

# INTEGRATED AND DISTRIBUTED E-LEARNING ENVIRONMENTS USING INTEROPERABILITY STANDARDS

Alexander Streicher, Eva Poxleitner, Christopher Krauß, Florian Ziemann



<http://s.fhg.de/fhgclm>



# The Fraunhofer-Gesellschaft at a Glance

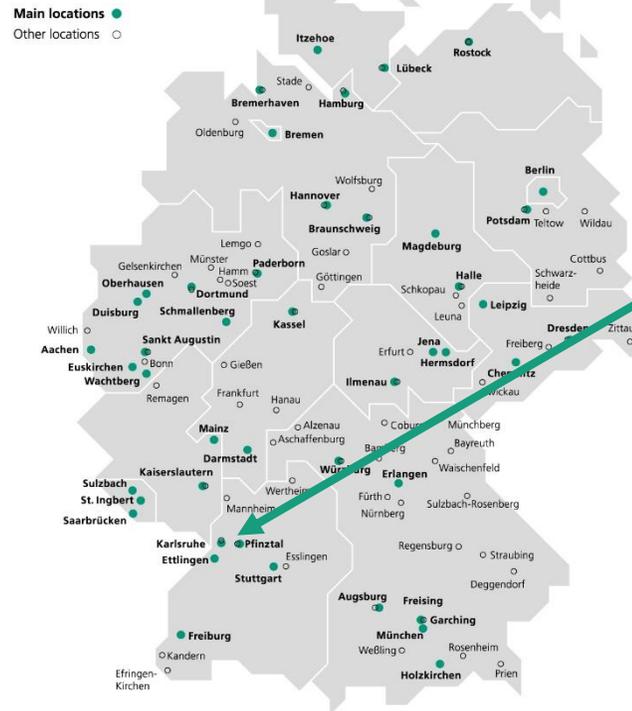
The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.



