Technical Whitepaper

imc Learning Suite
System architecture and technologies

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Content

1 Introduction and Further Documentation

This document describes the architecture and technologies used and discusses possible operating scenarios. However, it does not cover technical aspects and functionalities. The paper is aimed at decision-makers and IT professionals responsible for implementing a Learning Management System in their organisation.

Other documents provide in-depth information on topics covered in this document. These are:

- System requirements
- Universal API documentation (available on request)
- Configuration documentation (available on request)
- Security whitepaper

2 System architecture

The learning platform is a Web application that uses Java Servlets and JavaServer Pages on the server side. The end user uses a browser to communicate with the system via HTTP or HTTPS. Static content can be provided directly via a Web server. Requests for dynamic content (JSPs/Servlets) are forwarded to the Servlet engine. The Servlet engine executes the Java-coded learning platform program logic to respond to these requests. To obtain access to persistent data, it is connected to a database system by means of JDBC.

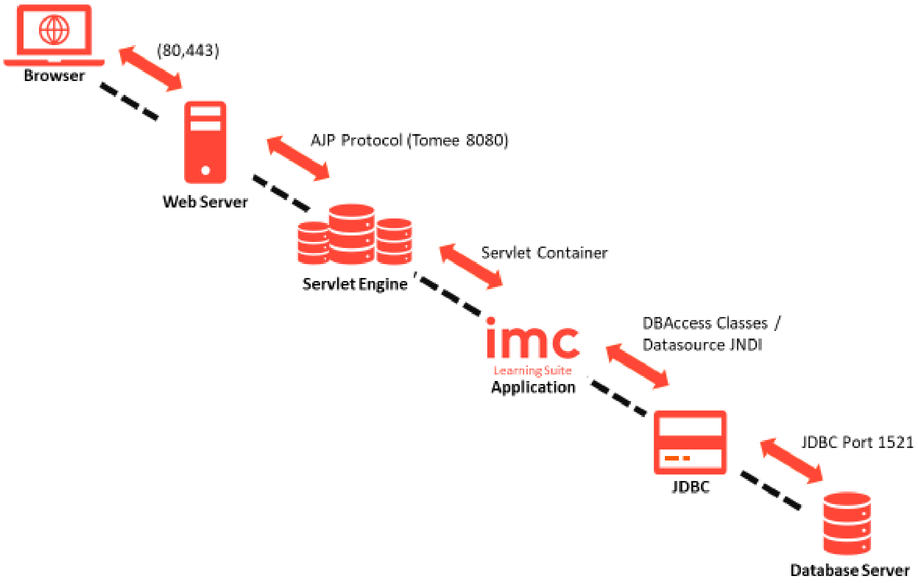

Fig. 2.1: Base architecture

The learning platform consists of several components that fulfill different tasks:

- ILS provides a comprehensive REST interface, the scope of which is described in more detail in section 4.1 Universal API. It provides a web interface for the various possibilities of administration and configuration of the learning platform. ILS ensures persistence of learning data by using a relational database or by writing learning contents into a file system.
- ILP offers a modern and mobile-compatible web interface for learners and other target groups. ILP does not itself store data, but communicates via REST with ILS
- Apache Solr provides a fast search index for catalog content. ILS regularly exports metadata of learning content to Apache Solr. ILP uses Apache Solr to display catalog content and to enable a quick search within the catalog.
- Gamification
  - IGS (imc Gamification System) provides a REST section to manage experience paths, badges, and rules. IGS also evaluates user activity against these rules.

- PRS (Profile Record Store contains aggregated information which points on experience paths and which "badges" learners or groups have achieved.
- LRS (Learning Record Store) is a data store for all actions performed by a learner, or their subsequent states, which result from a rule evaluation.

