including learning pathways and forums. Similar to L4All, NIIMLE aims at a user-driven design and development that will improve the interaction with the tool and will include user-adaptive features.

Project URL: <http://www.niimle.ac.uk/home.htm>

4 e-Learning Metadata Standards

This section provides a short review of the existing e-learning metadata standards and their characteristics. At the end of the section we describe our metadata standard choice for the L4All project.

e-Learning metadata standards are formal specifications used to semantically annotate educational material of all kinds. The use of e-Learning standards is imposed by the need of achieving application interoperability and high metadata resuability and accessibility.

The most widely accepted and used e-Learning metadata standards are listed below:

1. **ARIADNE** (Alliance of Remote Instructional Authoring & Distribution Network for Europe)
2. **IMS** (Instructional Management System)
3. **IEEE/LOM** (Institute of Electrical and Electronic Engineers/Learning Object Metadata)
4. **DC** (Dublin Core)
5. **ADL/SCORM** (Advanced Distributed Learning/Sharable Courseware Object Reference Model)
6. **PAPI** (Public and Private Information)
7. **EduPerson Object class**

4.1 ARIADNE

The ARIADNE educational metadata standard was produced as a result of the ARIADNE project and the IMS organisation. The main goals of this standard are summarised below:

- Easy and efficient LO indexing
- Easy metadata exploitation by users

The ARIADNE metadata schema contains a number of mandatory and optional categories. The mandatory categories constitute the minimal set of attributes that allow efficient searching capabilities.

4.2 IMS Metadata

The IMS Consortium (<http://www.imsglobal.org/>) defines a set of technical specifications for describing various aspects of learning materials, procedures etc. having as its main goal to facilitate interoperable learning technology applications.

The IMS Metadata specification (now in version 1.3 Public Draft) is exactly the same as the corresponding IEEE LOM version (Working Draft 6.4). The IMS Metadata specification provides all the necessary information for encoding learning material regardless of its complexity.

The IMS consortium provides, apart from the Metadata specification, a rich set of other technical specifications necessary for creating any kind of learning application. Among them those ones that are more closely related to L4ALL are the *IMS Simple Sequencing* and *IMS-LIP* (Learner Information Package).

IMS Simple Sequencing is a specification used to describe navigation paths through a collection of learning activities. It relies on the concept of learning activities, such as lessons and tests, and learning objectives that can be associated with other activities into a hierarchy, resulting in an activity tree. *IMS Simple Sequencing* can facilitate creating the learning pathways as part of the “mentoring” system of the L4ALL pilot.

IMS-LIP is a collection of information about a Learner or a producer of learning content. The IMS-LIP can be used in the L4All portal for encoding users’ information concerning their learning profile.

4.3 IEEE LOM

IEEE LOM has been created from the joint proposal of IMS and ARIADNE to IEEE. It is a superset of Dublin Core and thus it can cooperate with it using DC elements for the definition of some basic LOM elements. The IEEE LOM standard has the following characteristics:

- Specifies the syntax and semantics of LO Metadata using XML DTDs
- Provides the attributes required to adequately describe a LO
- Contains a minimal set of attributes for the management and evaluation of the learning objects

IEEE LOM specifies nine categories for over 70 metadata elements that are associated with Learning Objects. All of those categories are considered *optional* so an empty instance of LOM metadata still qualifies as a metadata record for the LOM standard. This implies that most of the existing LO metadata standards conform to IEEE LOM. Each other standard defines some of the IEEE LOM elements to be mandatory and extends this set of elements with its own “custom” elements.

The nine categories are listed below:

- *General* : Groups the general information describing a LO

- *Life Cycle* : Describes the history and the current state of the LO and all those affected it.
- *Meta-Metadata* : Describes information about the metadata record
- *Technical* : Contains description about the technical characteristics of a LO
- *Educational* : Contains description about the educational characteristics of a LO
- *Rights* : Intellectual property rights and conditions concerning a LO
- *Relation* : Describes the relationship between two LOs
- *Annotation* : Comments on a LO
- *Classification* : Describes where a LO is placed within a particular classification system

Figure 1 illustrates the hierarchy of IEEE LOM metadata specification. The LOM standard allows defining a learning object at one of the six granularity levels listed below:

1. Curriculum or Program
2. Course
3. Unit or Module
4. Topic
5. Lesson
6. Fragment or Component

4.4 ADL/SCORM

ADL SCORM also uses the IEEE LOM metadata descriptions. It maps IEEE LOM elements into three learning content elements in order to provide the missing link between general metadata specifications and content specific models. These three learning content elements constitute the granularity levels of SCORM which are listed below:

- (a) Raw media (e.g. Components, Fragments)
- (b) Content(e.g. Lessons, Modules)
- (c) Course

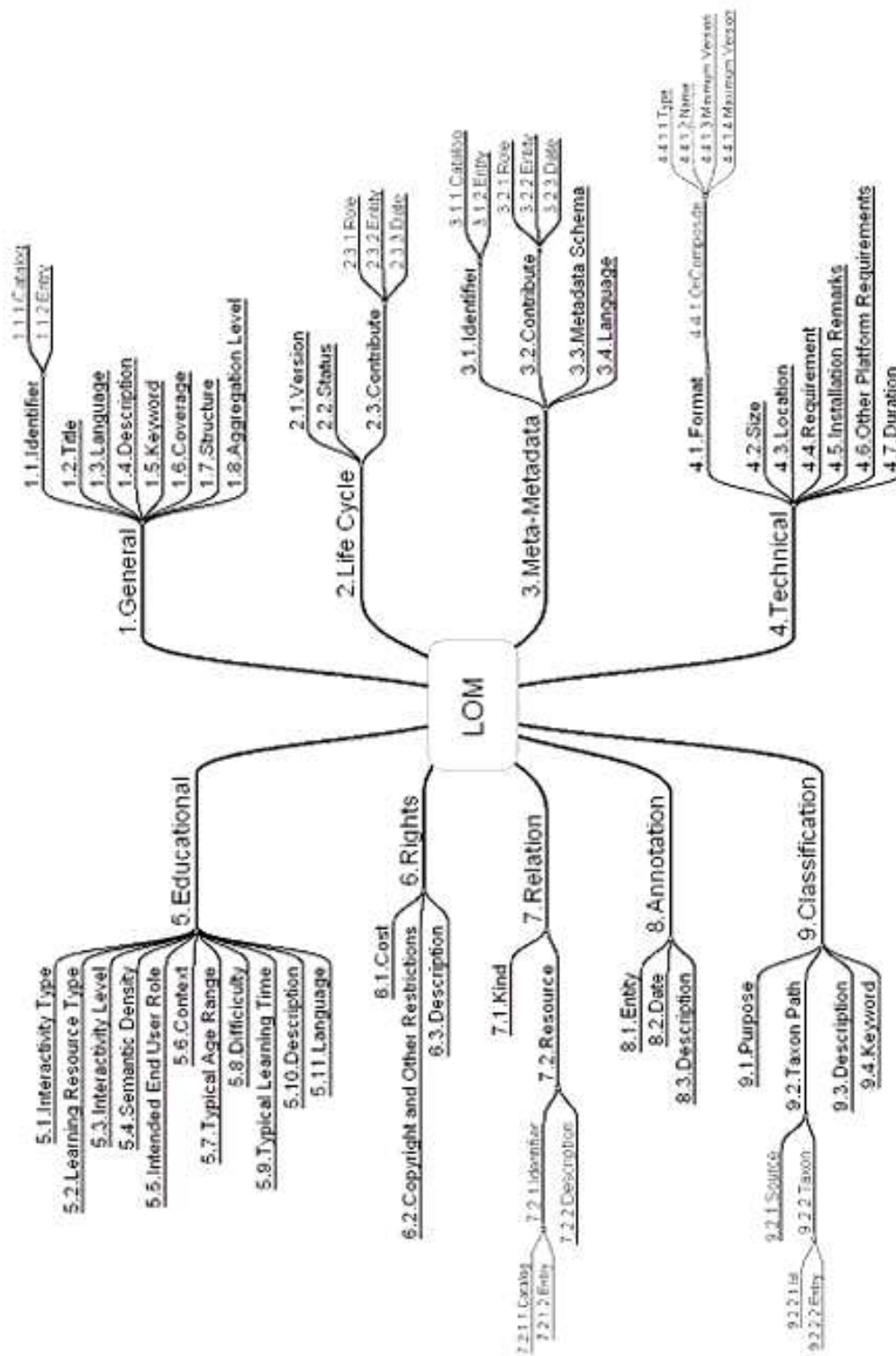


Figure 1: IEEE LOM Hierarchy

4.5 PAPI

The PAPI Learner Standard is a data interchange specification used for communication among cooperating systems. The PAPI standard specifies the semantics and the syntax of information associated with learners in a format appropriate for use by learning technology systems. It defines a set of elements for recording information concerning the learner including: knowledge acquisition, learner skills, abilities, security parameters, learner preferences and learner performance.