28,800 staff



74 institutes and research units

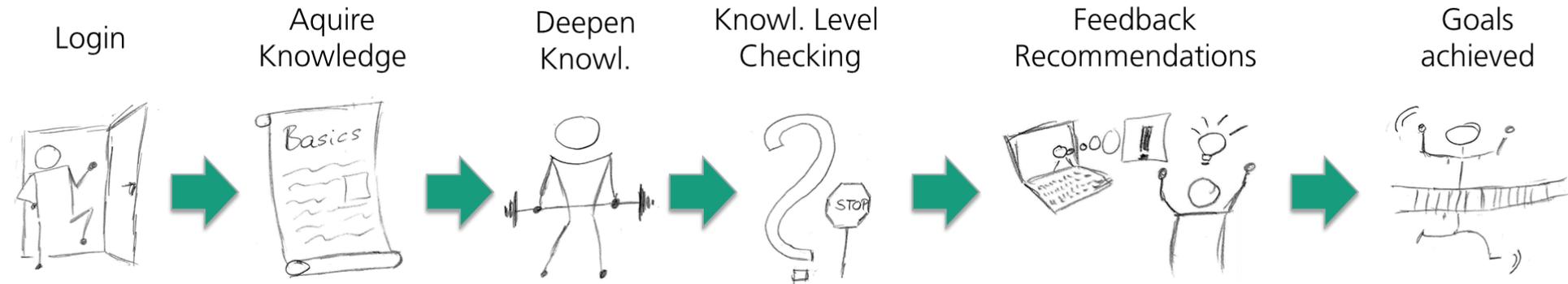


# AGENDA

1. Motivation, Challenges
2. Open Tools, Specification & Standards
3. CLM Solution
4. Conclusion & Outlook



# Learning Environments – Systems Everywhere...



Web-Portal



LMS



Serious Games



LMS/  
E-Assessment



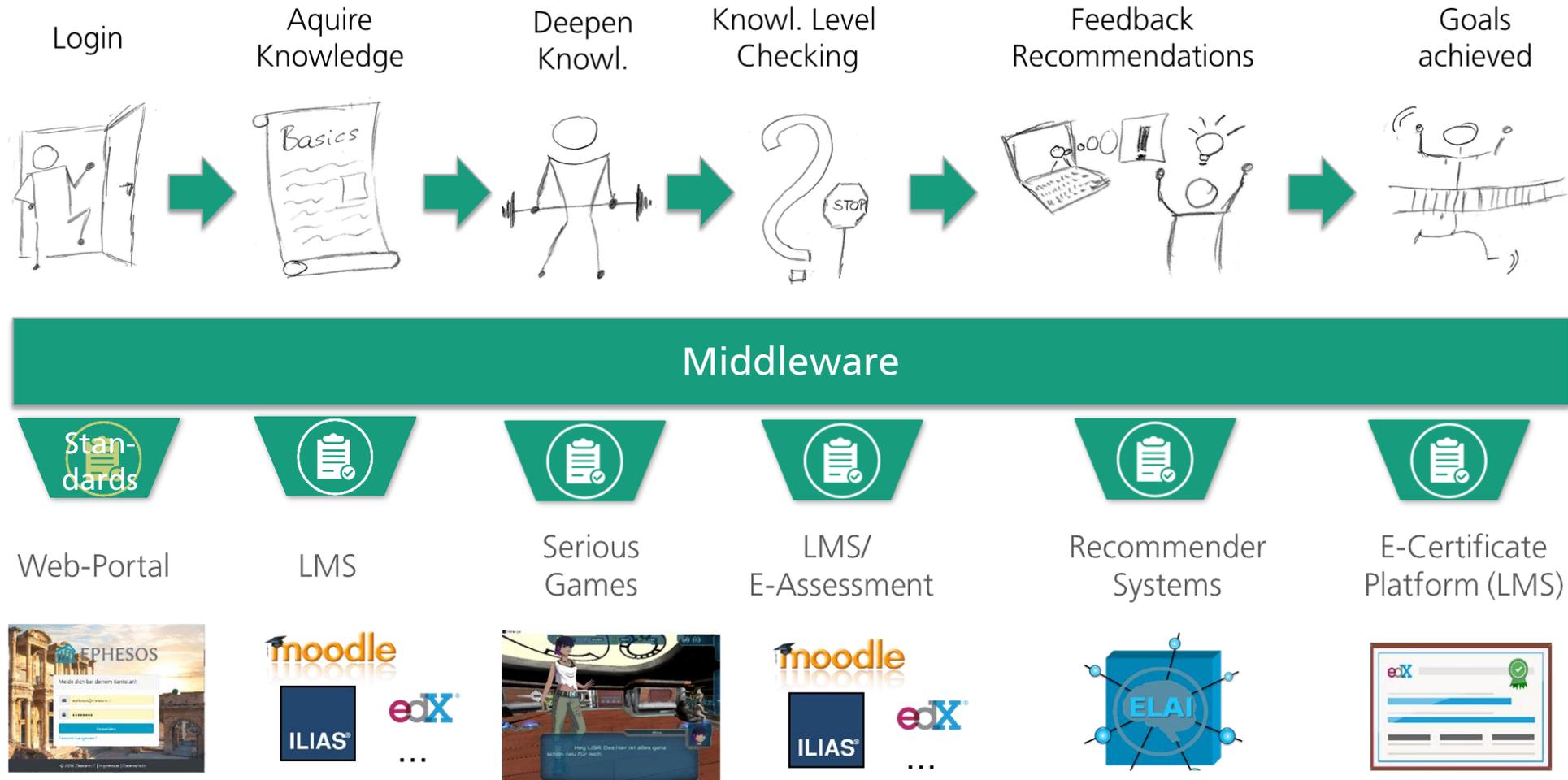
Recommender Systems



E-Certificate Platform (LMS)



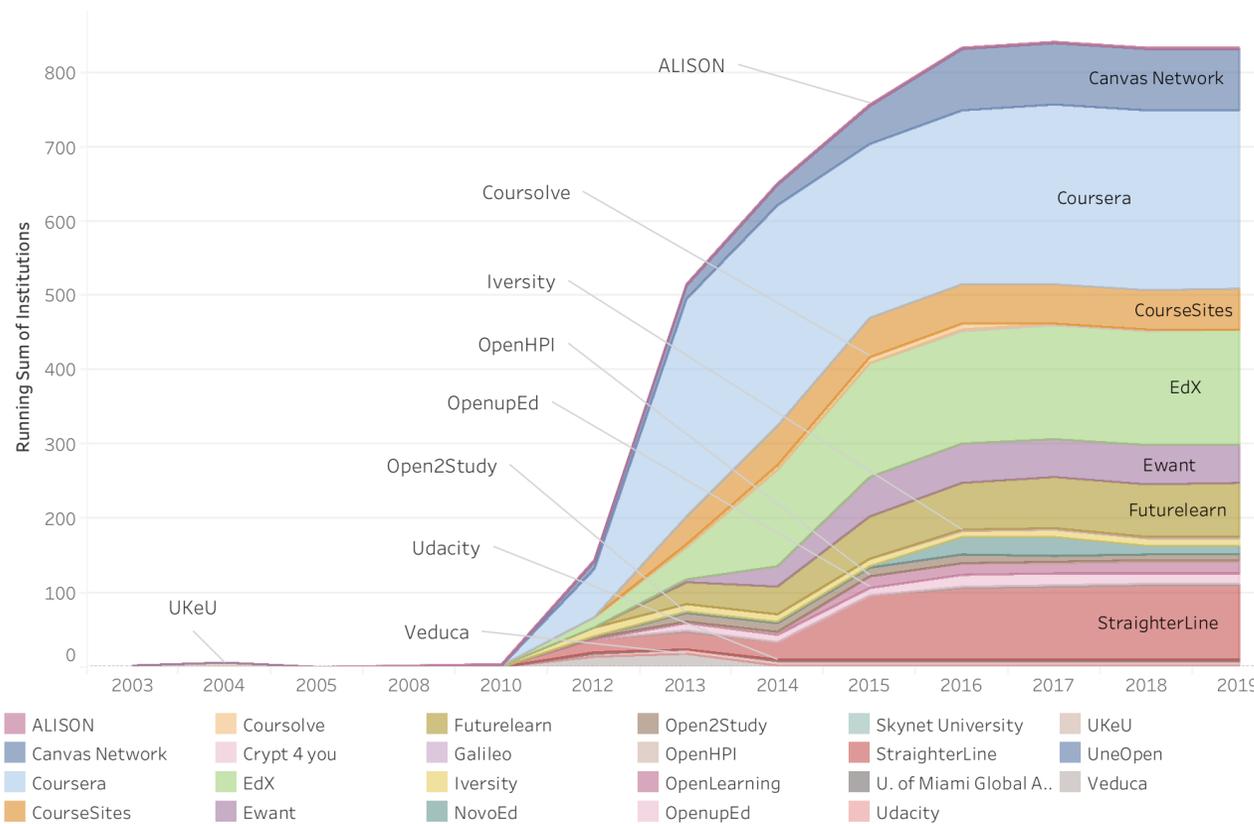
# Learning Environments – Systems Everywhere...



# Heterogeneity – Large But Highly Fragmented Market



Massive Open Online Course - MOOC; # Participating Institutions



„The LMS market size is expected to grow [...] to **\$ 22.4 billion** by 2023“ [1]  
 „The global MOOC market size is expected to grow [...] to **\$ 20.8 billion** by 2023“ [2]  
**~ \$ 43 billion by 2023**



