



Caliper Analytics[®]

e-Learning Korea 2018

Markus Gylling
Solutions Architect | Head, IMS Europe
mgylling@imglobal.org

This session

1. Introduction to IMS Global
2. Caliper Overview & Status
3. Caliper Architecture
4. Caliper Future & Next Steps

1. Introduction to IMS Global

- **Non-profit, member-based** collaborative with a mission to improve the learning experience for students, teachers and administrators

A world map showing the global distribution of members. Numerous colored dots (orange, blue, and white) are plotted across the map, with a high concentration in North America and Europe. A grey circular callout in the upper left quadrant contains the text '450+' and '++'.

450+
++

MEMBERS
AND GROWING

Suppliers, higher education institutions, K-12 school districts, states, and government organizations.

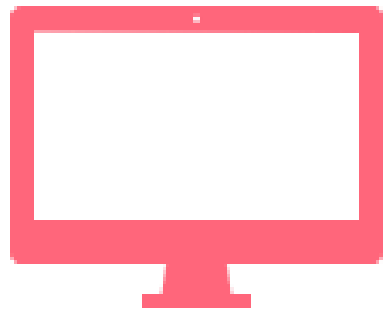
COLLABORATION



149 HED and K-12
institutions



16 government/state
education agencies

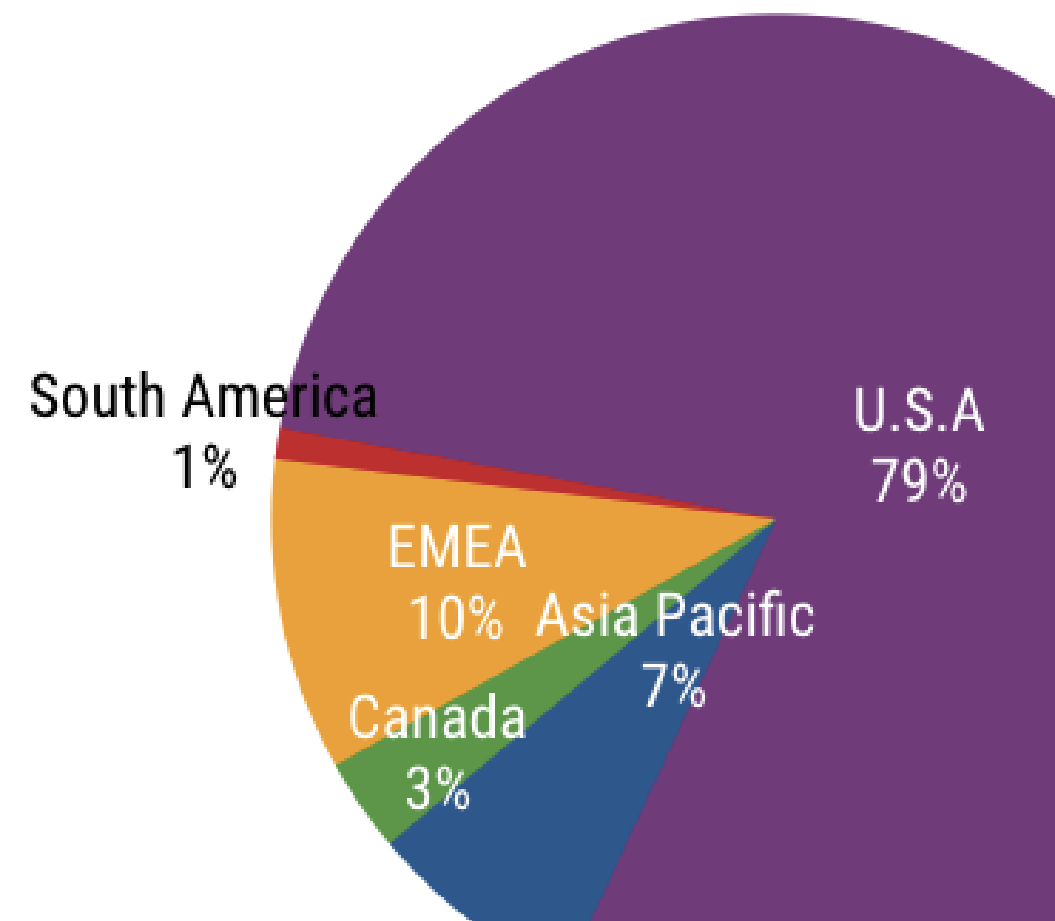


277 edtech suppliers



Members in **22** different
countries

IMS Members by Region



INITIATIVES



**DIGITAL
MICRO-
CREDENTIALS**



**LEARNING DATA
&
ANALYTICS**



**INTEGRATED
ASSESSMENT**

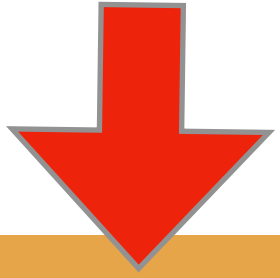


**LEARNING
PLATFORMS,
APPS & TOOLS**



**ADAPTIVE
DIGITAL
CURRICULUM**

INITIATIVES



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MICRO-
CREDENTIALS**



**LEARNING DATA
&
ANALYTICS**



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ASSESSMENT**

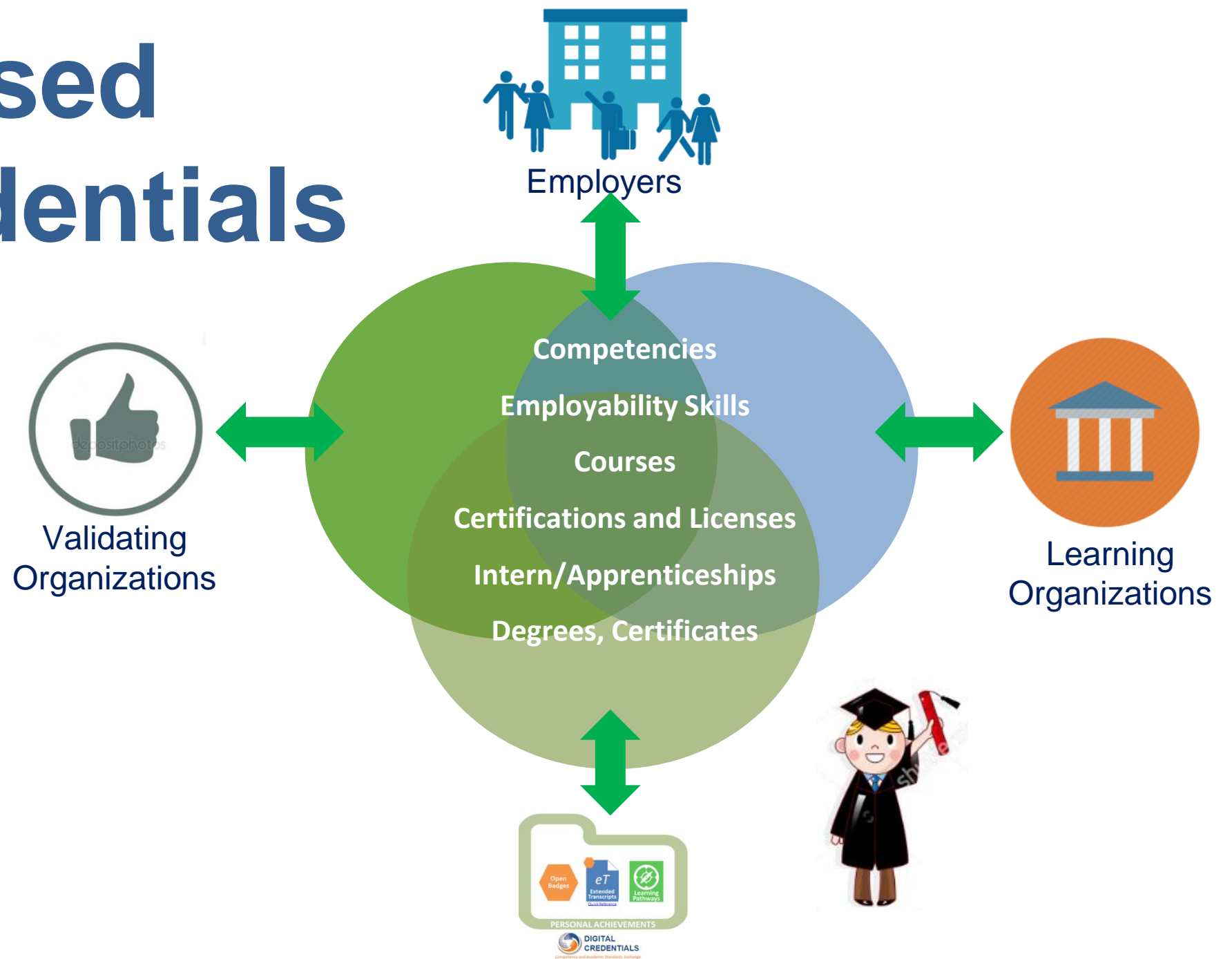


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PLATFORMS,
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CURRICULUM**

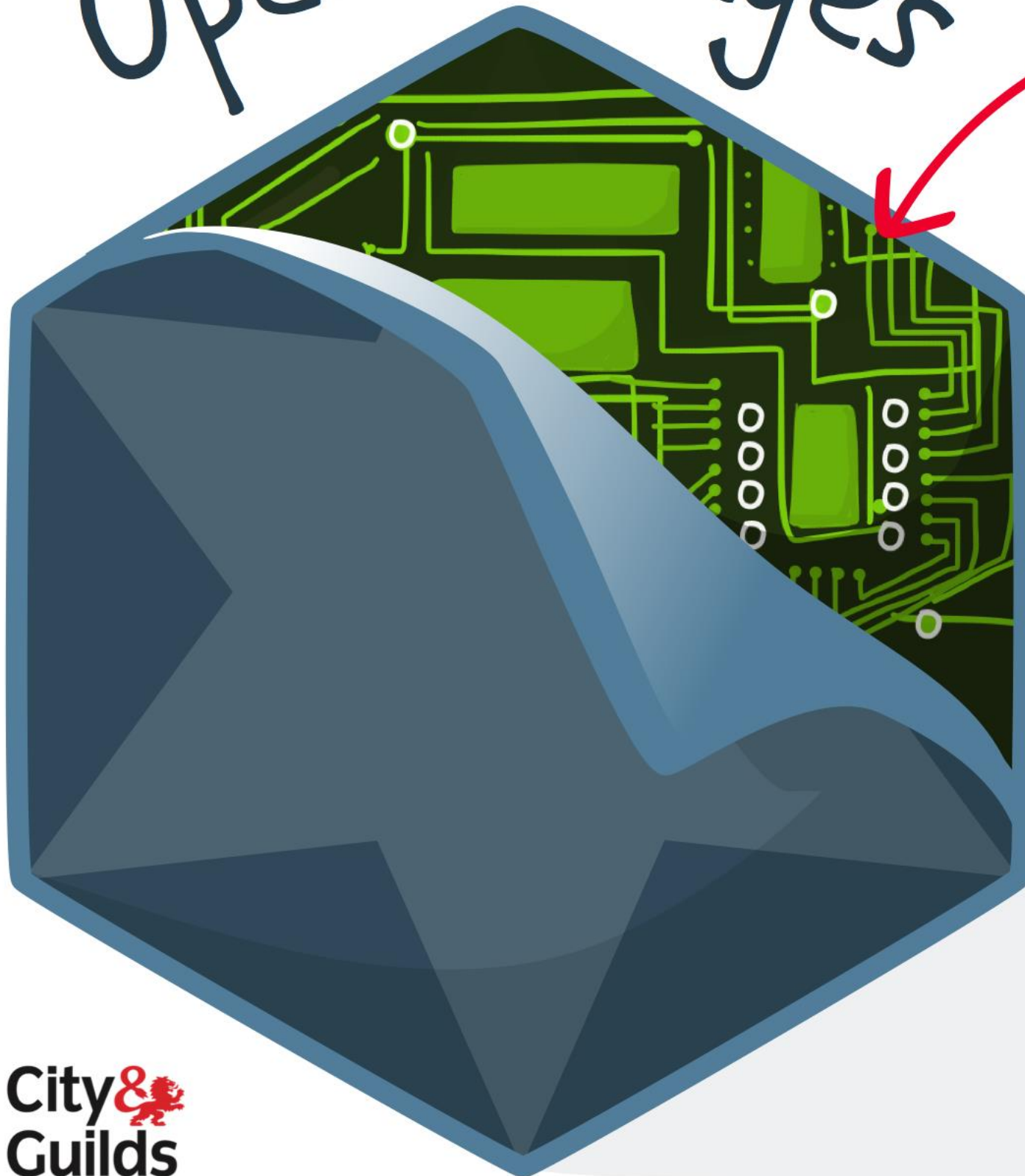
A Skills-Based Digital Credentials Ecosystem