4.6 eduPerson

The *eduPerson* is an object class developed by the Internet2 consortium as part of the EDUCAUSE project. EDUCAUSE aims to provide an Internet2-compatible legal file sharing services on research, teaching and learning networks.

The *eduPerson* is an LDAP object class that includes widely-used person attributes in higher education. These person class descriptions can be used in campus LDAP directories in order to facilitate communication and user information interchange between educational institutions. The *eduPerson* class consists of a set of data elements and attributes about individuals within a higher education institution, along with recommendations on the syntax and semantics of the data that may be assigned to those attributes.

A customised version of *eduPerson* named *UKeduPerson* (<http://www.angel.ac.uk/UKeduPerson/>) was developed by London School of Economics, driven by the needs of UK institutions to share learning and teaching resources more freely and the needs of the Shibboleth project for more sophisticated access to password-protected web resources. *UKeduPerson* is not yet supported by any UK institution, but it was rather developed as a test bed standard in order to fill the standards gap for the next generation of user description standards.

The *UKeduPerson* schema can describe information about individuals affiliated to a UK educational institution, including mechanisms for achieving data anonymity as is required by Shibboleth. The *UKeduPerson* schema comes in three versions: (a) *Straight XML version* that describes the fields of the schema and is not intended to be used in practice, (b) *SAML (Security Assertions Markup Language) embeddable version*, that describes how the Straight XML schema can be expressed in the SAML specification and (c) *LDAP version* for achieving interoperability with existing legacy directory systems.

4.7 e-Learning Metadata in L4All

In the L4All project we will store two types of metadata, the Learning Object metadata concerning the learning materials that are available to the system's users, and the User metadata concerning information about the users of the system including learning profile, preferences etc. Concerning the user metadata, there is requirement for the metadata schema to be supported by Shibboleth since the L4ALL pilot will be integrated with it.

Taking into account the L4All project requirements and the existing metadata standards as described above, we believe that the most appropriate standards to be used for the learning material and the users are *IMS Metadata* and *IMS-LIP* and *eduPerson*, respectively.

The *IMS Metadata* specification is among the most popular standards used for describing this type of material and it has been used with success in similar projects such as NIIMLE. It is also supported by the JISC and the CETIS consortium. Using *IMS Metadata* for describing the learning material also ensures compatibility with the other IMS specifications such as *IMS Simple Sequencing* and *IMS-LIP*.

eduPerson is the only solution for encoding and exchanging user information between Shibboleth-enabled systems. Although UKeduPerson was developed as an extension of eduPerson in order to describe more sophisticated information, the reason that it is still in pilot phase and is not used by any UK institution yet, discourages us from using it for L4All at this stage. Finally, *IMS-LIP* is a specification that is fully compatible with *IMS Metadata* and covers a wide range of user properties that can be potentially used for encoding the user profile and learning-related information.

5 L4All Pilot Architecture

In Figure 2 below, we illustrate the ELF services that will be used or implemented by the L4All pilot. The services are grouped into three sets. The “Common Services” concern core system functionality, the “Application Services” that provide e-Learning-related functionality and the “User Agents” that constitute the interface with the system’s user.

In Figure 3, a general overview of the pilot system architecture is provided. The rounded boxes correspond to external eTool services that will be called. Within parentheses is mentioned the name of the project or projects that we expect will provide each service. The main criteria for adopting an eTool or service can be summarised as follows:

- The level of support of L4All functionalities in terms of L4All user requirements
- The technologies involved in accessing the service, the web service or the tool
- The usability of a service/tool
- The current developmental stage

As mentioned above, we are going to adopt the uPortal framework for implementing the L4All portal pilot. According to the uPortal requirements and the Shibboleth technical requirements (which will be described in detail later in the project as part of Workpackage 8), an Apache Tomcat 5.x application server is necessary for the whole system to be deployed as a web application. As a direct consequence of this, a set of Java Web service clients implemented on Apache AXIS SOAP will be used as an external layer for calling the external eTool SOAP services, such as Federated Search or ePortfolio services.