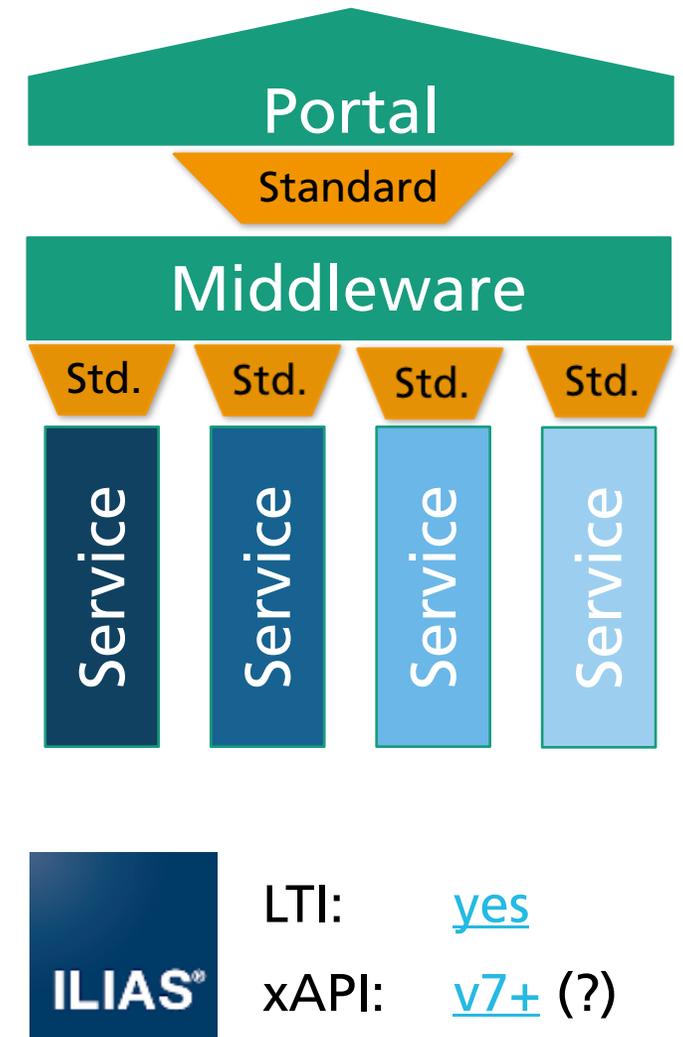
# Challenges

- LMS (e.g. ILIAS) are often part of bigger (corporate) learning environments
  - typically heterogeneous environments, i.e., different systems (ILIAS, Moodle, Edx, ...)
  - grown/established structures, overhaul is expensive
- Difficult interoperability
  - Content exchange is cumbersome (e.g. with SCORM)
  - (Learning-)Information not exchanged (e.g. progress)
  - Standards exist, but are often put in second place
- Cross-system all-in-one solutions are closed software
- How to easily integrate new/existing e-learning courses (e.g. in ILIAS) into new environments?
- What is an open and sustainable software architecture?



# Solution Approach

- The idea is to unite different teaching/learning technologies in a common infrastructure
- Use of established (e-learning) standards to achieve interoperability, e.g.
  - *Learning Tools Interoperability* (LTI) for system interlinking
  - *Experience API* (xAPI) for usage tracking and Learning Analytics
- Web-based portal for single-sign-on
- Open architecture, standard communication (HTTPs REST)
- Installation in cloud or locally



# AGENDA

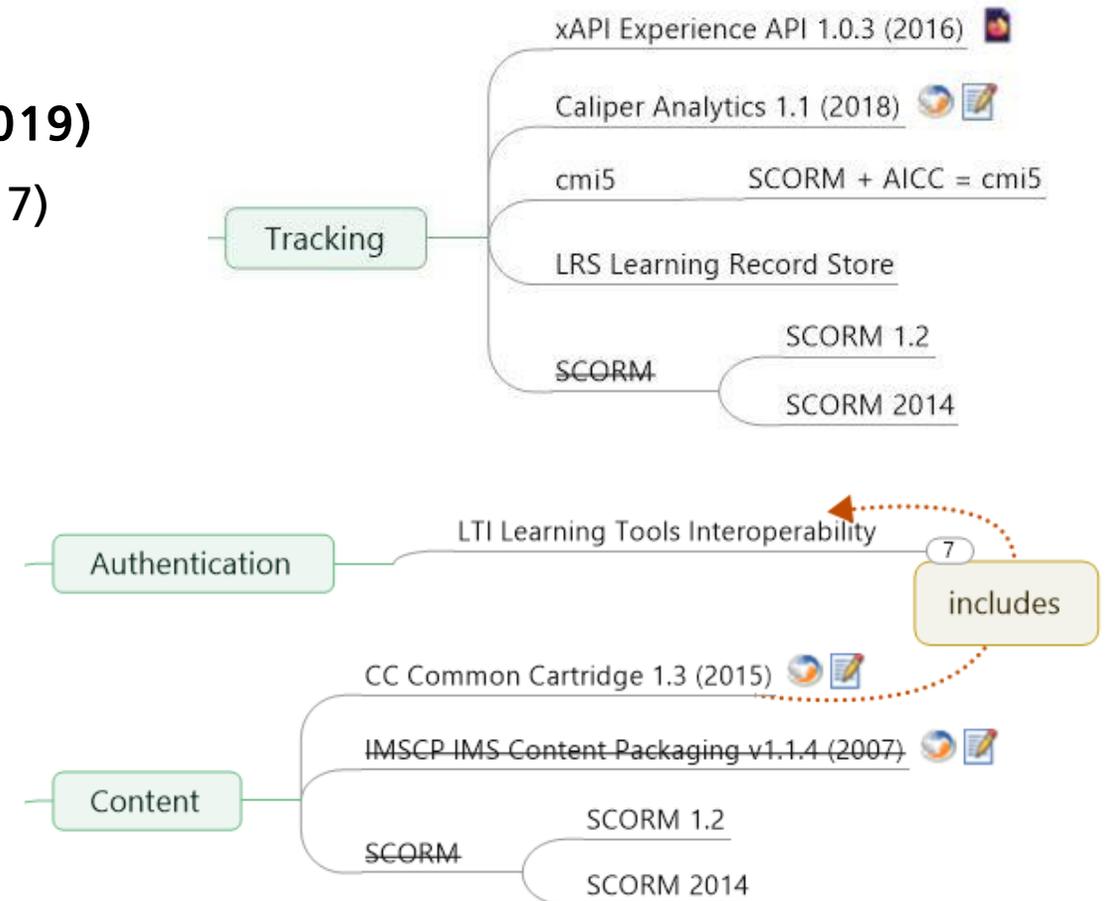
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# Notable E-Learning Interoperability Standards