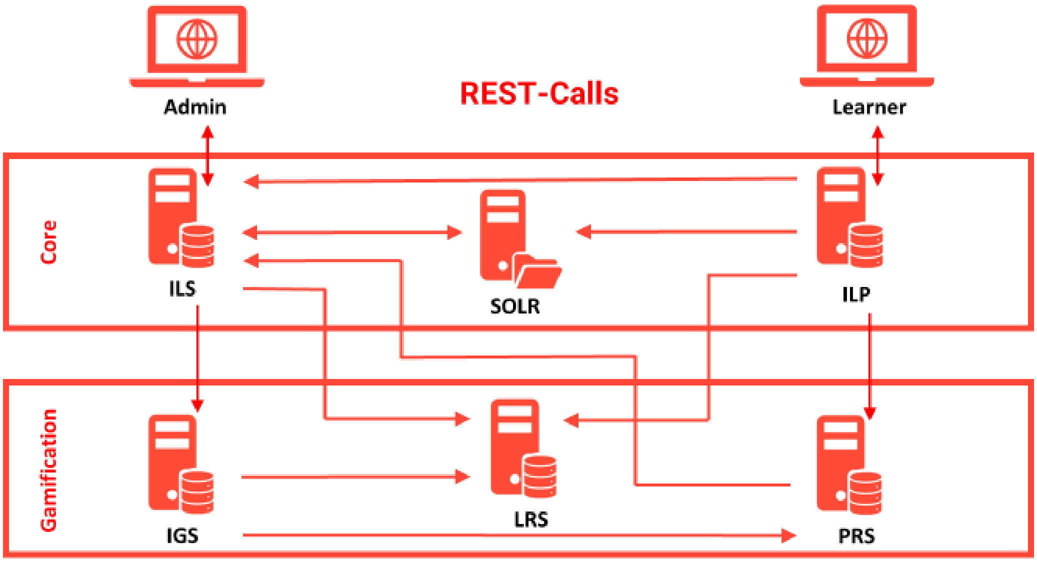

Fig. 2.2: REST Communication of the components within the learning platform

3 Network integration and scalability

The system architecture shown in section 2 System architecture is simply integrated into an existing IT environment. The components described can be separated by firewalls and use the communication protocols shown. For a simple operating scenario, the platform can be integrated into an existing network without any additional system components. In order to do this, the Web server is run together with the Servlet engine on a server instance The Web server processes the static data and the Servlet engine processes the dynamic content. Content can be streamed through an additional streaming server (third-party product). Fig. 3.1 shows a simple operating scenario (with no streaming server), as can be used for test systems. As in all scenarios, the operating system environment can be used virtually.

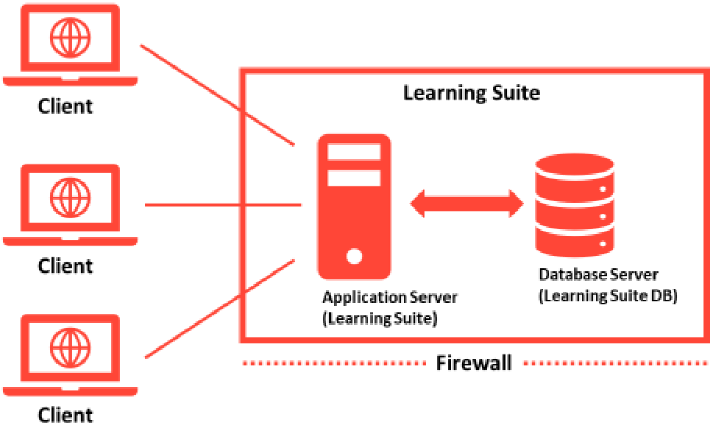

Fig. 3.1: Simple operating scenario

Load distribution and increased reliability can be achieved by distributed operation in a cluster. The platform allows application servers to be clustered for the purpose of load distribution. Database software can be used to achieve load distribution for the database. When distributing application logic to a number of computers, the content needs to be transferred to the content server. An application server can assume the role of the content server. Alternatively, the role can be transferred to a separate server. Fig. 3.2 illustrates fail-safe operation with load distribution on the application server side with no separate content server.

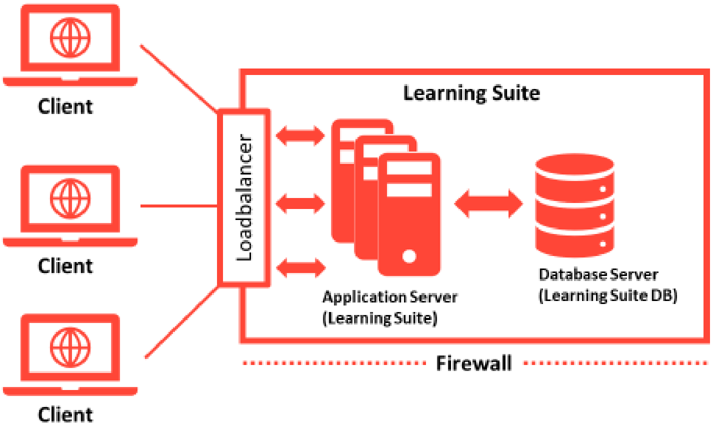

Fig. 3.2: Operation in a cluster scenario

Database reliability can be increased using a failover cluster.
Furthermore, in order to provide content to locations with poor connectivity, the content can be separated from the system. The resulting content server is installed at the respective locations complete with a cache function. A reverse proxy on the content server ensures support for the SCORM interface.