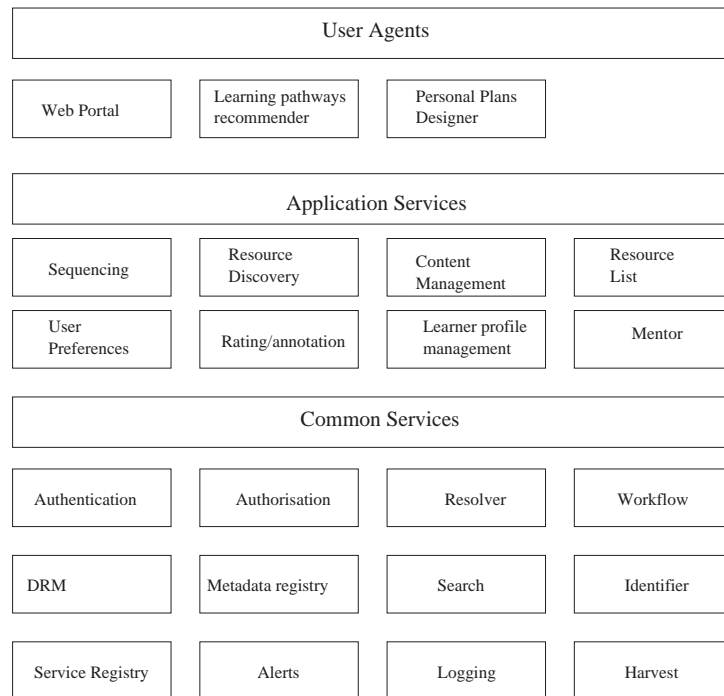


Figure 2: The envisaged services of the pilot

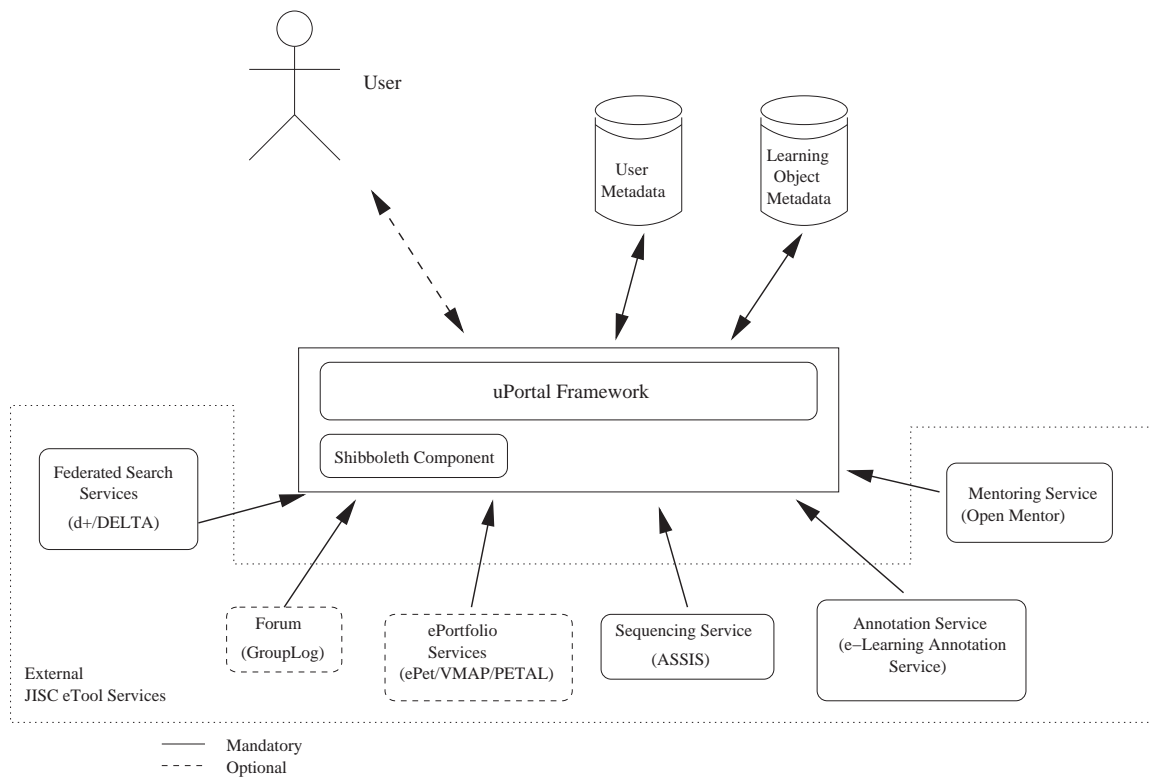


Figure 3: Portal Architecture

Regarding metadata management, and following our discussion in previous sections, we intend to encode the whole system metadata in RDF using the *IMS Metadata* standard for the learning material and the *eduPerson* and *IMS-LIP* specifications for the user metadata information.

The user metadata part will encode user profile information such as the user's level of knowledge, experience, preferences etc. The learning material metadata will maintain information about the learning resources, courses etc. A custom defined ontology that will describe the relations between the learning materials will also be developed in order to facilitate inferencing and suggestions/recommendations of learning pathways to users according their profile metadata.

For storing the RDF metadata we will use the Jena2 RDF framework (<http://www.hpl.hp.com/semweb/jena.htm>) in conjunction any relational database. The use of Jena2 as the RDF management framework provides a flexible and database-agnostic solution conforming to the standards, while also providing a high degree of compatibility with the existing RDF metadata management applications and services such as the DELTA federated search service.