IMS GLOBAL[®]
Learning Consortium
Better Learning From Better Learning Technology[®]

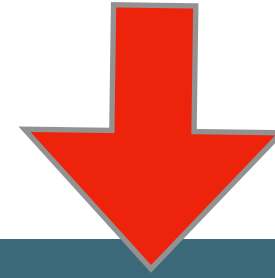
Open Badges

**THERE'S
DATA INSIDE!**



```
badge name  
badge URL (description)  
badge criteria  
badge image  
issuer  
issue date  
recipient  
tags  
alignment (standards)  
expiration date  
evidence URL
```

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**LEARNING DATA
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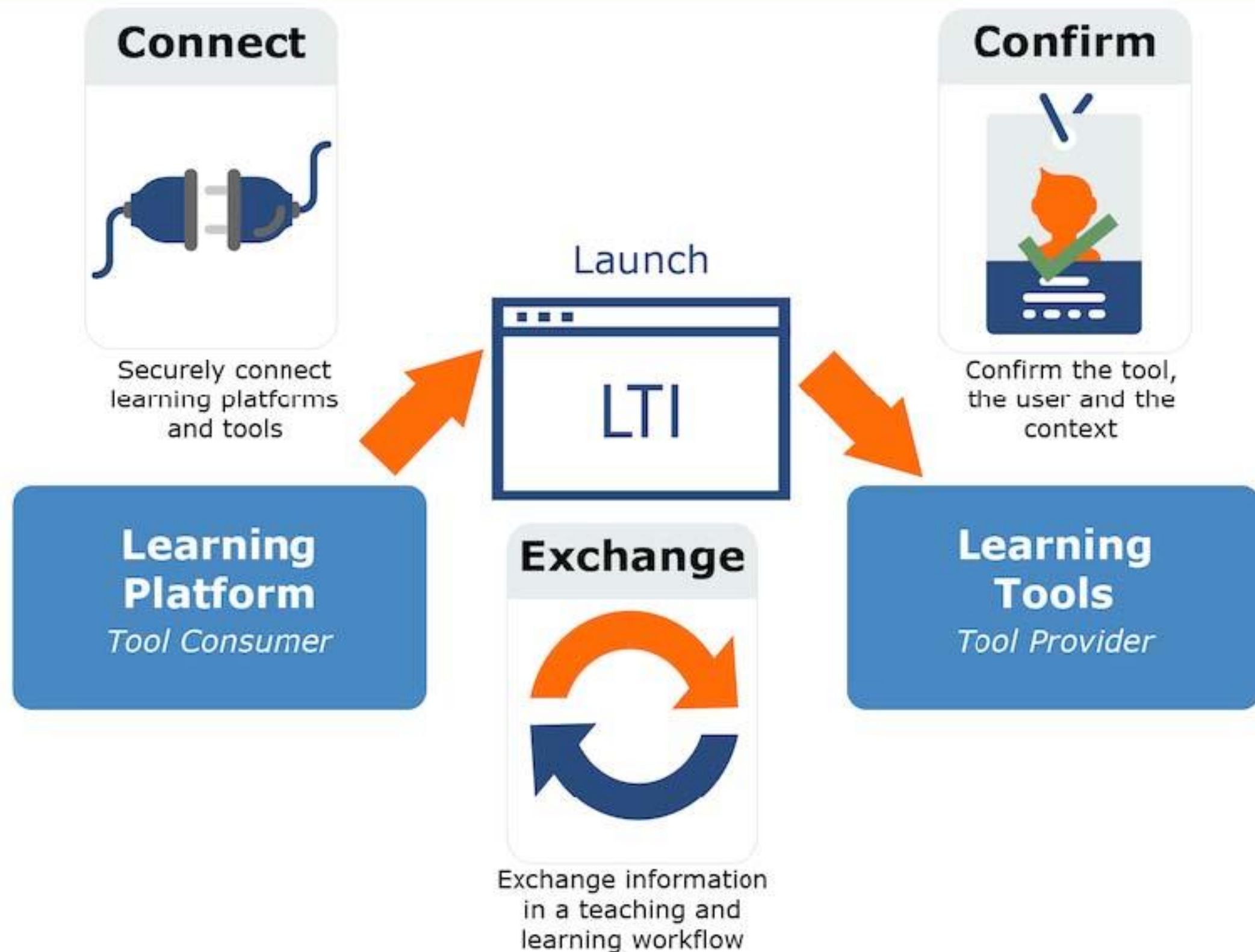


**LEARNING
PLATFORMS,
APPS & TOOLS**



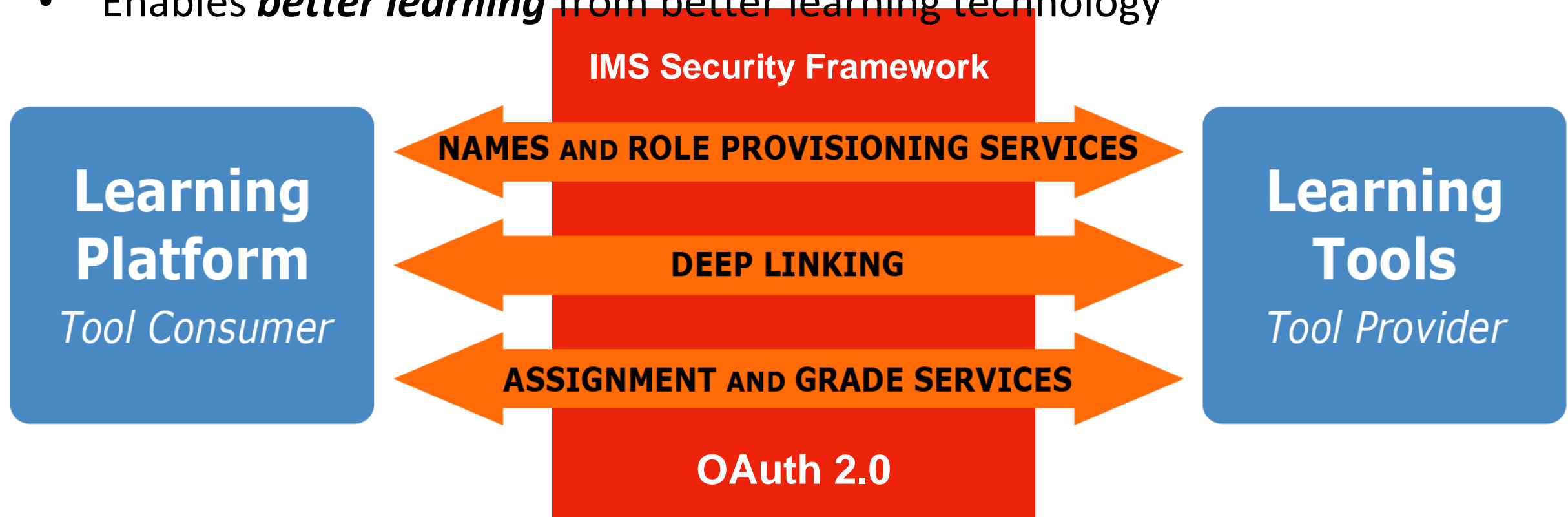
**ADAPTIVE
DIGITAL
CURRICULUM**

Essential Features of Learning Tools Interoperability® (LTI®)

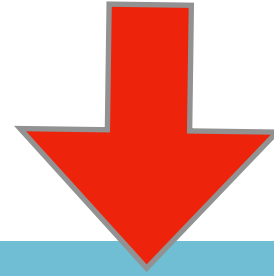


Next Generation Integrations at the Speed of Now

- LTI Advantage builds on LTI v1.3 to enable ***better and more secure integrations***
- Creates ***better user experiences***
- Enables ***better learning*** from better learning technology



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**LEARNING DATA
&
ANALYTICS**



**INTEGRATED
ASSESSMENT**



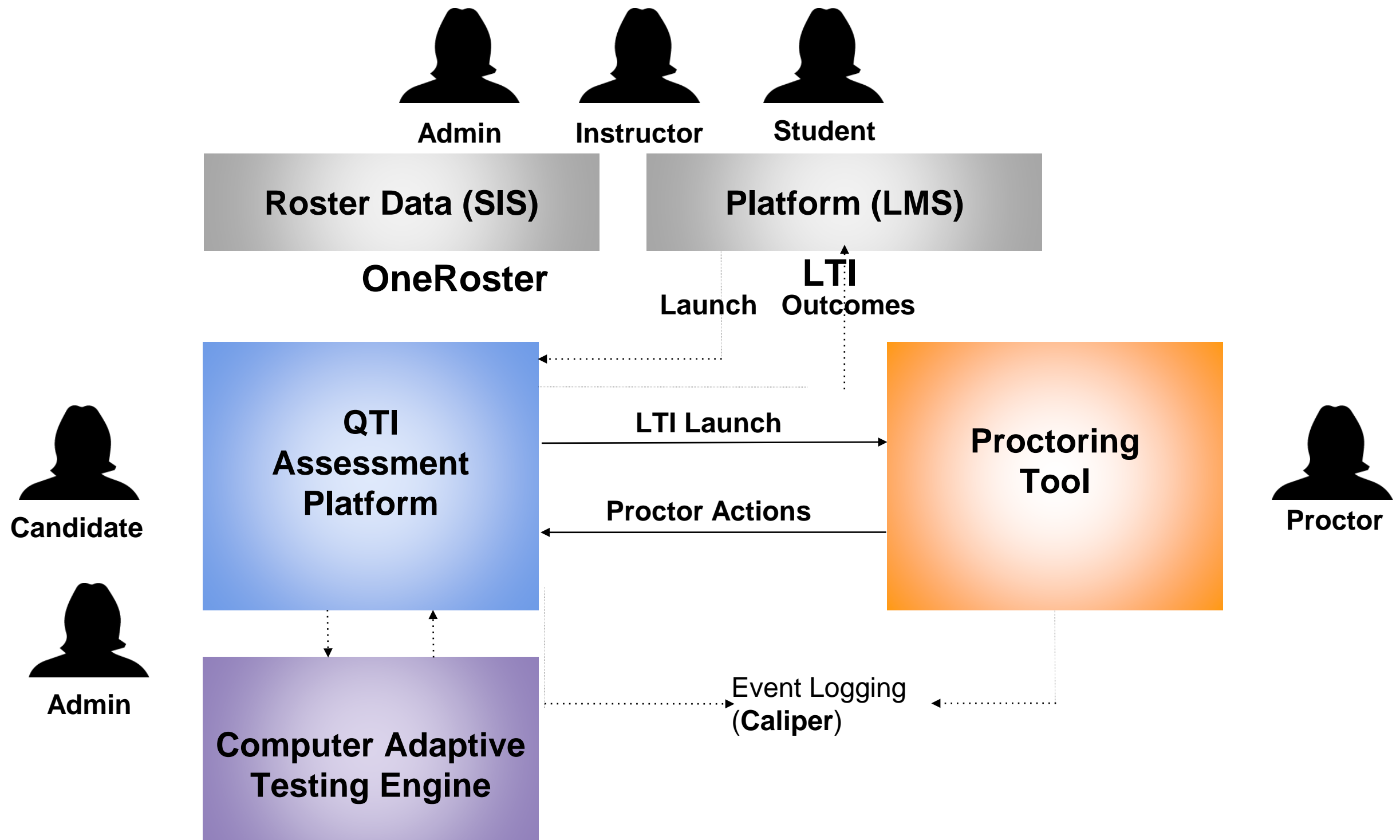
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PLATFORMS,
APPS & TOOLS**



**ADAPTIVE
DIGITAL
CURRICULUM**

QTI Benefits

- **Universal Design** – accessibility and accommodations for all students
- **Open Format** – ability to port test items between vendor platforms
- **Diagnostic, Formative and Summative** – applicable to all forms of assessment (paper and online)
- **Device Independent** – assessments can be delivered across a variety of devices, operating systems, and browsers
- **Ecosystem** – alignment with other edtech standards