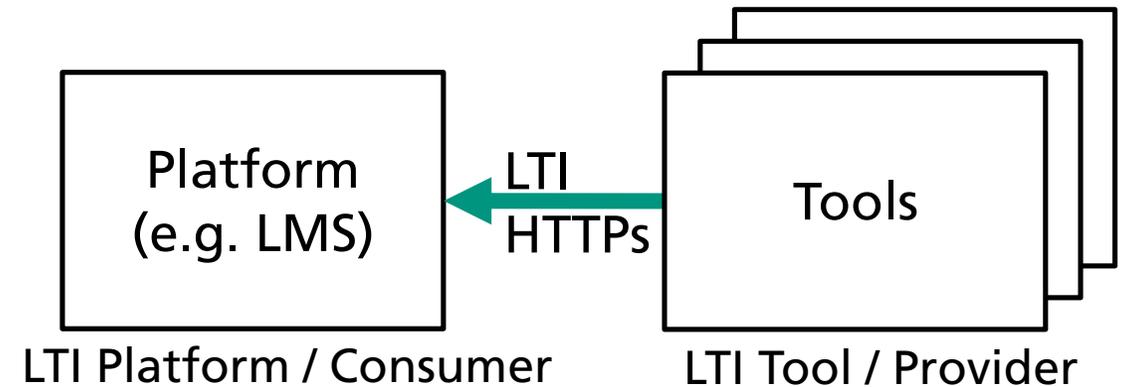
(subjective)

- ADL **xAPI** – Experience API 1.0.3 (2016)
- IMS **LTI** – Learning Tools Interoperability 1.3 (2019)
- IMS **QTI** – Question & Test Interoperability 2.2.2 (2017)
- IMS **CC** – Common Cartridge 1.3 (2015)
- IEEE **LOM** – Learning Object Meta-data (2002)
- W3C Activity Streams 2.0 (2017)
- IMS Caliper Analytics 1.2 (2018)
- IMS OBv2 Open Badges 2.0 (2018)
- ~~SCORM 2004~~
- ...



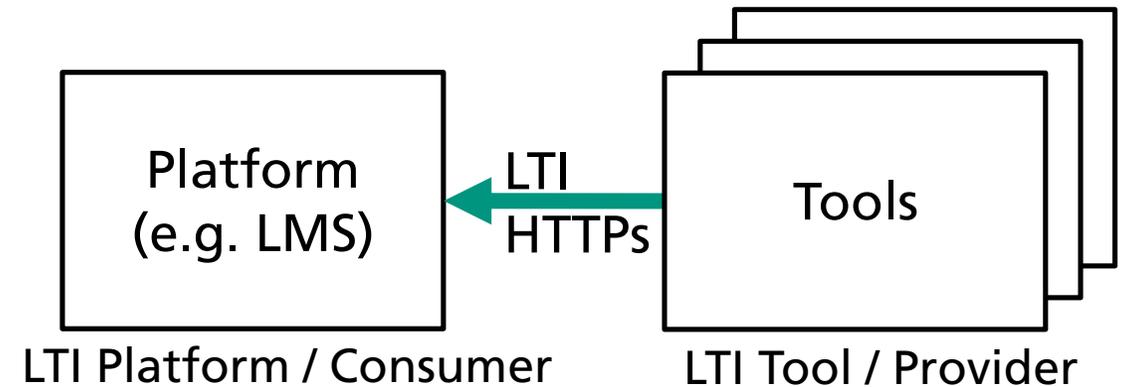
# Don't Export & Import Content – Interlink Systems!

- IMS Learning Tools Interoperability (LTI) [1]
- Since 2010, newest version is v1.3 (05/2019)  
(no more LTI 2.0)
- HTTPs interlinking of LMS (or other LTI tools)
- Primarily authentication
- Direct access to external content  
(deep linking)
- Exchange of user and course metadata



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- ILIAS can be tool and platform
  - For platform install *External Content plugin*  
<https://github.com/ilifau/ExternalContent>



```
{  
  "lti_message_type": "basic-lti-launch-request",  
  "lti_version": "LTI-1p0",  
  "resource_link_id": "resourceLinkId",  
  "oauth_consumer_key": "jisc.ac.uk",  
  "oauth_nonce": "MTU2ODg5Mjg5MQ==",  
  "oauth_signature_method": "HMAC-SHA1",  
  "oauth_timestamp": 1568892811,  
  "oauth_version": "1.0",  
  "oauth_signature": "Ajv0iphovLls8xmwhQPU="
```

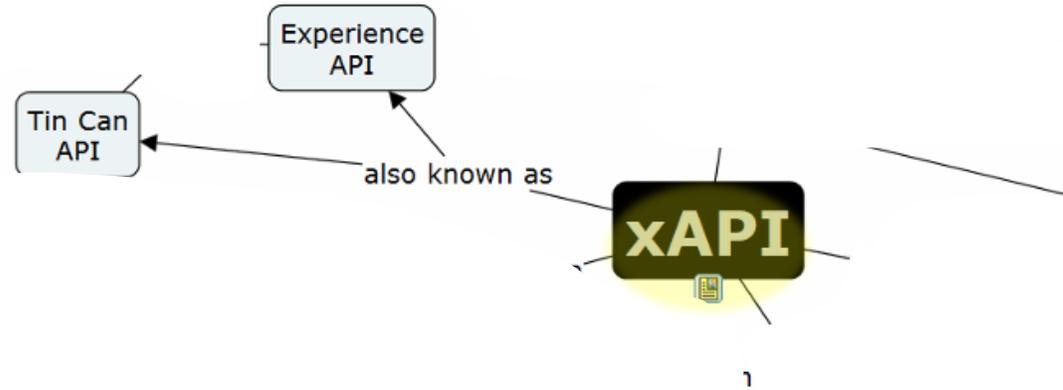
# Inter-System Experiential Data Tracking & Exchange – xAPI

