

# A Technical Framework to Support e-Learning

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## Executive Summary

## Introduction

This paper introduces a technical framework designed to support e-learning, and in particular to provide a basis for pedagogic diversity.

This is not intended to be prescriptive, or to deny practitioners or institutions the capability to deliver distinctive forms of learning. Nor is it intended to restrict the choices of systems that institutions may purchase (whether commercial, freeware or open source). Instead, what we hope to present in this document is a set of patterns that can be used to implement a variety of e-learning strategies.

Although we set out a service framework for e-Learning, we make no assumptions about how many services are deployed in a particular instance, or whether services are delivered by computerised, computer-assisted, or manual processes.

Our starting point has been the “very high level Use Case” of learner-centred education, which can be found in the document entitled Learner Use Cases. This is an extreme simplification, and part of the evolution of this framework depends upon teasing out the complexities of much finer-grained processes and looking at learning and teaching from a variety of viewpoints.

## The Scope of this framework

This framework is very explicitly centred on the learning and teaching aspects of institutions and organisations in the UK. We are very aware that this is only one perspective, and there are other areas, such as logistics, HR and finance, which may also benefit from the approach taken. Although services defined for this framework may be usable for purposes other than learning and teaching, we make no guarantees that the service definitions will be suitable for other domains.

## Value Proposition

What value can we gain by providing this framework? We identify several key objectives:

### Benefits to teachers and learners

- Support pedagogic diversity
- Enable pedagogy-driven implementations

### Benefits to institutions

- Make collaboration between institutions easier
- Provide better returns on technology investment
- Enable faster deployment of technology
- Reduce e-Learning deployment costs
- Provide a modular and flexible technology base

### Supporting pedagogic diversity

By enabling institutions to reconfigure the lowest-level elements of the learning architecture it becomes possible to support a very diverse set of learning models and institutional business models, while at the same time not jeopardising interoperability.

### Enabling pedagogy-driven implementations

By exposing modular processes as separate services, the construction of technology solutions can become driven by pedagogical imperatives, rather than the reverse.

===other benefits described here

## Key Concepts

### Building on prior work

We are not setting out to create a technology framework from a blank page; instead, we are looking to efforts around the world to make sense of learning technologies. We have drawn upon the work of MIT Open Knowledge Initiative, Sun Microsystems' E-Learning Framework, the UK e-University, the Carnegie-Mellon Learning Systems Architecture Laboratory, the IMS Global Learning Consortium and the JISC Managed Learning Environment and Information Environment programmes. We also believe that this framework should be constantly re-evaluated and evolved in response to outside developments that show promise.

### Unified solutions, piecemeal implementation




===not lots of things with own logon and no common usability etc, but instead can grow solution incrementally==

### Open systems

===not proprietary, but can be commercial===

### Building on successful technologies

A key consideration for this framework is the establishment of core technologies for building large-scale modular implementations.

-  Java 2 Enterprise Edition (J2EE) and JINI
-  Microsoft .net Framework
-  Web Services

### The Role of Standards

===goes here

### Service-level Abstractions

===goes here

### Managing identity and security

===goes here

## Replacing, Reusing, Adapting, and Prototyping Components

===goeshere

## The Layered Services Framework

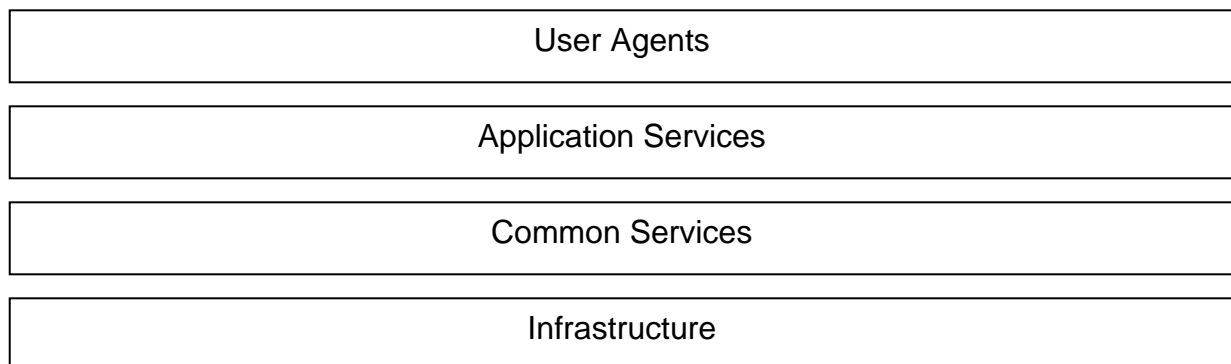
As with other approaches to e-learning frameworks, the starting point is the abstraction of service layers. We identify four layers of the framework:

**User Agents** interact with users directly, such as portals, learning delivery systems, authoring tools, administration interfaces and so on. User Agents based on this framework can be either very small and focussed or span many processes to provide a coherent workflow.

**Application Services** provide functionality required by user agents, such as retrieving learner information, or storing content in a repository. Application Services may be implemented so that they have some sort of user interface, but the key requirement for an application service is that it exposes its functionality for reuse by any number of user agents or other application services, and that it implements a standard interface to support this reuse

**Common Services** provide lower-level functionality which is not education-specific, such as authentication and authorization services, but upon which application services and user agents depend.



**Infrastructure** is the underlying network, storage, and processing capability provided for an implementation. This is assumed by the framework, but not defined.
























### Application Services

We do not consider this to be a definitive list of the services that can be provided, and we hope that additional services are identified, or identified services refined, in the light of future requirements analysis.












We have identified the following Application services:




-  Sequencing
-  Collaboration

-  Learning Flow
-  Activity management
-  Course management
-  Group management
-  Scheduling
-  Resource management
-  Discover
-  Content management
-  Cataloguing
-  Packaging
-  Activity authoring
-  Resource List
-  Archiving
-  Rating/Annotation
-  Terminology
-  Assessment
-  Grading
-  Learner Profile management
-  Competency
-  ePortfolio
-  User Preferences

### Common Services





We have identified the following common services:

-  User Messaging
-  Authentication
-  Authorization
-  Hierarchy
-  DRM
-  Terms/Conditions
-  Logging
-  Identifier
-  Filing
-  Workflow
-  Search

-  Service Registry
-  Resolver
-  Institutional Profile
-  Metadata Registry

## Service Specifications

To implement a Service requires a Service Specification – a set of documents that provides a ‘blueprint’ for building the service. This document set comprises, at a minimum:

-  A narrative description of the component and its role in the framework
-  A set of Interface definitions, or references to relevant specification
-  A set of DataType definitions, or references to relevant specifications
-  A binding to the implementation technology

Examples of bindings include java interfaces and classes for J2EE, COM interfaces and classes for .net, and WSDL interfaces and XML Schemas for a web services implementation. A service specification may not necessarily cover all of these bindings.

In cases where no service specification currently exists, implementers may choose to develop and publish a service specification themselves. We recommend that JISC provides a suitable structure for publishing and sharing service specifications.

## Mapping Processes to Services and Agents

A good way to understand how the framework can be used in practice is to take learning and teaching processes and map those to both Application Services and User Agents.

[This is where we take the use cases – like James' examples – and map them onto an example architecture using the framework.](#)

## Implementation

NOTE: Web Services should be normative/preferred?

### Integrating Legacy Applications

In many cases, the services listed may have their functionality embedded within legacy applications. In such cases, one strategy for implementation is to expose the functionality using a service agent. This agent provides the standard service interface, and translates calls upon that interface into messages that are understood by the legacy application. Agent code could easily be generalized across multiple services.

### Use of standard integration components

It should be possible to use standard industry integration solutions to provide the service infrastructure. For example, Microsoft BizTalk Server, BEA Weblogic, Sun iPlanet and ONE suites, IBM MQSeries, or Sonic MQ/XQ.

### Implementing with J2EE

Sun's Java 2 Enterprise Edition provides excellent support for distributed components and component reuse through the Enterprise JavaBeans technology (EJB). Using this architecture, services can be implemented using a combination of Entity Beans and Session Beans, with the service interfaces exposed through a Session Bean.

To allow a service delivered via J2EE to be accessed by non-J2EE compliant software, each service may also provide a servlet to allow access via Web Services. (This servlet could be written using a standardised agent codebase that could be adapted to serve multiple services.)