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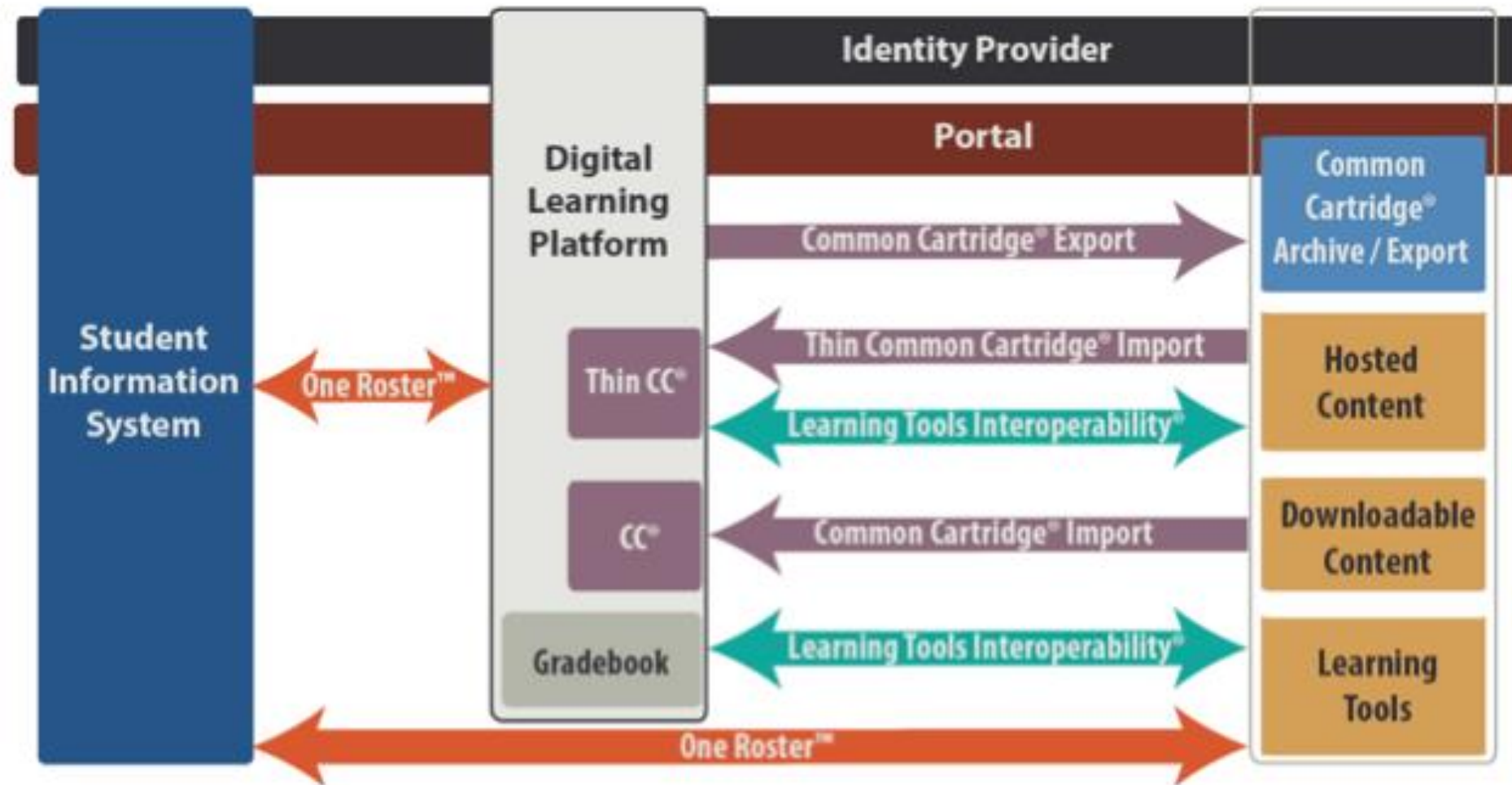


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PLATFORMS,
APPS & TOOLS**



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OneRoster & Common Cartridge



| | Technical Work | Technical Focus |
|---|--|--|
|  | Accessibility | Accessibility, inclusive design, and personalization of online learning resources to meet the needs of all users/learners |
|  | App Sharing & Integration Protocol | Peer-to-peer educational app sharing catalogs and storefronts |
|  | Caliper Analytics | Consistently capturing and presenting measures of learning activity and defining a common language for labeling learning data, with a standard way of measuring learning activities and effectiveness enabling designers and providers of curriculum to measure, compare and improve quality |
|  | Common Cartridge | Organization, publishing, distribution, delivery, and search of a wide variety of collections of digital learning content, applications used as the basis for or in support of online learning of any type. |
|  | Digital Credentialing | Development of "eT," an extended transcript description protocol, and based programs and creation of a Credentialing Library Framework (CLF) |
|  | EDUPUB | Establishing a globally interoperable, accessible, open ecosystem for e-Textbooks and other Digital Learning Materials via EPUB3, Educational Sector Standards and the Open Web Platform |
|  | Learning Tools Interoperability | Integrating rich learning applications (often remotely hosted and provided through third-party services) with platforms like learning management systems, portals, learning object repositories, or other educational environments. |
|  | OneRoster and Learning Information Services | Exchange and synchronization of roster information and grades which focuses on people, memberships, courses and outcomes. |
|  | OpenVideo | Creation of video capture metadata to enable information from any video to be shared and searched |
|  | Privacy and Security | Development of a Privacy Service which will carry privacy preferences across systems and tools |
|  | Question and Test Interoperability/Accessible Portable Item Protocol | Exchange of item, test and results data between authoring tools, item banks, test construction tools, learning systems and assessment delivery systems, including accessible assessments. |

IMS Technical Activities

see <http://www.imsglobal.org/developers>

Towards an interoperable ecosystem: modus operandi

- Technical Specifications
- Best Practices & Guidelines
- Code Libraries / Reference Implementations
- *Certification & Product Directory*

IMS Standards

☐ Common Cartridge

☐ LTI

☐ IWBCFF

☐ LIS

☐ QTI/APIP

☐ Caliper Analytics

☒ OneRoster

☐ OneRoster v1 Certified

☐ OneRoster v1.1 Certified

☐ CASE

☐ OpenBadges

Product Category

Audience



D2L™

D2L Corporation

Product:

Brightspace By D2L V10.7.3

OneRoster V1.1 CSV
Rostering Import Bulk,

canvas
BY INSTRUCTURE

Instructure

Product:

Canvas V2017.7.11
OneRoster V1.1 REST
Data Consumer
Rostering Core

ClassLink

ClassLink, Inc.

Product:

Classlink OneClick V2016.7.28
OneRoster V1.0 REST
Data Consumer,

ClassLink

ClassLink, Inc.

Product:

ClassLink OneRoster V3.24.2017

OneRoster V1.0 CSV
Export Bulk Only,

Classworks

Classworks

Product:

Classworks V3.2017
OneRoster V1.1 CSV
Rostering Import Bulk

Clever

Clever

Product:

Clever V2017.07.06
OneRoster V1.1 CSV
Resources Export
Bulk

Clever

Clever

Product:

Clever V2016.9.16
OneRoster V1.0 CSV
Import Bulk Only,
OneRoster V1.0 REST

Authentica
SOLUTIONS

Authentica Solutions

Product:

DataSense
Integration PaaS And
Education Data

EASOL

Learning Tapestry, Inc.

Product:

EASOL Ed-Fi To
OneRoster Tool 1.1
OneRoster V1.0 CSV

EasyBridge

Pearson Education

Product:

EasyBridge V4.3
OneRoster V1.0 CSV
Import Bulk Only
OneRoster V1.1 CSV

EdGraph

EdWire Inc.

Product:

EdGraph V2017.02.01
OneRoster V1.0 CSV
Export Bulk Only

SUNGARD K-12

SunGard K-12 Education

Product:

ESchool Plus V3.X
OneRoster V1.0 REST
Data Provider

ExploreLearning

ExploreLearning

Product:

ExploreLearning Gizmos
OneRoster V1.1 CSV
Rostering Import Bulk

FastBridge Learning

FastBridge Learning

Product:

FAST V07152016
OneRoster V1.0 REST
Data Consumer

gauge

Instructure

Product:

Gauge V2017.7.26
OneRoster V1.1 REST
Data Consumer
Rostering Core

Gwinnett County Public Schools

Gwinnett County Public Schools

Product:

GCPS OneRoster API V1.0.0
OneRoster V1.1 REST

Gabbart
COMMUNICATIONS

Gabbart Communications

Product:

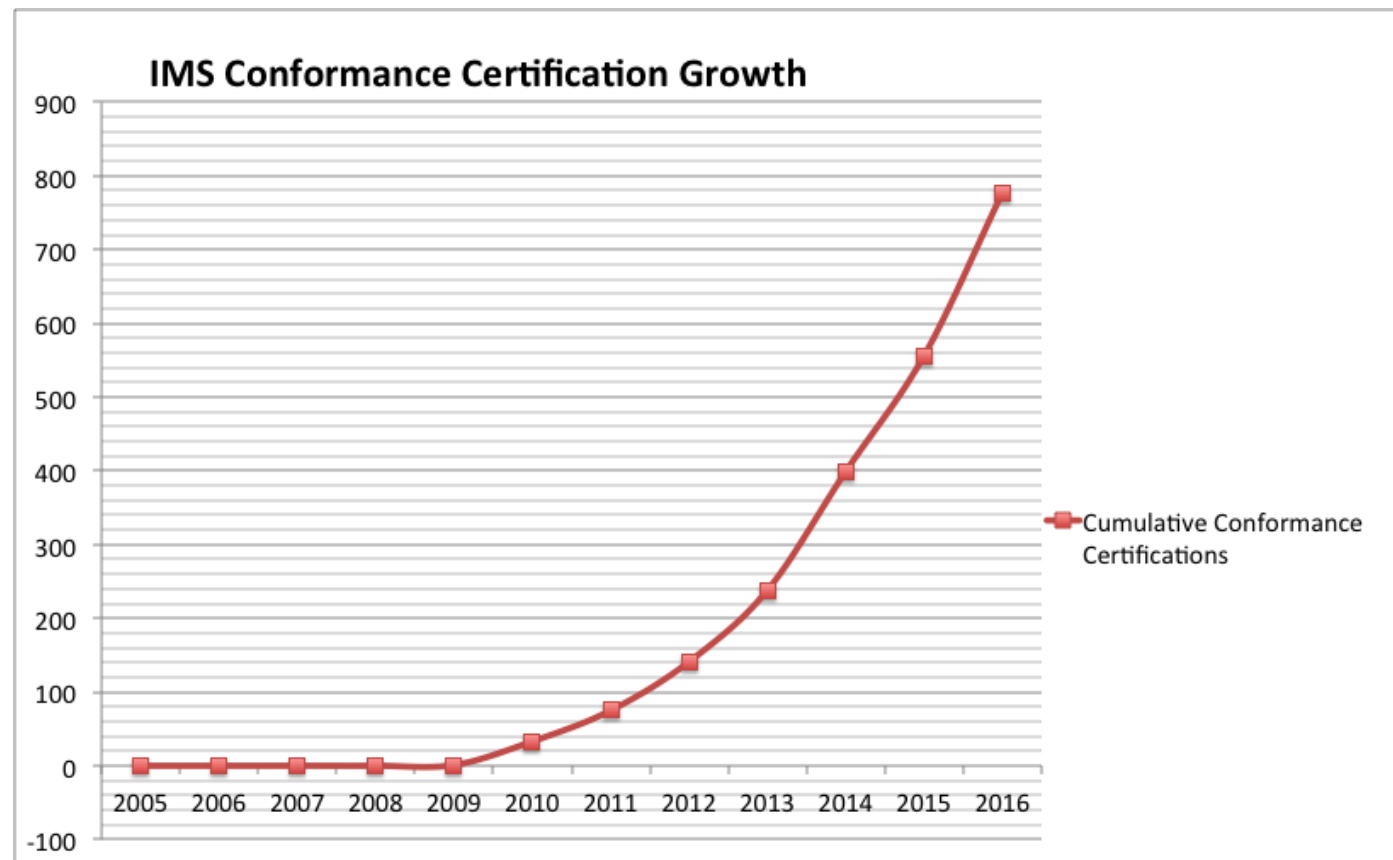
Harmony V17.8.3
OneRoster V1.0 REST
Data Consumer