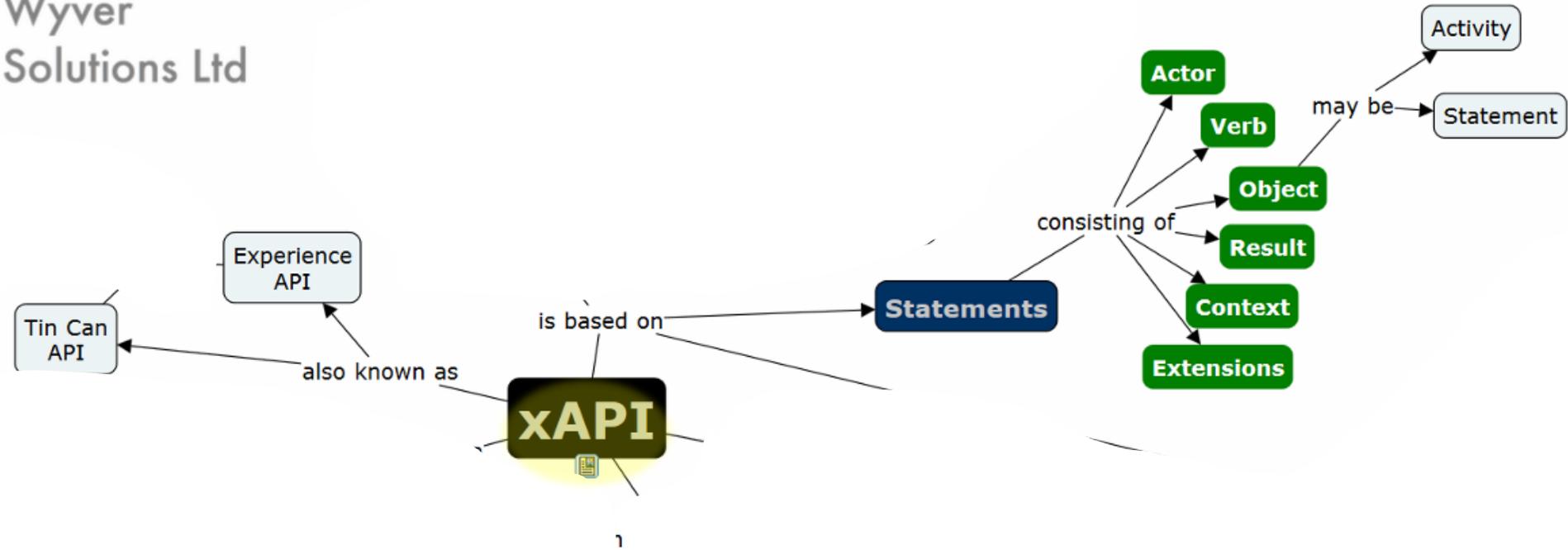
- *ADL Experience API – xAPI* [1]
- Since 2010, formerly TinCanAPI, newest v1.0.3 (2016)
- Related to W3C Activity Streams
  
- xAPI Statements = Triples
- **Actor** – **Verb** – **Object / Activity**
  
- Storage in Learning Record Stores
- Most LMS support it
- Easy to implement (JSON, HTTPs),  
but take care to follow specification and conventions,  
i.e., vocabularies/registries