### Implementing using JINI

==Bill would be the expert on this one

### Implementing using Web Services

===tbc

### Implementing using .net

Like J2EE, Microsoft's platform provides foundation technologies for distributed and reusable components. The Component Object Model (COM) and Distributed Component Object Model (DCOM) provide CORBA-like interface abstractions that allow applications to share code deployed in dynamic link libraries (DLLs). To share services beyond the firewall, components also need to provide web services interfaces, perhaps through deployment using Microsoft BizTalk Server.

Mixed implementations

===TBC



## Descriptions of Application Services

Not all descriptions completed.



### Sequencing

A Sequencing service provides support for the use of sequenced learning objects.

The key functions for a sequencing service are:

-  Managing the creation and maintenance of sequences
-  Providing runtime support for sequences, such as getting the next item in a sequence





Specifications with applicability to this area are:

-  IMS Simple Sequencing
-  SCORM 1.3

### Collaboration

A Collaboration service supports the use of collaborative learning tools.



The key functions for a collaboration service are:

-  Managing the setup of collaborative sessions
-  Supporting synchronous communication
-  Supporting asynchronous communication
-  Supporting collaborative document creation

### Learning Flow

A Learning Flow service supports the management and use of complex learning scenarios.

The key functions for a Learning Flow service are:

-  Managing the setup of learning designs
-  Providing runtime support for learning designs, such as sequencing activities

Specifications with applicability to this area are:

-  IMS Learning Design

### Activity Management

An Activity Management service supports the management of learning activities.

The key functions for an Activity Management service are:

- Populating activities with groups of individuals in particular roles

Specifications with applicability to this area are:

- IMS Learning Design

### Course management

A Course management service allows applications or services to access and manage courses, modules and other units of learning.

The key functions for a Course management service are:

- Support creating, reading, updating and deleting units of learning
- Support creating, reading, updating and deleting data regarding membership of units of learning
- Support creating, reading, updating and deleting people information

Specifications with applicability to this area are:

- IMS Enterprise
- IMS Enterprise Services (not yet available)
- OKI Course Management OSID

### Group management

A Group management service is an abstraction of Course management, with applicability to groups other than units of learning.

The key functions for a Group management service are:

- Support creating, reading, updating and deleting groups
- Support creating, reading, updating and deleting data regarding membership of groups
- Support creating, reading, updating and deleting people information

Specifications with applicability to this area are:

- IMS Enterprise
- IMS Enterprise Services (not yet available)
- OKI Group Management OSID (not yet available)

### Scheduling

A scheduling service supports allocating resources (such as modules, roles, people, or physical resources) against time, supporting basic shared calendaring and resource management.

The key functions for a Scheduling service are:

- Support allocation and deallocation of resources against time slots

- Support requests for schedules by resource and/or timeframe

Specifications with applicability to this area are:

- OKI Scheduling OSID

### Resource management

A Resource management service supports the management of finite resources, such as equipment and rooms.

### Discover

A Discover service supports the finding of information resources including learning objects, assets, e-reserves and so on.

### Content Management

A Content management service supports the publishing, retrieval, description, and organisations of information resources.

### Cataloguing

A Cataloguing service supports the management of descriptions for information resources.

### Packaging

A Packaging service supports the assembly of packages of information resources by aggregation and disaggregation, and their preparation for transport and delivery.

### Activity Authoring

Supports the process of creating, storing, retrieving, aggregating and otherwise managing learning activities.

### Resource List

Supports the creation, access and management of reading lists and other lists of resources.

### Archiving

Supports the long-term preservation of documents and content.

### Rating/Annotation

Provides support for the use of secondary metadata (user ratings and text annotations) for resources.

## Terminology

Provides automated, machine-readable mappings between terms, either within a particular thesaurus or across multiple thesauri or classification schemes. The intention is to allow consumers of the service to map terms, allowing users to use one set of terminology, but automatically mapping their terms to alternative or additional terms in thesauri or classification schemes used by target services. (Note that terminology is not limited to subject but also includes audience level, resource type and certification).

Specifications with applicability to this area are:

-  IMS Vocabulary Definition and Exchange (VDEX)

## Resolver

Provides services based on the use of OpenURL metadata, including redirection to document delivery services, redirection to online bookshops, to local library services, and other discovery activities. Resolver services work with Institutional Profiling services to determine institutional resolution preferences.