HISD

Houston Independent School District

Product:

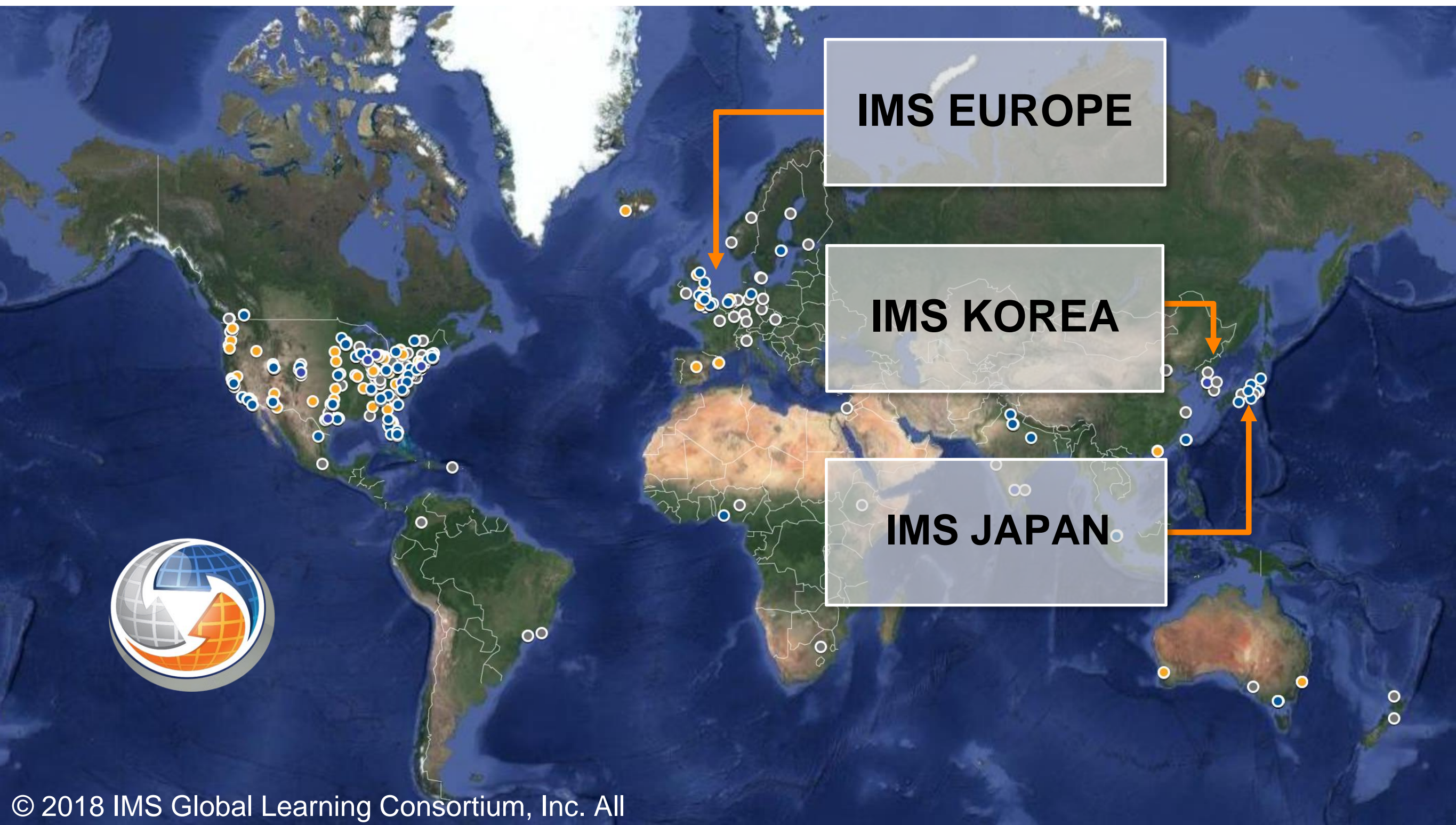
HISD Standard Roster V1.0



Adoption of certified applications/digital resources enables any application to seamlessly plug into another without requiring costly and timely custom integrations and share data to aid understanding of use of digital resources & student progress

Processes & Intellectual Property

- Formalized specification development process
 - Draft stages & TAB review approval, member vote
- IP protection policy embedded in process
- Specifications are not made available to the public until...
 - At least two interoperable implementations
 - IP review is completed



IMS EUROPE

IMS KOREA

IMS JAPAN

IMS Europe Summit November 8-9 Utrecht, Netherlands

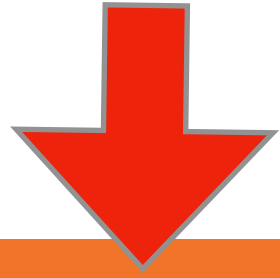
**Includes general sessions
and LTI Advantage Bootcamp**

<https://www.imsglobal.org/event/ims-europe-summit-2018>

also coming this autumn:

- **IMS Korea & Japan tech briefings**
- September: LTI Advantage Developer Toolkit
- Expansion of train-the-trainers programme

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CREDENTIALS**



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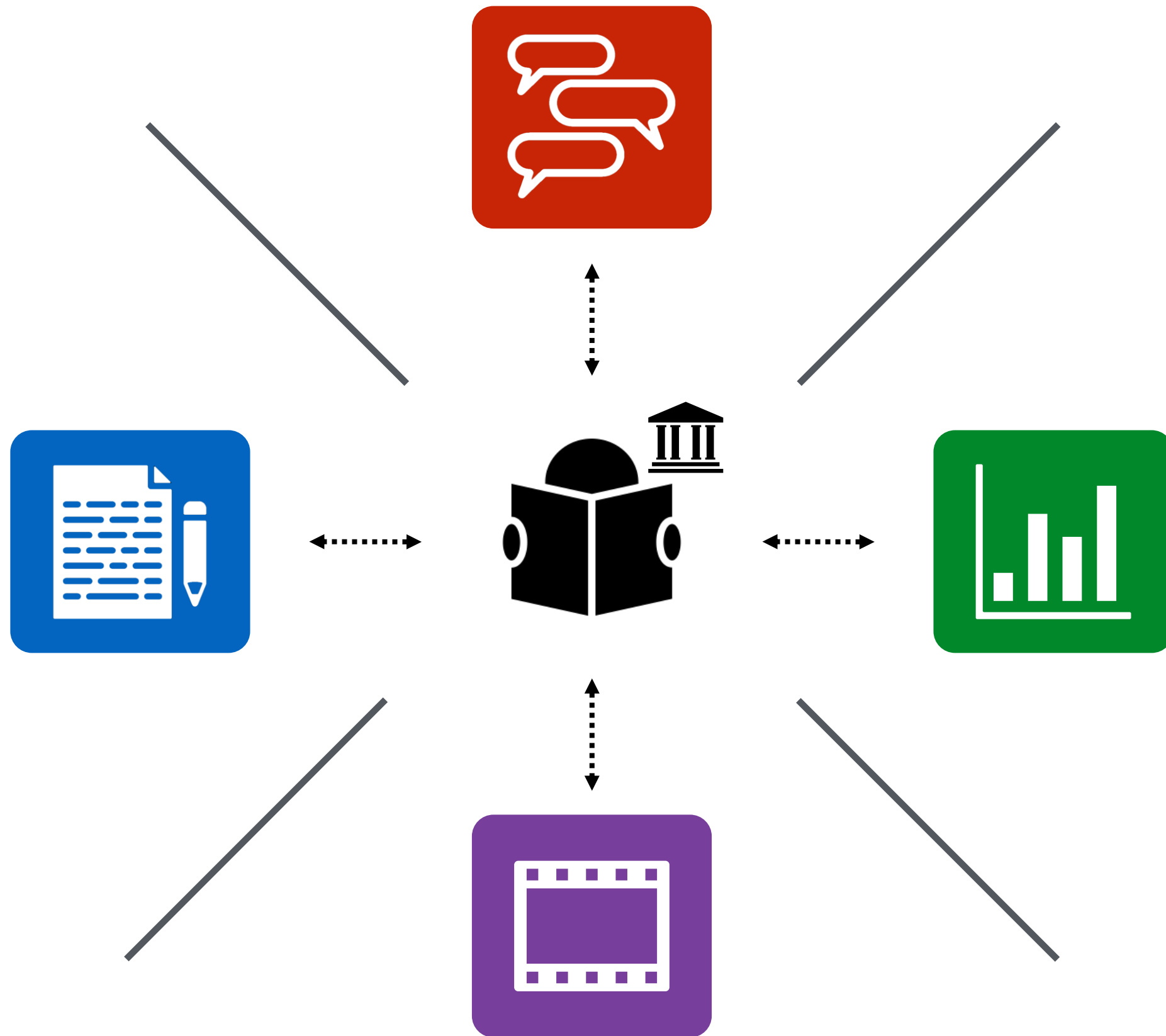
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PLATFORMS,
APPS & TOOLS**



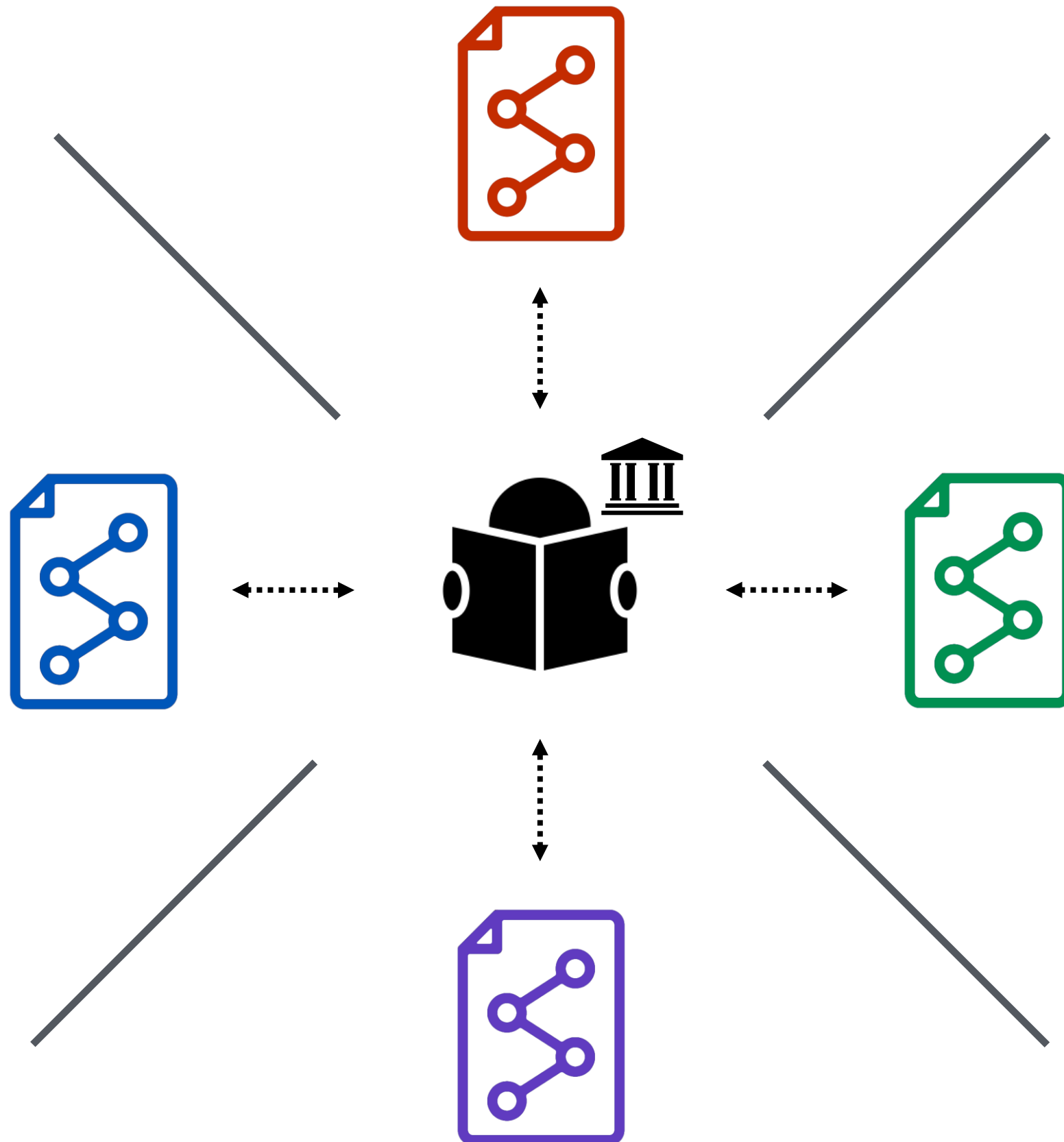
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DIGITAL
CURRICULUM**