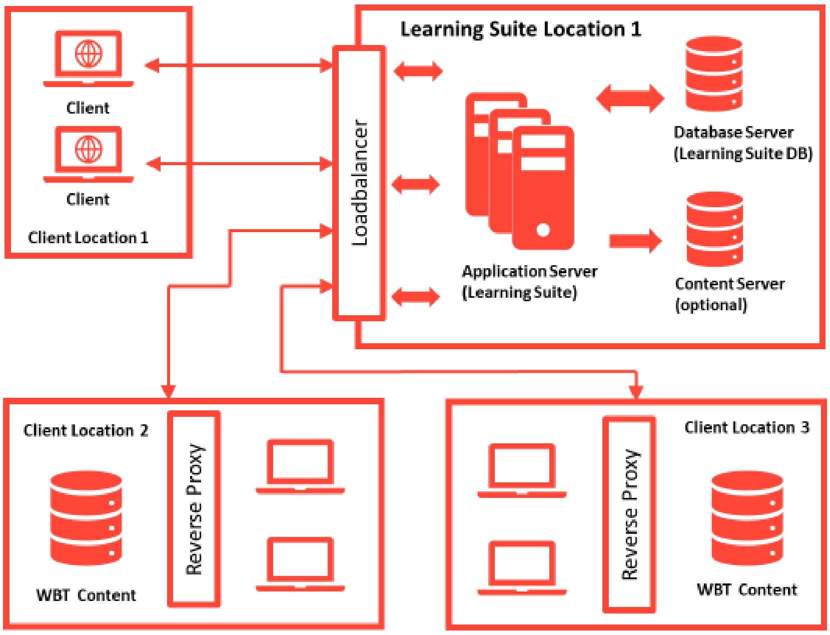

Fig. 3.3: Distributed content server

For requirements such as heavy user scenarios running into millions, global platform use, constantly changing load scenarios or infrastructure outsourcing, the platform can be made available in the Microsoft Azure cloud. Simple allocation to the various function groups enables Azure services to be used as platform system components. Enhancing the program logic for deploying, controlling and managing the platform in the Azure cloud makes it possible to provide linear scalability, availability in worldwide data centres and secure integration of these services in the particular IT infrastructure. Fig. 3.4 shows how Microsoft Azure components are used to run the platform in the Azure cloud.