Figure 4 illustrates how the different system components will be layered and organised in the L4All pilot. The "External JISC eTool Services" box represents the services to be used in L4All, which are illustrated in Figure 3, whilst the "Institutional Data" boxes illustrate each external institution's metadata that are accessible via the L4All portal. The "Portal User Metadata" repository which is attached to "L4All Portal" stores user metadata information that are managed by the L4All portal system and are used by Shibboleth for user authentication. The "uPortal Framework" is operating on top of an Apache Tomcat application server which has integrated appropriate Shibboleth components for providing inter-institutional authentication and authorisation. A bunch of Java Web service clients, tightly integrated with the rest of the system, will provide the necessary communication and information retrieval functionality with external JISC eTool/services.

Each separate institution participating in the L4All pilot, provides metadata content to the system, while it cooperates with the L4All portal via Shibboleth components enabling inter-institutional user authentication and authorisation.

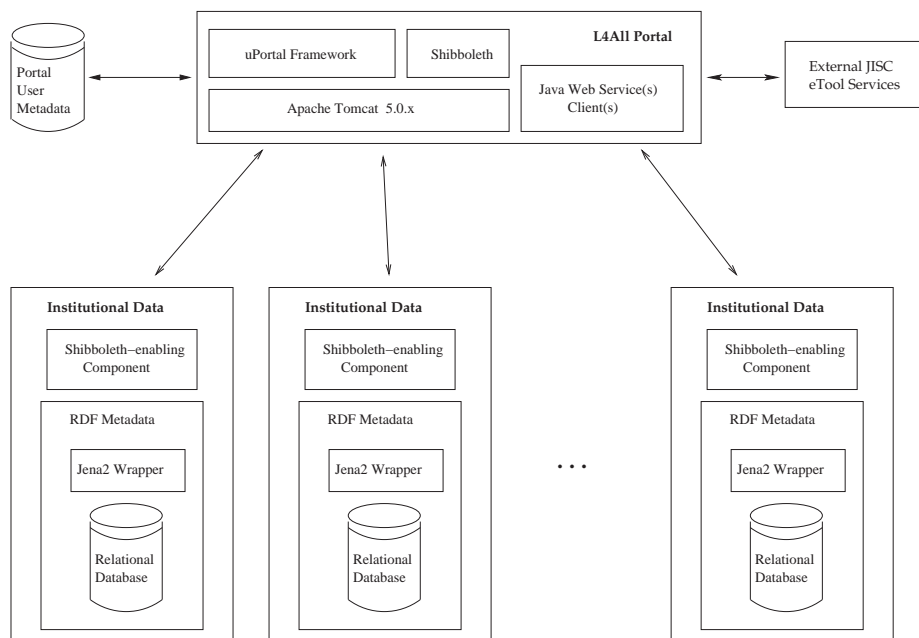


Figure 4: L4All Pilot Component Description