2. Caliper Overview & Status

Challenge: a world of distributed apps



Challenge: a world of distributed data

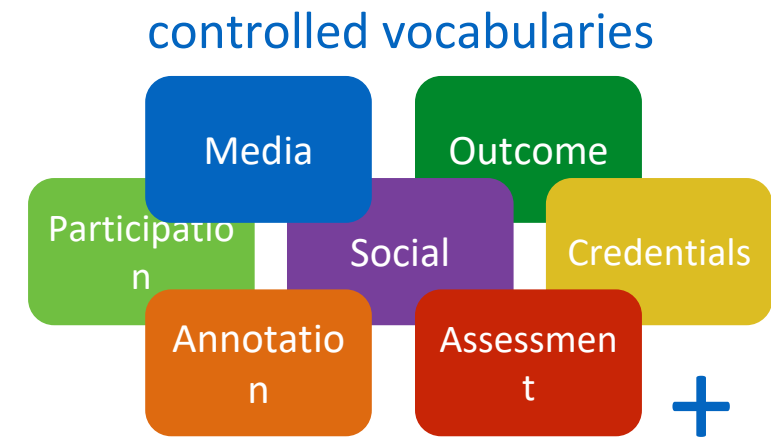


Why Caliper?

promote

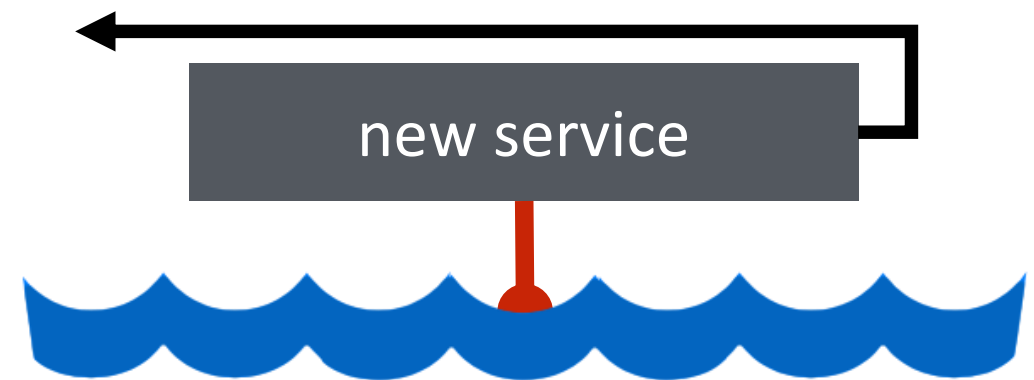
interoperability

data / semantic



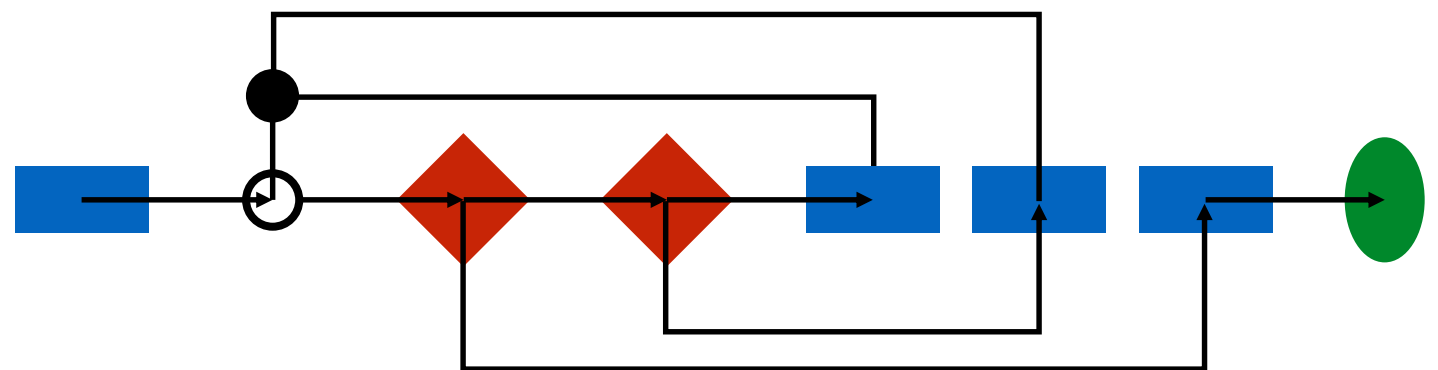
enable

innovation

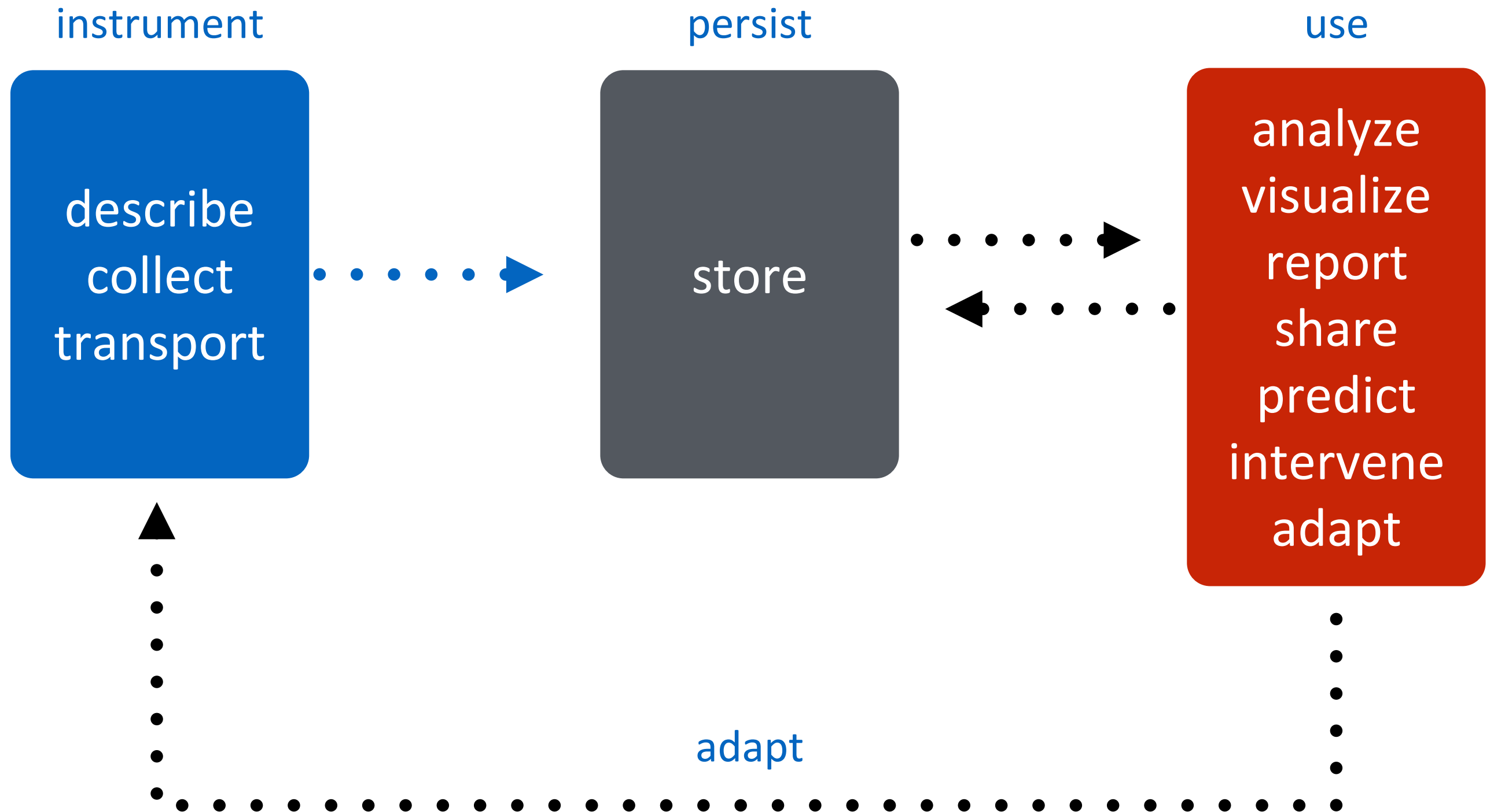


feed

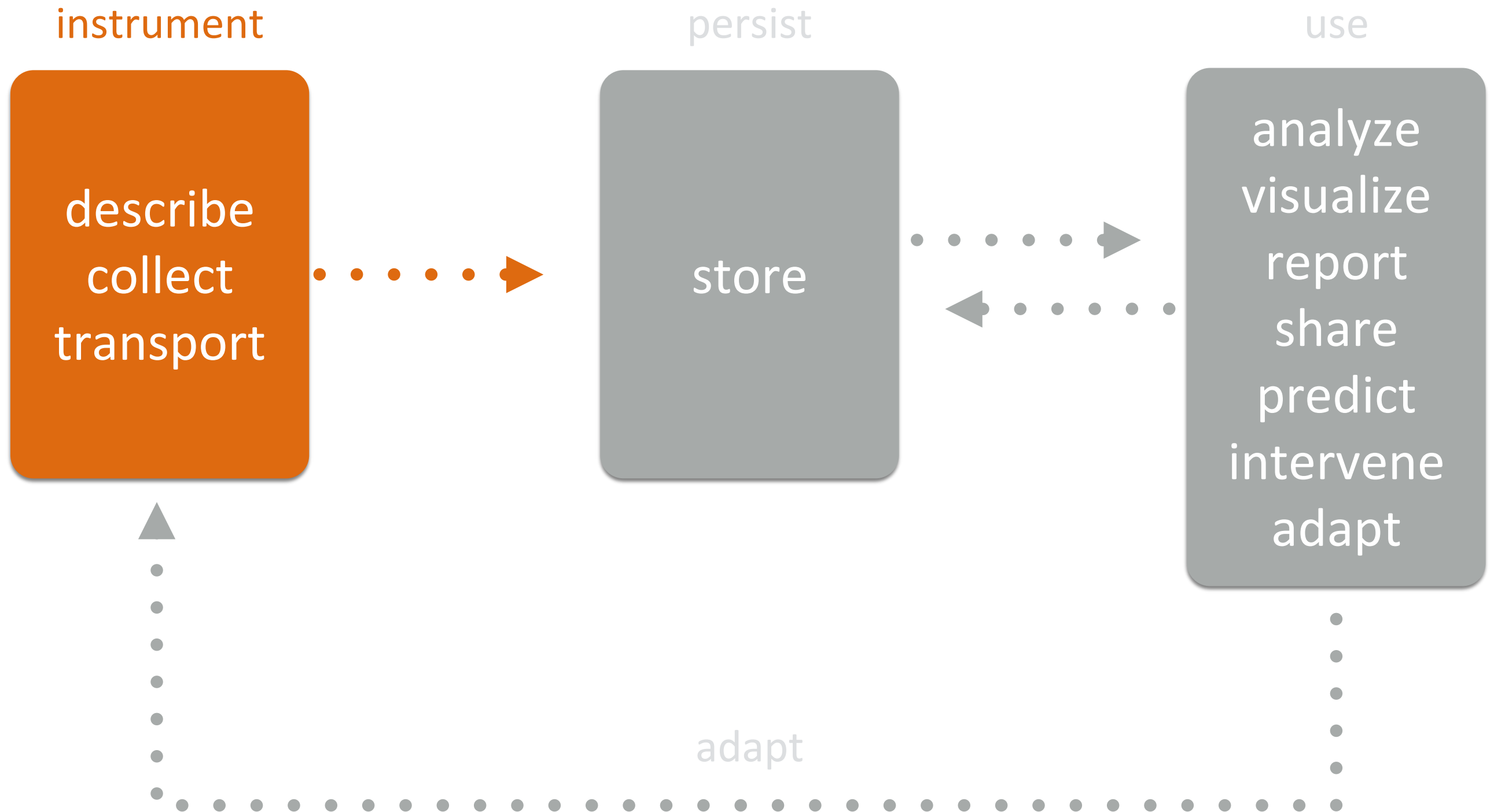
insights



Caliper 1.x scope

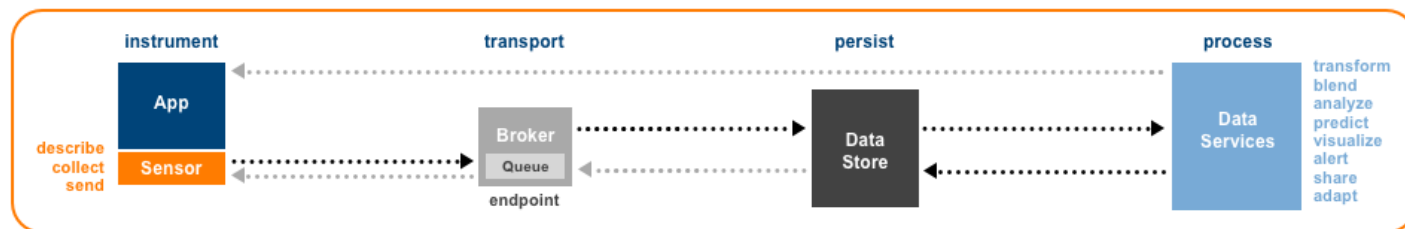


Caliper 1.x scope

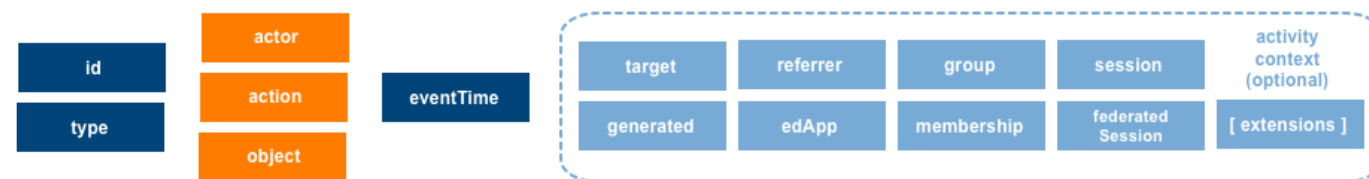


Caliper 1.1 specification

<https://github.com/IMSGlobal/caliper-spec/>

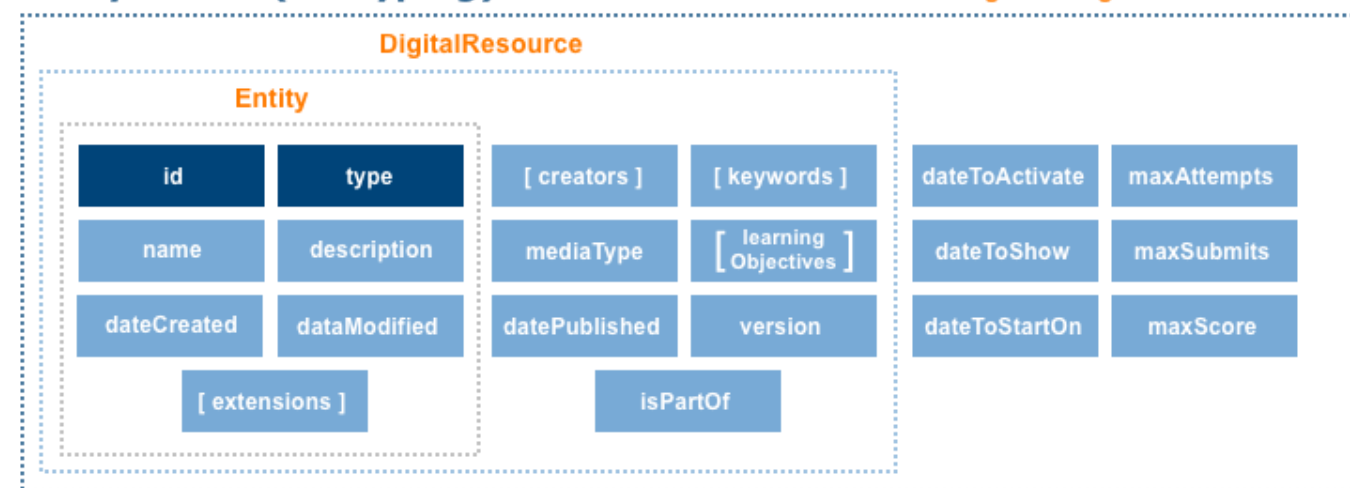


Event model

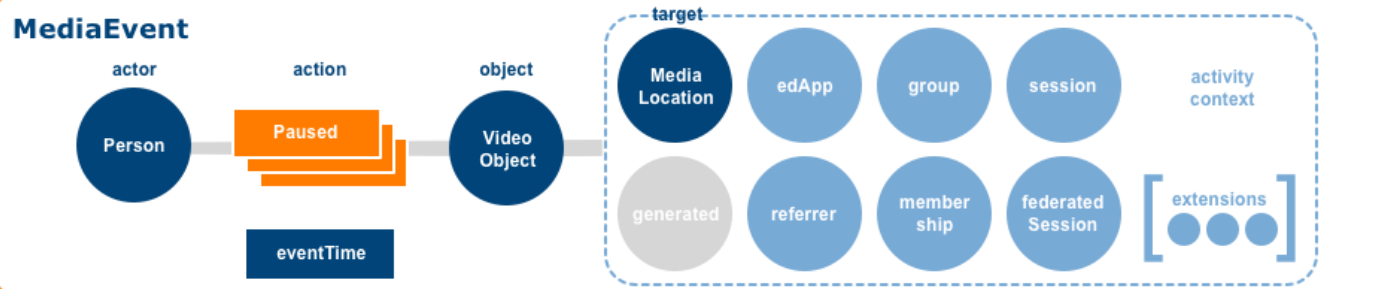


Entity model (subtyping)

AssignableDigitalResource



MediaEvent



[Code](#) [Issues 16](#) [Pull requests 1](#) [Projects 0](#) [Wiki](#) [Insights](#)

Branch: master caliper-spec / caliper-spec.md [Find file](#) [Copy path](#)

Clarify MediaEvent.target description. Resolves #241 c016364 on Jan 18

3 contributors

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IMS Global Learning Consortium, Inc.

Caliper Analytics® Specification, version 1.1

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 - 1.1 Status of this Document
 - 1.2 Summary of Changes
 - 1.3 Conventions
 - 1.4 Terminology

Caliper 1.1 certification

<https://github.com/IMSGlobal/caliper-cert-guide/>



[Code](#) [Issues 1](#) [Pull requests 1](#) [Projects 0](#) [Wiki](#) [Insights](#)