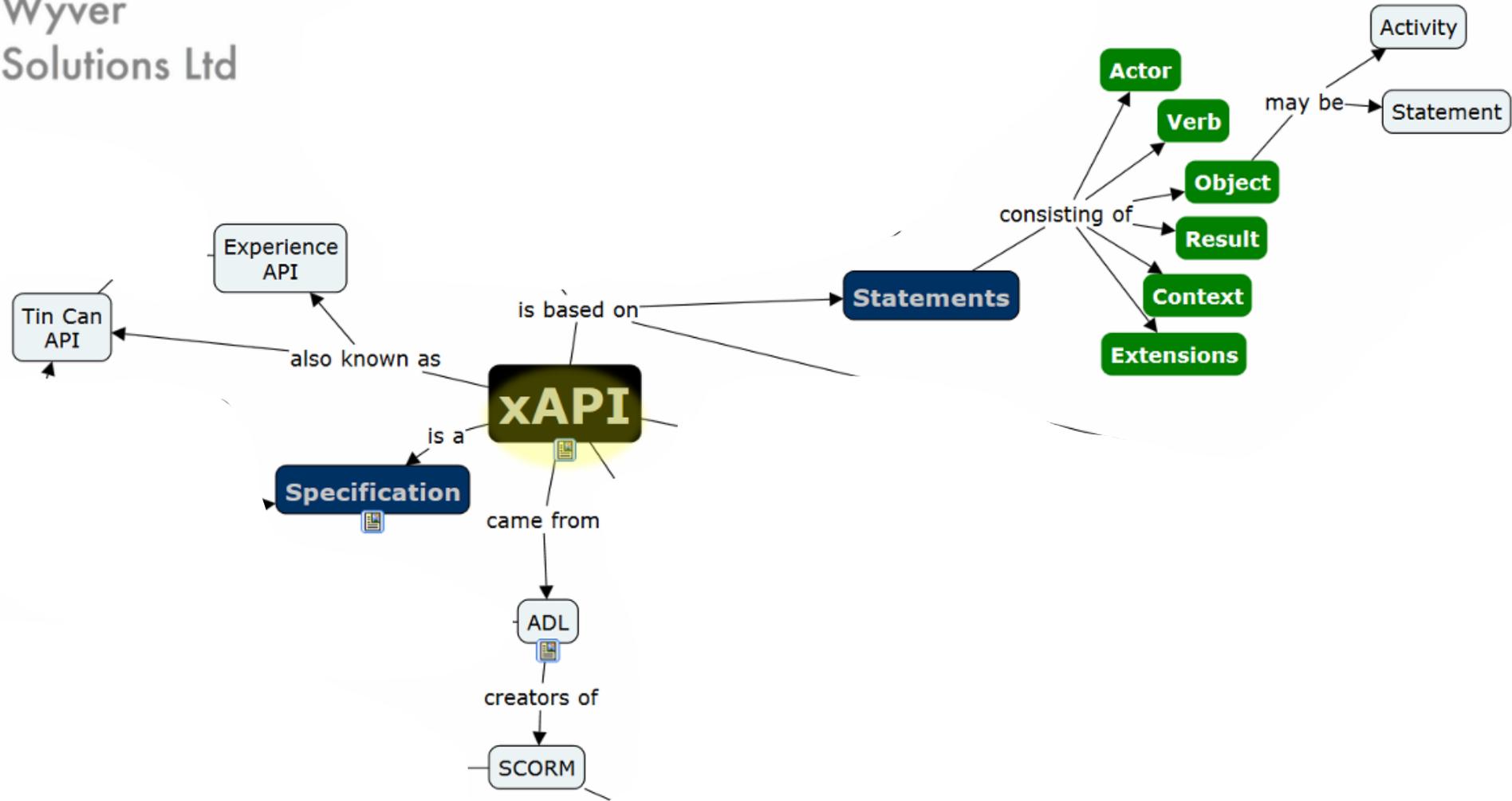
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```
{
  "actor":{
    "name":"Max Mustermann",
    "mbox":"mailto:max.mustermann@example.com"
  },
  "verb":{
    "id":"http://adlnet.gov/expapi/verbs/experienced",
    "display":{
      "en-US":"experienced"
    }
  },
  "object":{
    "id":"http://example.com/activities/solo-hang-gliding",
    "definition":{
      "name":{
        "en-US":"Solo Hang Gliding"
      }
    }
  }
}
```







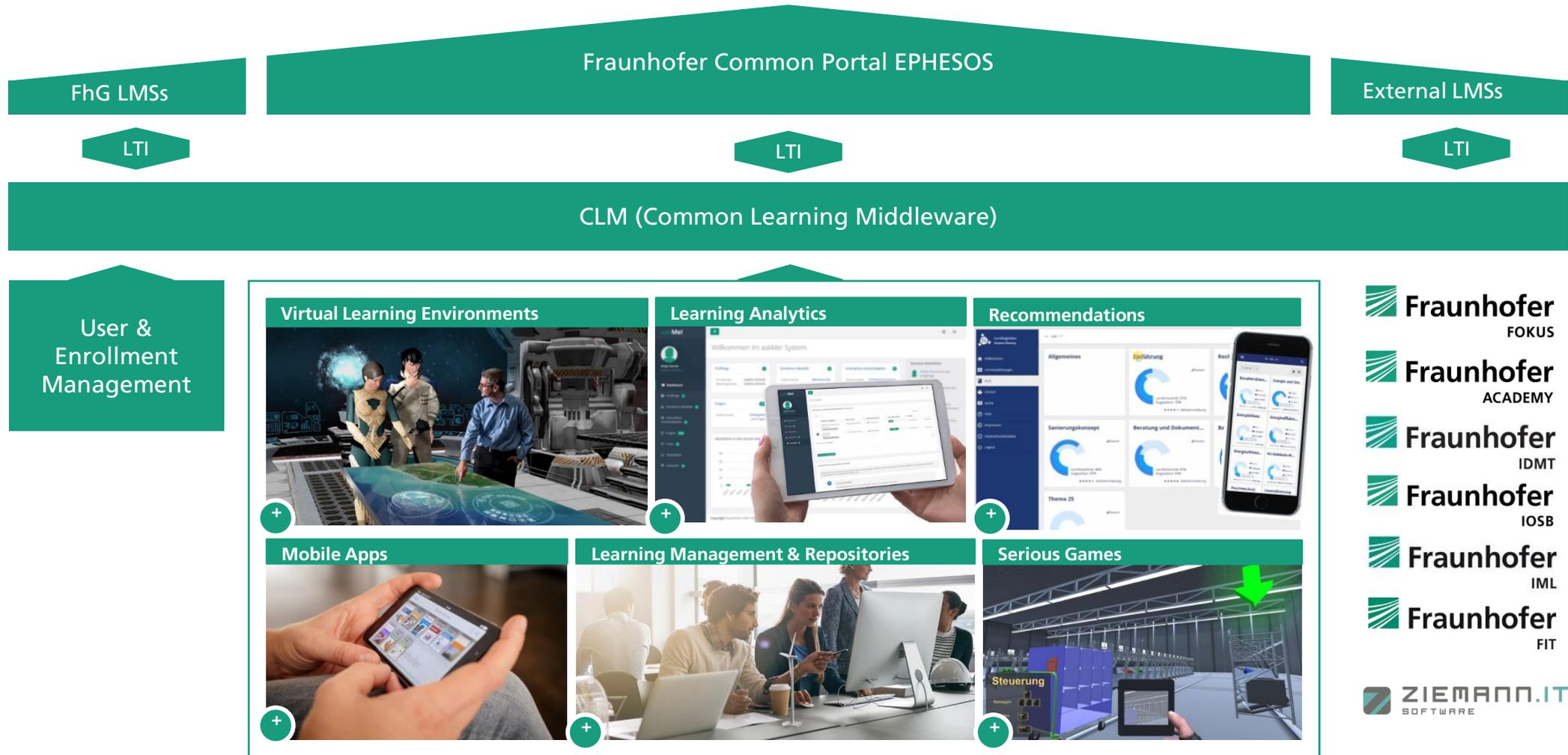


# AGENDA

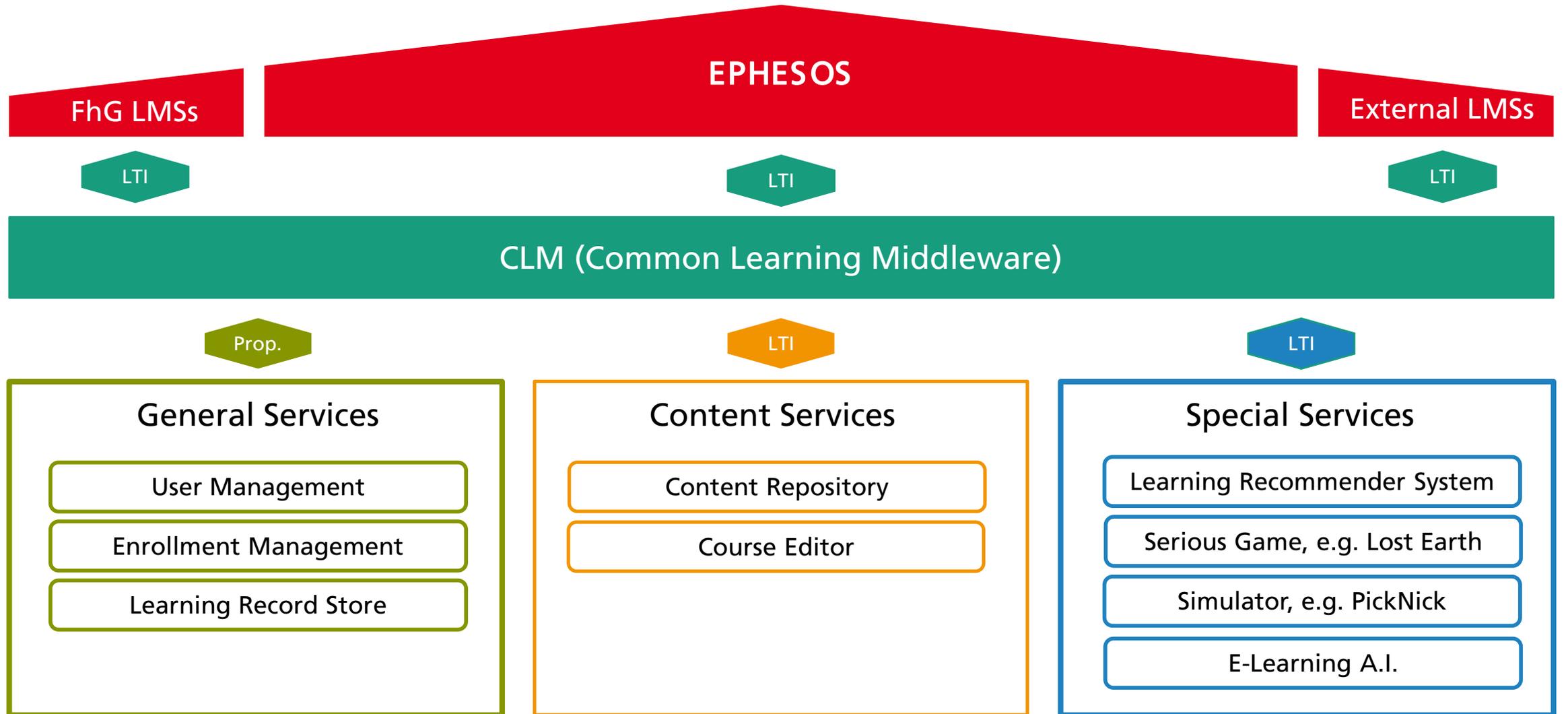
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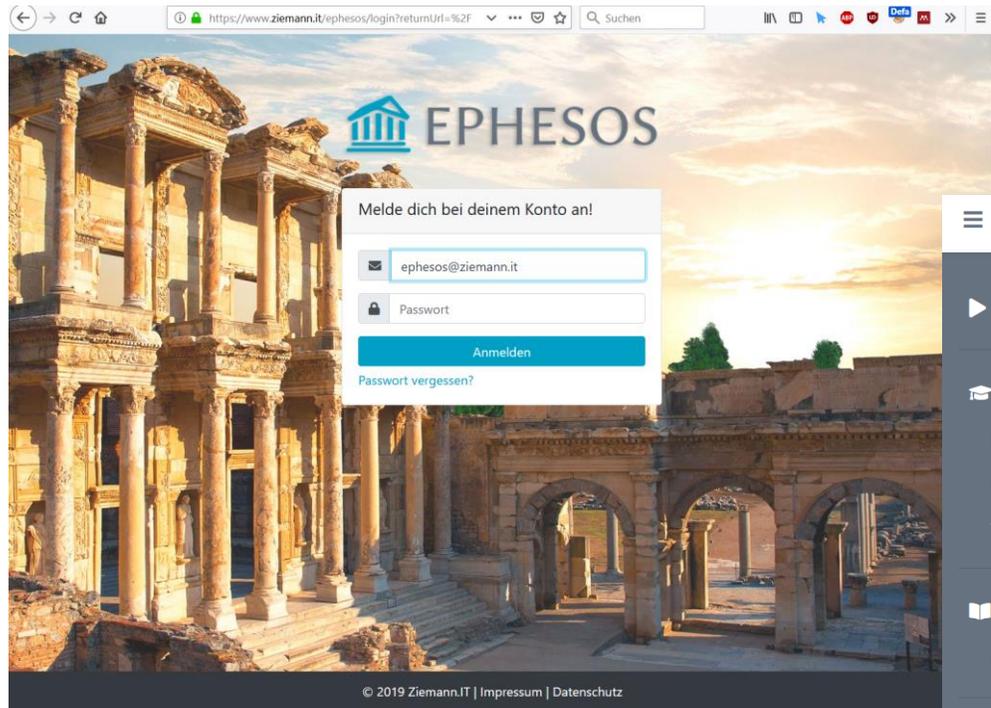
# Fraunhofer Common Learning Middleware (CLM)



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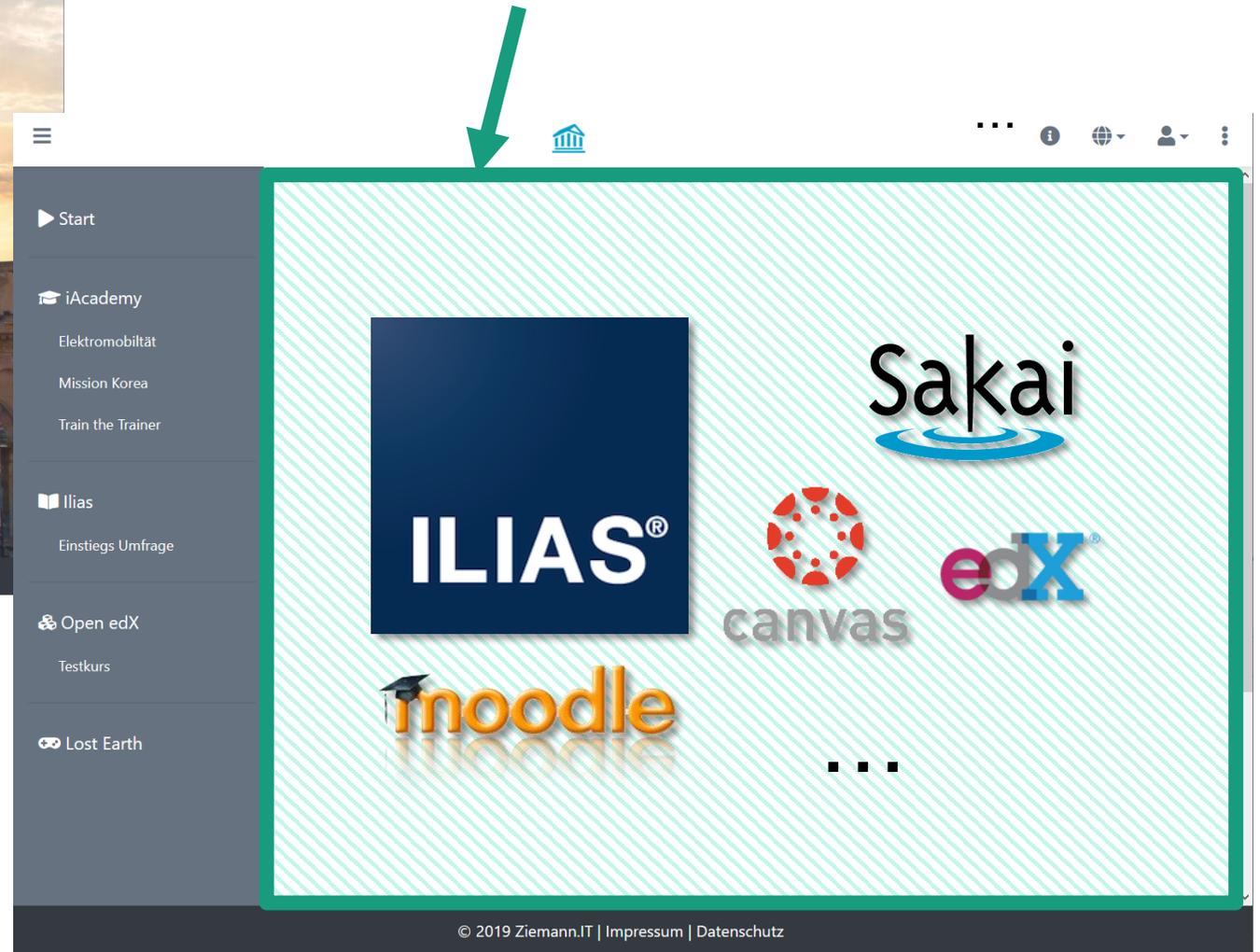