## Institution Profiling

Provides machine-readable information about resolution preferences (e.g. using Amazon rather than Waterstones for online book purchases) and local library holdings information. Intended to support OpenURL and Resolver services (above).





## Metadata Registry

A metadata registry provides machine-readable information about the metadata schemas in use by particular metadata-based services. The primary intention of this service is to allow service consumers to automatically determine information about appropriate search terms and the structure of metadata records that will be returned to them. However, metadata registries also provide a useful human-oriented service, allowing people to see what metadata schemas are in use by which services - providing a basis for metadata schema sharing and re-use.

## Assessment



An Assessment service supports the use of automated assessments.

The key functions for an assessment service are:

-  Storing, retrieving, deleting and updating Items (individual questions)
-  Storing, retrieving, deleting and updating Sections (groups of questions)
-  Storing, retrieving, deleting and updating Assessments (groups of sections or questions)
-  Publishing Assessments against a Course, Module, or other unit of learning

## Storing and retrieving Results from Assessments



Specifications with applicability to this area are:

-  IMS Question & Test Interoperability (QTI) provides data models for assessments, sections, items, and results reports
-  OKI Assessment OSID provides APIs for managing banks of items, sections, and assessments, and for publishing assessments


## Grading

A Grading service supports submitting grades against courses, modules, and other units of learning

The key functions for a grading service are:

-  Submitting grades against courses, modules, and other units of learning
-  Submitting feedback and comments associated with grades

Specifications with applicability to this area are:

-  OKI Grading OSID provides an API for submitting grading reports

## Competency

Supports the management of competency frameworks, and the mapping of units of learning, assessments, and activities against specific competencies.

## Profile

Supports the management of a learner's personal development record.

## ePortfolio

Supports the management and assessment of artefacts created by learners, such as essays and projects.

## User Preferences

A user preferences service provides machine-readable information about users' personal preferences. The primary intention of this service is to allow user agents, such as portals, to automatically configure themselves for particular end-users and to prevent end-users from having to enter their preferences into multiple user agents.

Specifications with applicability to this area are:

-  IMS Learner Information Package (including Accessibility)

## Descriptions of Common Services

To be completed

### Service Resolution

Allows agents to locate services implementing a particular service definition according to local business rules.

### User Messaging

Allows broadcast of important messages to users and groups using appropriate communication technology.

### Authentication

Allows the identity of agents to be established.

### DRM

Supports the allocation and application of rights policies against resources, consuming data in a digital rights expression language (DREL) to determine access. Works through Authorization services, and is generally intended to be called by Authorization implementations as the result of a request to use a resource.

Specifications with applicability to this area are:

-  IEEE Digital Rights Expression Language

### Terms and Conditions

Provides access control support for IE resources – probably a sub-service of DRM.

### Logging

Generic logging service for applications (OKI).

### Identifier

Service to create and allocate identifiers (such as GUIDs, LUIDs, PLIRIDs, DOIs etc). This service may also resolve identifiers.

### Filing

Generic storage system support (OKI).

### Authorization

Supports the management of access to resources by agents.

### Workflow

Supports creation and management of multi-service transactions, usually for administrative purposes.

### Search

A search service allows application services to support resource discovery by sending a query formatted according to a particular query syntax.

### Harvest

Allows application services to support resource discovery by harvesting copies of some or all metadata records.

### Alert

Allows application services to support resource discovery by alerting them to lists of new resources.

### Service Registry

Allows application services to discover available services implementing a particular service definition according to local business rules.

This was formerly comprised of “IE Collection Description” and “IE Service Description” Application Services:

#### (DEPRECATED) IE Collection Description

Provides access to machine-readable descriptions about the collections that are available as part of the JISC Information Environment. The primary intention of the service is to allow service consumers (including portals, brokers, and aggregators) to automatically determine what collections are available to end-users of the JISC IE.

#### (DEPRECATED) IE Service Description

Provides detailed technical information in machine-readable form about JISC IE Services. The primary intention of the service is to allow service consumers (including portals, brokers, and aggregators) to automatically determine how to interact with content providers and other IE services.