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 arwhyte Fix Caliper spec reference link. 08533f4 on Jan 19

1 contributor

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Learning Consortium

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Caliper Analytics® Sensor Certification Guide, version 1.1

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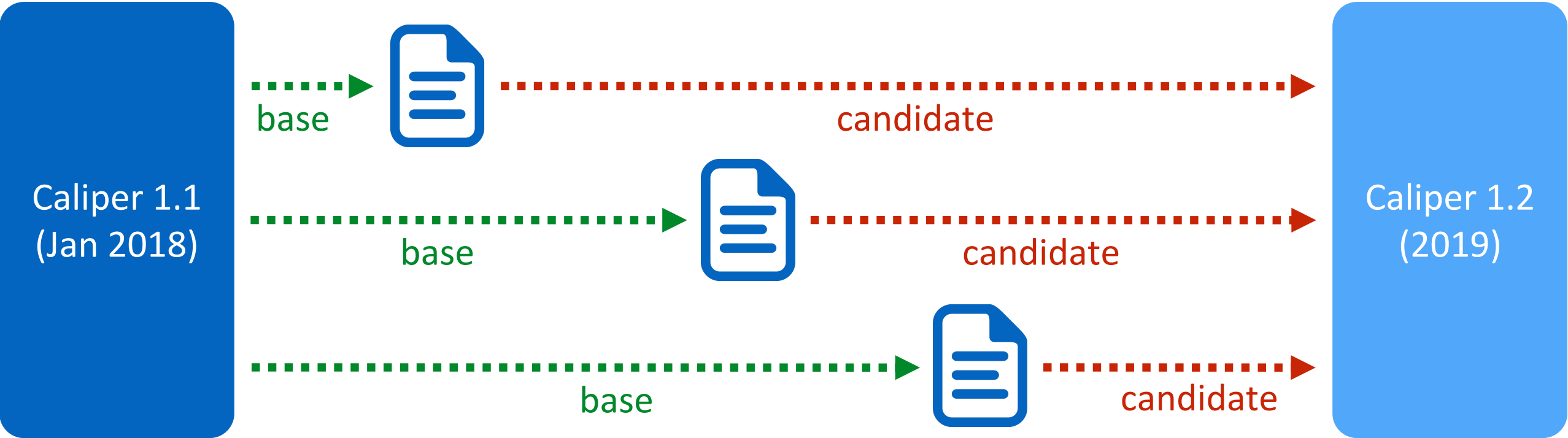
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- 2.0 [Certification Prerequisites](#)

Caliper standalone profile releases



| Phase | Stability | Visability | Contract |
|-------------|-----------|----------------------|--|
| Base (beta) | unstable | contributing members | vocabulary additions removable at any time |
| Candidate | stable | public | vocabulary additions included in next point release |
| Final | Stable | Public | Vocabulary additions rolled into Final Vocabulary/Syntax spec. |

Caliper 1.1 profiles (vocabulary)

1.1 additions



Annotation
Profile



Assessment
Profile



Assignable
Profile



Forum
Profile



Grading
Profile



Media
Profile



Reading
Profile



Session
Profile



Tool Use
Profile



Basic
Profile

Caliper: upcoming profiles

Place

Rubric

Case Item



Tool Launch
Profile



Search
Profile



QTI
Profile



Survey
Profile



Feedback
Profile



Mastery
Profile



Badging
Profile



Participation
Profile



Resource Mgmt
Profile



Social
Profile

...