# CLM Portal and LMS Integrations



CLM Portal EPHEOS

CLM Web-View

## LTI Tools Embedding



# Realized E-Learning Courses with CLM and ILIAS

## (1) Data Science

EPHEOS

Prof. Dr. Adrian Paschke

Video

0:49 / 1:19

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## (2) Cyber Security

EPHEOS

Bibliothek Hochschule Mittweida : Schutz vor Social Engineering

Fraunhofer Academy 150 HOCHSCHULE MITTWEIDA UNIVERSITY OF APPLIED SCIENCES

SCHUTZ VOR SOCIAL ENGINEERING

WIE SICHER SIND MEINE DATEN?

START

Was ist Social Engineering und wieso betrifft es Sie? Wie und mit welchen Werkzeugen leiten Human Hacker personenspezifische Daten aus sozialen Netzwerken ab? Welche Angriffsmöglichkeiten gibt es und wie kann man sich davor schützen? Auf all diese Fragen finden Sie in diesem Kurs Antworten. Der Kurs richtet sich gezielt an Personen, im polizeilichen Dienst und der polizeilichen Ausbildung.

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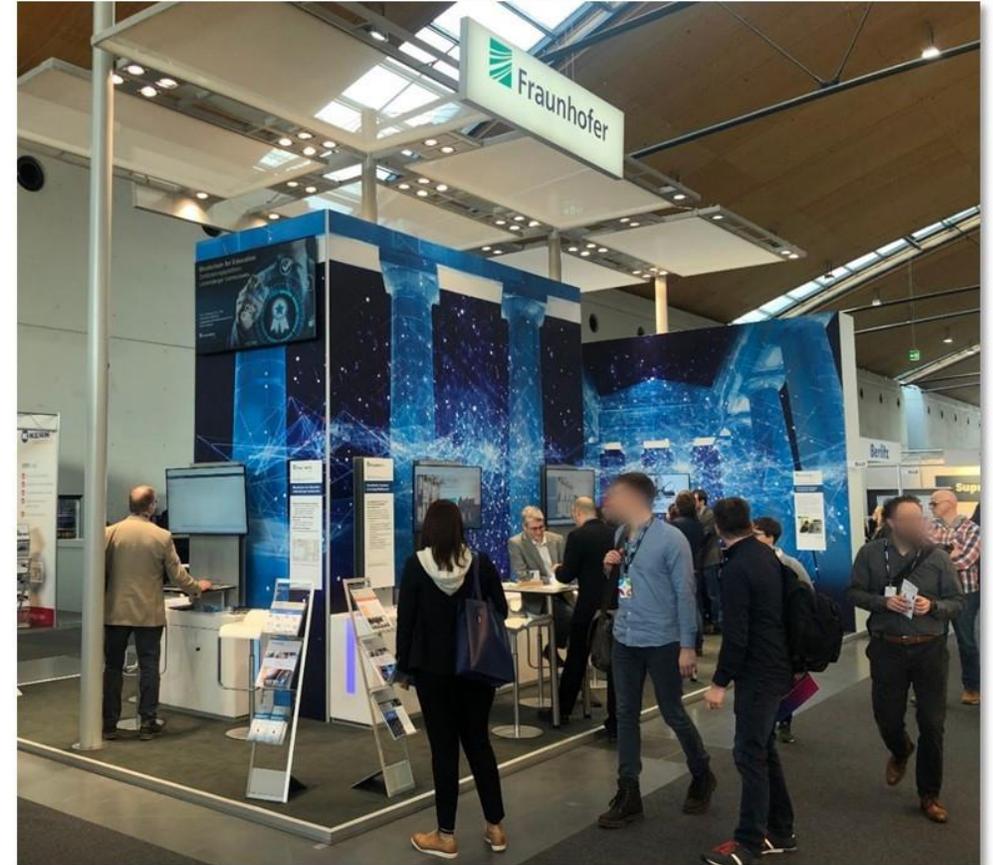


# Conclusion & Outlook

- Common Learning Middleware (CLM) to interconnect ILIAS, Moodle, Edx, etc. for decentralized learning environments
- CLM integrates tested tools and technologies masquerading complexity
- Working applications include Fraunhofer Academy E-Learning courses using ILIAS

## Outlook:

- Research on automatic interlinking and search engines
- Development of tools for data privacy, course management, activity management



CLM+ILIAS Demonstration at LEARNTEC 2020, Karlsruhe

# Thanks!

CLM Web-Page:

<http://s.fhg.de/fhgclm>



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