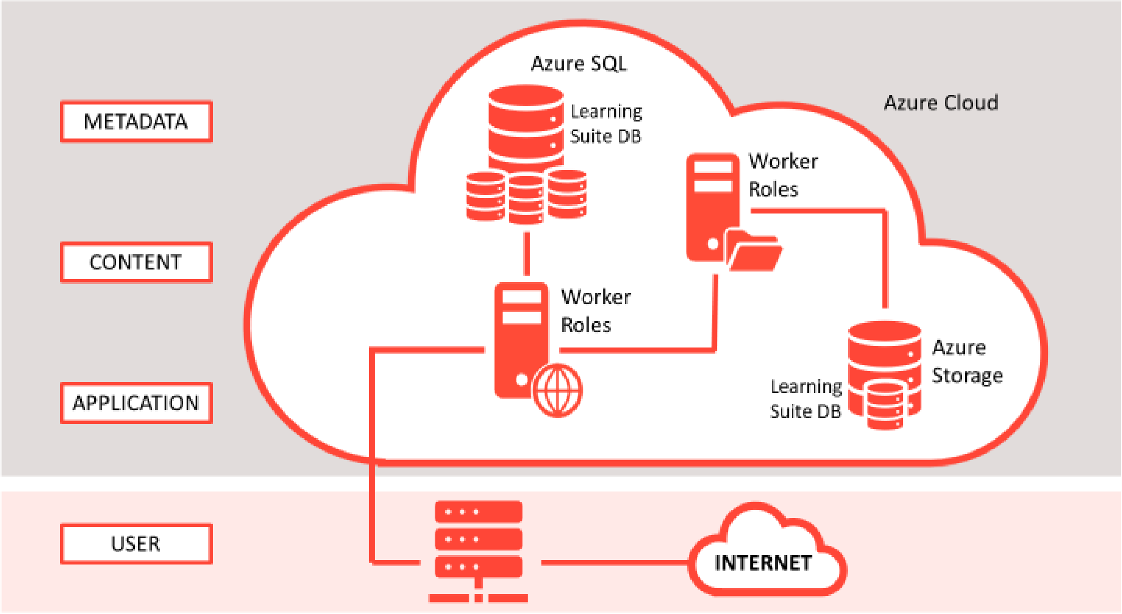

Fig. 3.4: Simple Azure deployment

4 Software integration and interoperability

4.1 Universal API

The imc Learning and Talent Suite provides a REST interface for the following content:

- People (export): profile data for the user who is logged on
- News (export), which is assigned to a news panel marked as visible in mobile apps
- Courses (export):
    - News
    - Syllabus and library
    - Tests, questions and feedback
    - Course registration and start by learners
    - Rating
    - Course room configuration
    - Prerequisites
    - Course templates
        - prebooking
- Media for selected content types (export)
- Catalogue (export):
- Dates (export)
- SCORM data (import/export)
- Search (export): selected simple and aggregated searching for learners, tutors, HR and supervisors. The searches available are listed in the section "Search Queries Available in the API” in the Universal API documentation.
- Dashboard pages (export)
- Groups (export)
- Programs (export)
- Bookshelf

Area of application:

- Mobile apps
- Client-specific interfaces
- Portal systems

Also, see: technical specification of the universal interface.

4.2 People interfaces

The personal profiles of platform users are managed within the database. As well as a unique internal data record number, each person is uniquely identified by his or her login name.

4.2.1 User import mechanisms

The system supports the following profile data sources:

- CSV
- LDAP
- Shibboleth
- LOCAL (self-registration by the user in the system)

Fields from a CSV file or the LDAP attributes can be assigned to the platform attributes. This procedure is used to set access authorisations, check licence rights and assign clients and groups.

If personal data is mainly maintained in an external system, the identifying profile attribute is not necessarily the login name. Therefore, an additional personal profile attribute needs to be maintained for each external profile data source. This is known as an external identifier. This attribute is used to identify a person in the external system.

4.2.2 Authentication mechanisms

The system supports the following procedures for user authentication:

- Local login (using system database)
- Login via a connected LDAP server
- Single sign-on (using the remoteUser of the HTTP request header)
- Shibboleth Version 1.3
- SAML2

If several authentication mechanisms are used in parallel, attempts to login are made in an authentication sequence, in the order specified in the system configuration.

After a specified number of unsuccessful attempts to login, the user is blocked. The block is released automatically or manually after a configured period of time.

4.3 Content interfaces

4.3.1 The AICC interface

The AICC (Aviation Industry CBT Committee) has developed a (somewhat outdated) standard for media, which is supported by certain authoring tools. Compliance with the standard enables integration in a LMS, which must also support this standard. Media can then be imported in a standardised way into the LMS and played through the LMS. The learning platform supports contents that communicate via HACP (HTTP AICC CMI protocol) in accordance with AICC standards for Web-based contents.

4.3.2 The SCORM interface

SCORM (Sharable Content Object Reference Model) is a standard for Web-based media that is supported by a number of authoring tools. Compliance with the standard enables integration in a LMS, which must also support this standard. Media can then be imported in a standardised way into the LMS and played through the LMS. The learning platform supports content that have been created in accordance with the SCORM 1.2 (level 3) standard or the SCORM 2004 (3rd edition) standard.

4.3.3 The QTI interface

IMS QTI is a standard for online test materials. The QTI interface enables the importing and exporting of test content that complies with the imc Learning and Talent Suite. The interface only supports item-type elements.

4.3.4 The LTI interface

LTI stands for Learning Tools Interoperability and is a specification developed by IMS Global Learning Consortium (https://www.imsglobal.org/activity/learning-tools-interoperability). LTI allows imc customers to embed external learning applications (tools) in courses delivered via imc Learning Suite and imc Learning Portal.
The term "learning applications" has a broader scope than traditional learning content focused standards and specifications like SCORM or AICC. Learning applications can be anything from Open Educational Resources (OER) repositories, e-books, interactive assessments, chats and community tools, virtual labs (e.g. for chemistry or physics) to Dropbox and Microsoft Office 365 applications OneNote and OfficeMix.