Caliper code repos (Github)

project backlog

caliper-central

docs

caliper-spec

caliper-ontology

sensors

caliper-java

caliper-js

caliper-ruby

caliper-

python

caliper-php

caliper-net

JSON-LD

caliper-contexts

caliper-common-fixtures

sample code

caliper-java-example

caliper-js-example

caliper-net-example



Caliper repositories are open to the public

Open Source Implementations

Caliper Sensors

caliper-java

caliper-js

caliper-ruby

caliper-python

caliper-php

caliper-net

<https://github.com/imsiglobal>

Caliper Endpoints

OpenLRW

<https://github.com/Apereio-Learning-Analytics-Initiative/OpenLRW>

Callisto

<https://openedinc.github.io/callisto/>



<https://github.com/purdue-tlt/Caliper-iOS>

OSS (Apache 2)



Real World Implementation Examples

Real World Implementation Examples:

Unizin



The Unizin Consortium

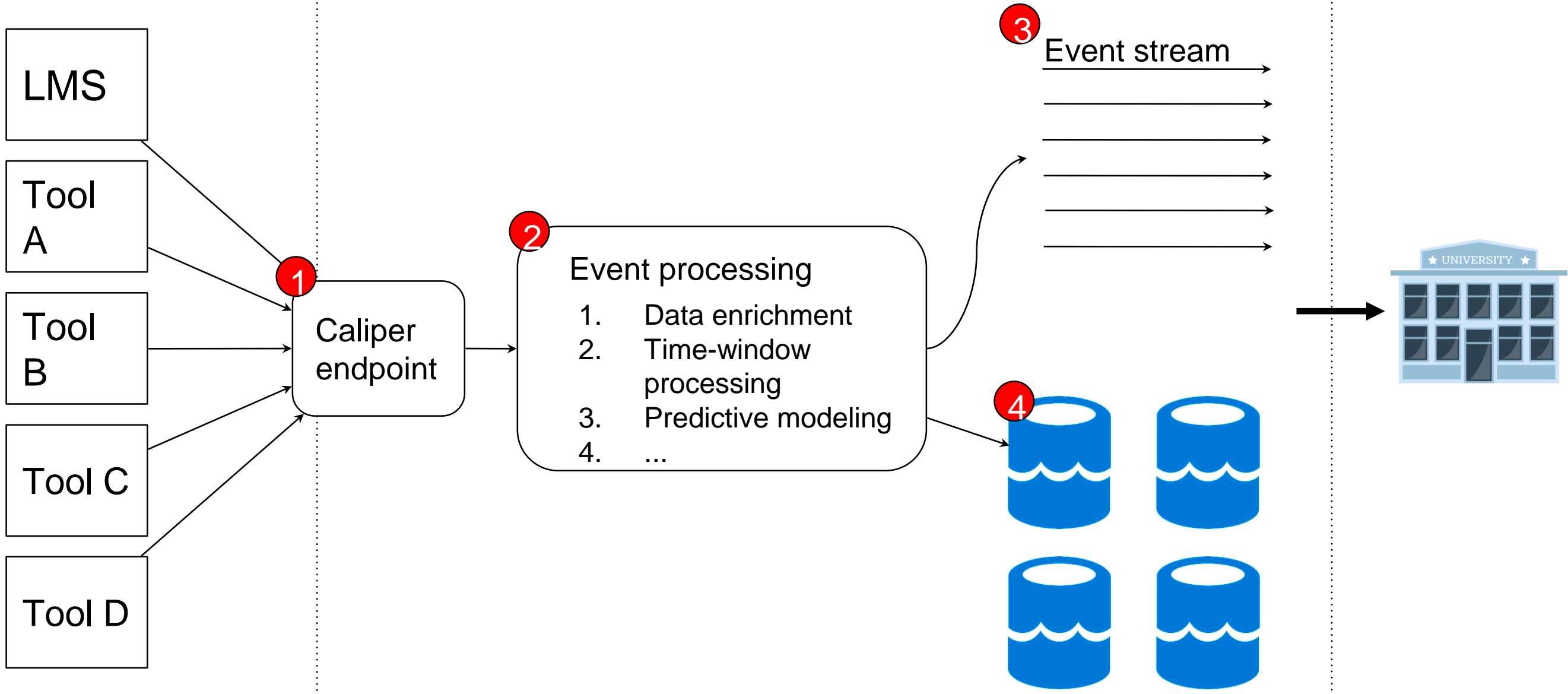


Unizin Data Platform

Three key ideas

- **A common model for all T&L data**
Unifies a representation of teaching & learning data
- **An institutional T&L data platform**
Integrate all T&L tool data and create a single, dynamic view of the learner.
- **Collaboration in data products and services**
Enable collaboration in research, analytics, reporting, tools, etc.

Unizin Data Platform



State today

- 4 running Unizin Data Platforms
- Fall 2018: 500M+ events across the consortium
- Partners: Instructure Canvas, Turnitin, Macmillan Learning, TopHat
- Institutional tools: IU Quickcheck, UMich LectureCapture, Unizin Engage

Data-driven teaching and learning

- **Advising.** Understanding and guiding student habits, practices, behaviors.
- **Content and course design.** Outcomes-oriented behaviors reveal efficacy of design.
- **Teaching analytics.** In-the-moment, just-in-time-teaching analytics based on interaction data.
- **Learning analytics.** Student insights into own behaviors, habits; nudging.
- **Adaptive learning.** Analytics-driven content and assessment.
- ... and many more.

Caliper endpoint

- Required component for any data ingestion
- Unizin has built one
- <https://unizin.caliper.dev.cloud.unizin.org>

Real World Implementation Examples:

Canvas

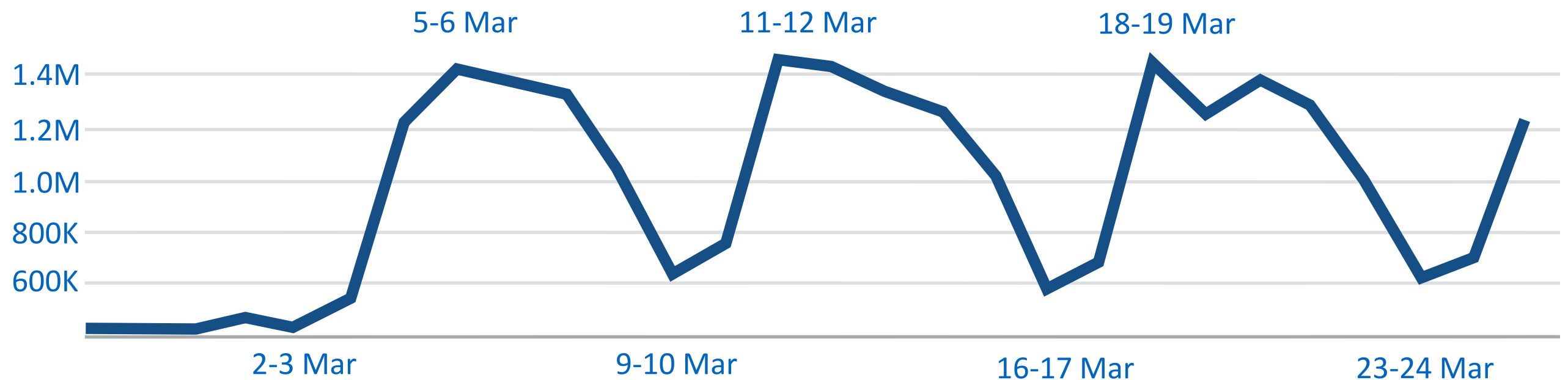
Canvas LiveEvents migration to Caliper 1.1 completed by EOY 2018

Michigan/Canvas LMS Live Events (Caliper)



Unizin UDP endpoint

Messages per day, March 2018



Peak: ~1.43M events/day

Real World Implementation Examples:

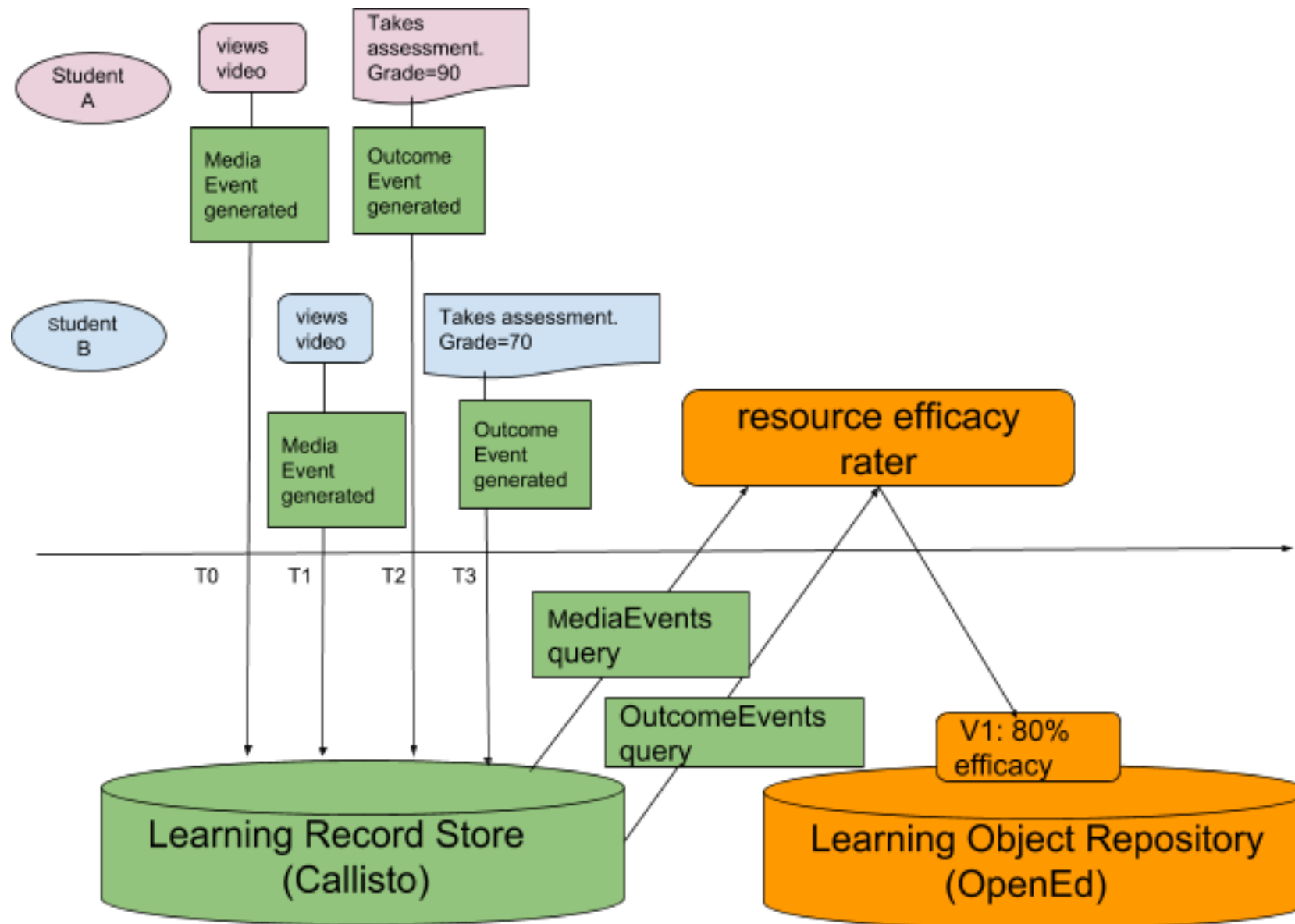
Blackboard Learn

*Migration to Caliper 1.1
currently ongoing*

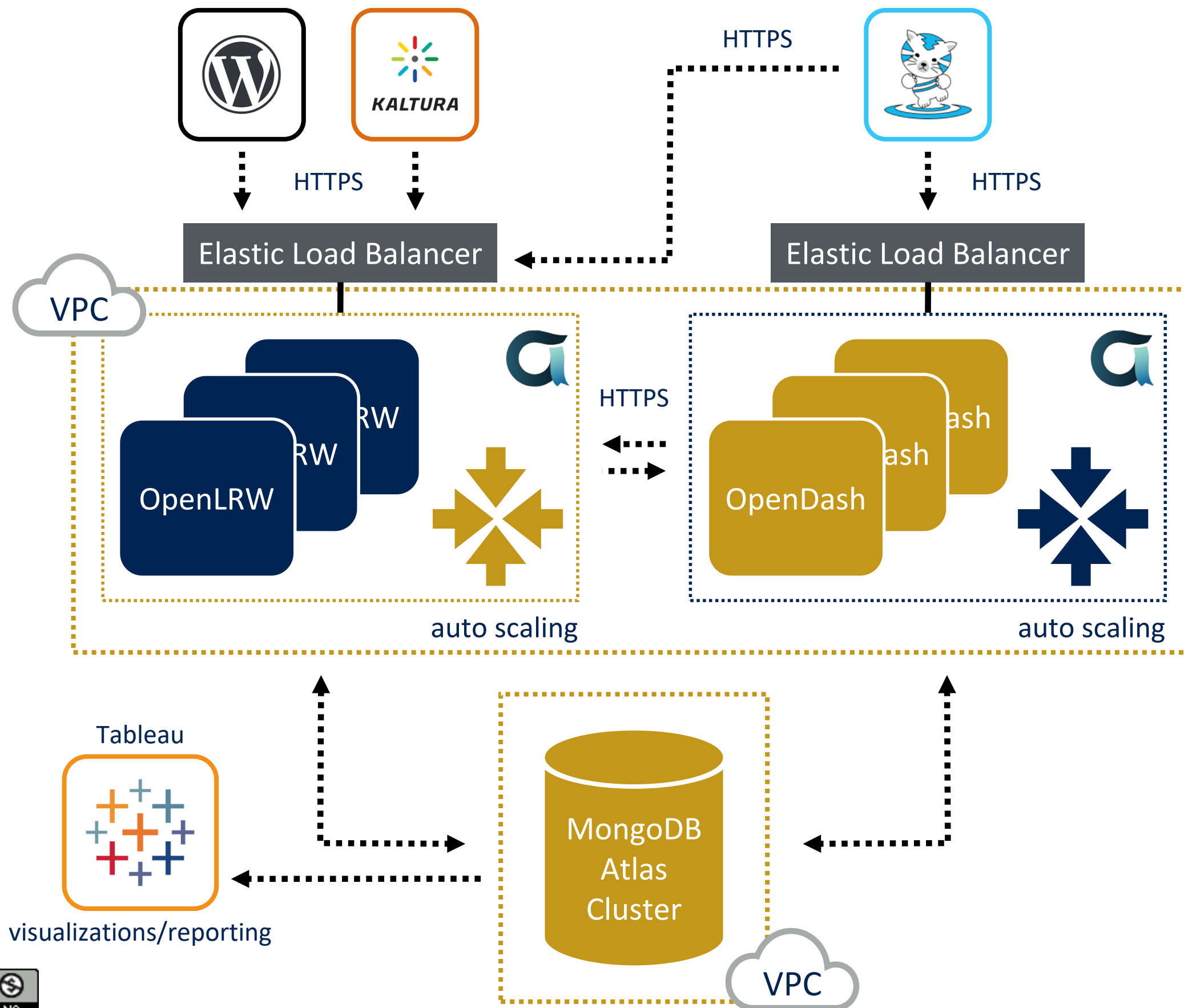


Blackboard

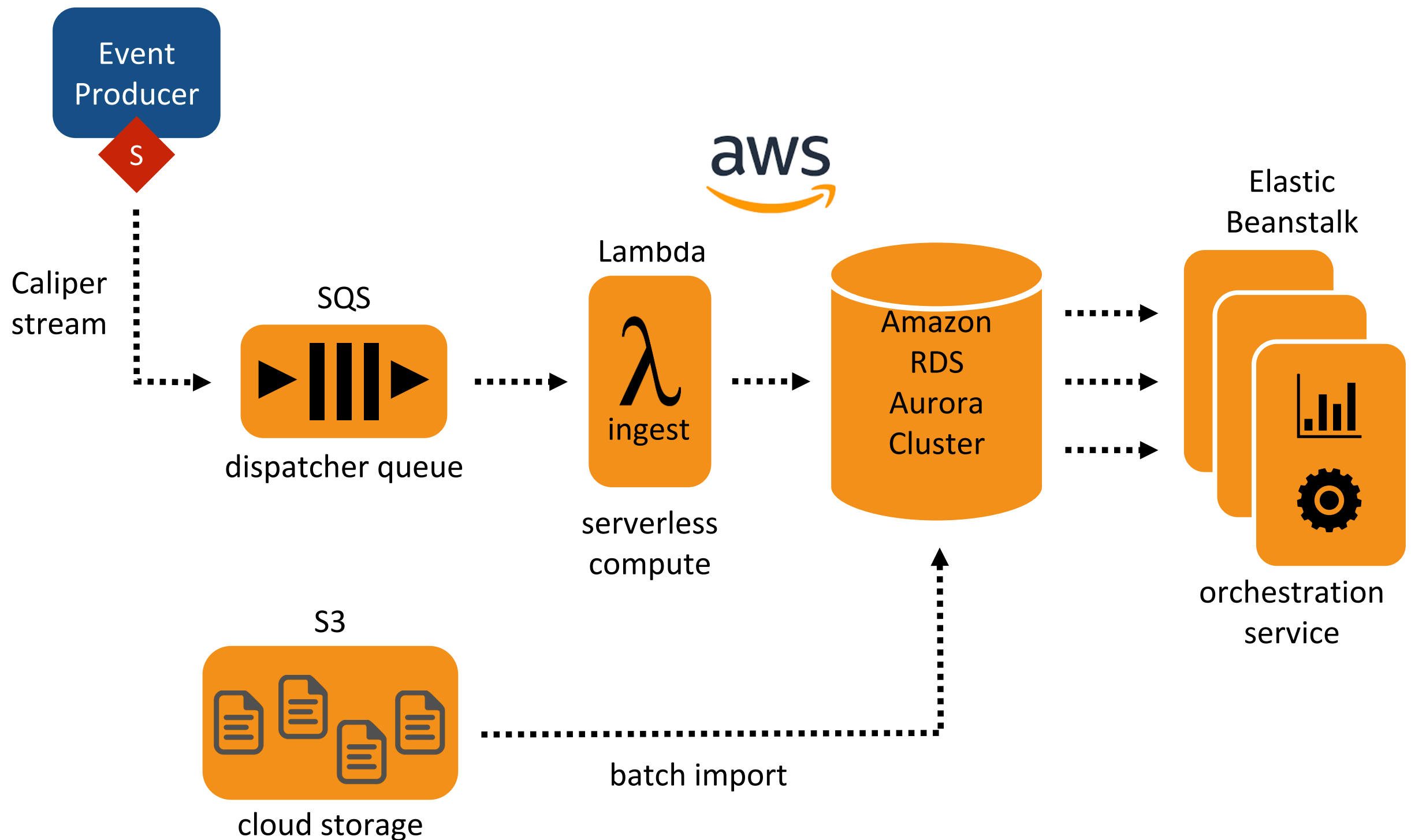
- AssessmentEvent
- AssessmentItemEvent
- AssignableEvent OutcomeEvent
- SessionEvent
- ViewEvent
- LTIEvent
- ContentEvent
- CalculatedGradeSnapshotEvent
- ForumEvent
- BlogEvent
- WikiEvent



Notre Dame: OpenLRW



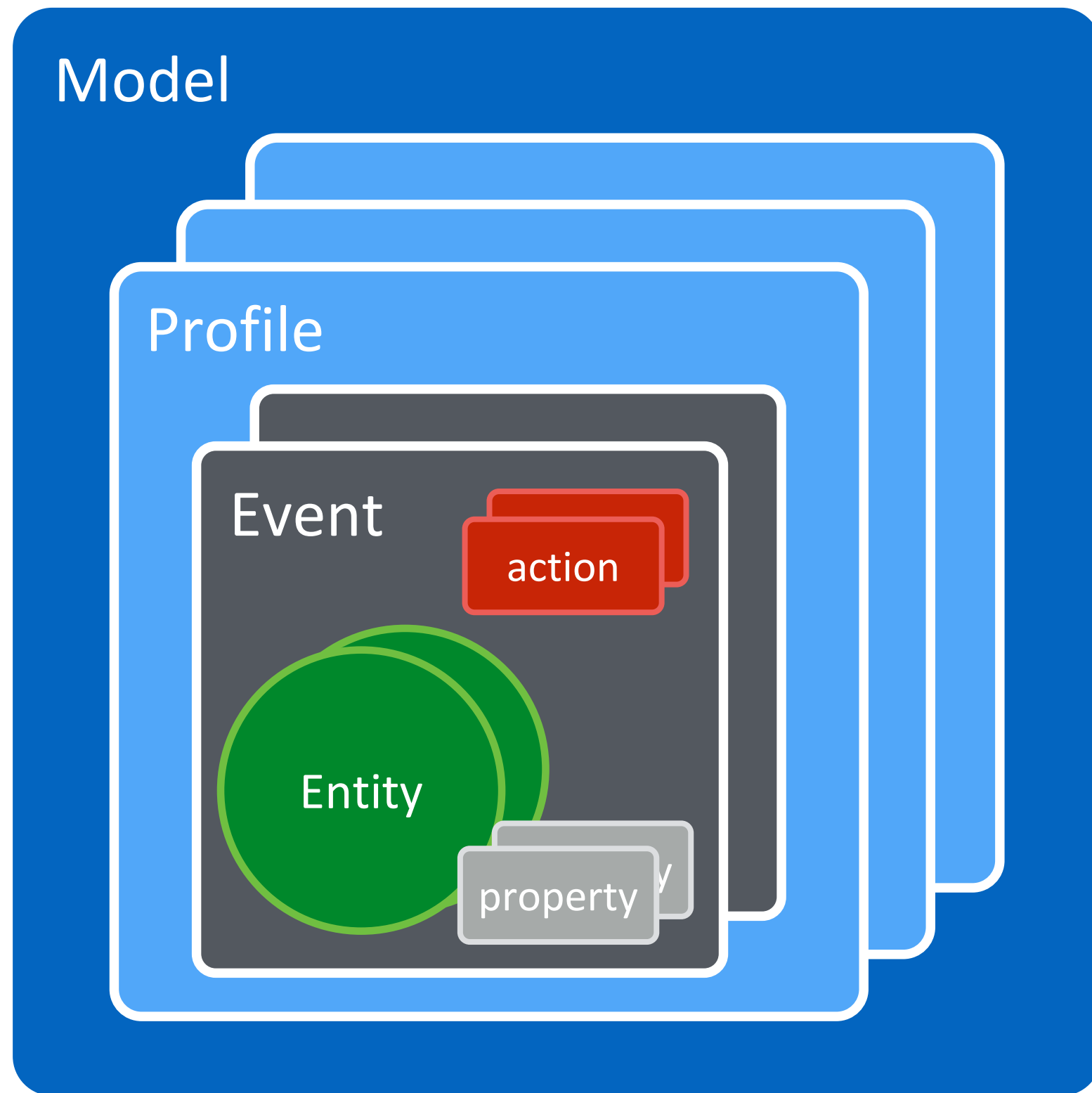
UC Berkeley: CloudLRS



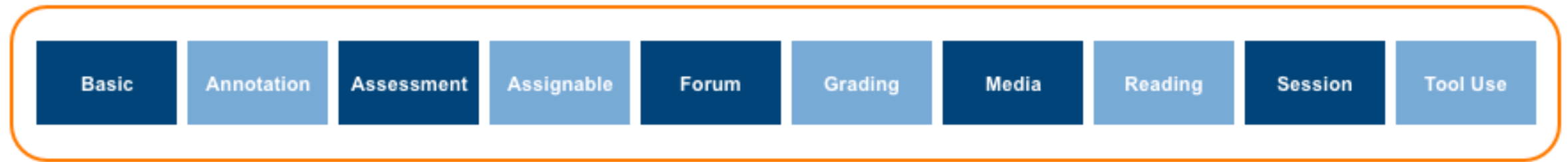
<https://aws.amazon.com/about-aws/global-infrastructure/>

3. Caliper Architecture

Caliper model



The Caliper Profile



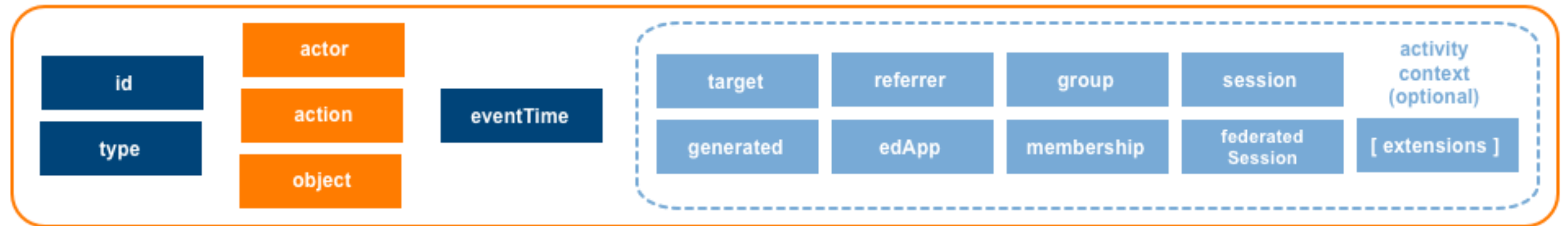
Provides a domain-specific set of terms and concepts to describe common user interactions in a consistent manner using a shared vocabulary.

- models a learning activity or a supporting activity that helps facilitate learning
- encourages vocabulary standardization and re-use among application providers

Vocabulary restrictions are outlined in each profile:

- supported events
- supported actors
- supported actions
- supported objects
- supported generated entities
- supported target entities
- other requirements

The Caliper Event



Describes the relationship established between an actor and an object, formed as a result of a purposeful action undertaken by the actor at a particular moment in time and within a given learning context.

The Caliper Event: properties

 = new 1.1

@context

type

id

actor {}

action

object {}

eventTime

required

target {}

generated {}

referrer {}

edApp {}

group {}

membership {}

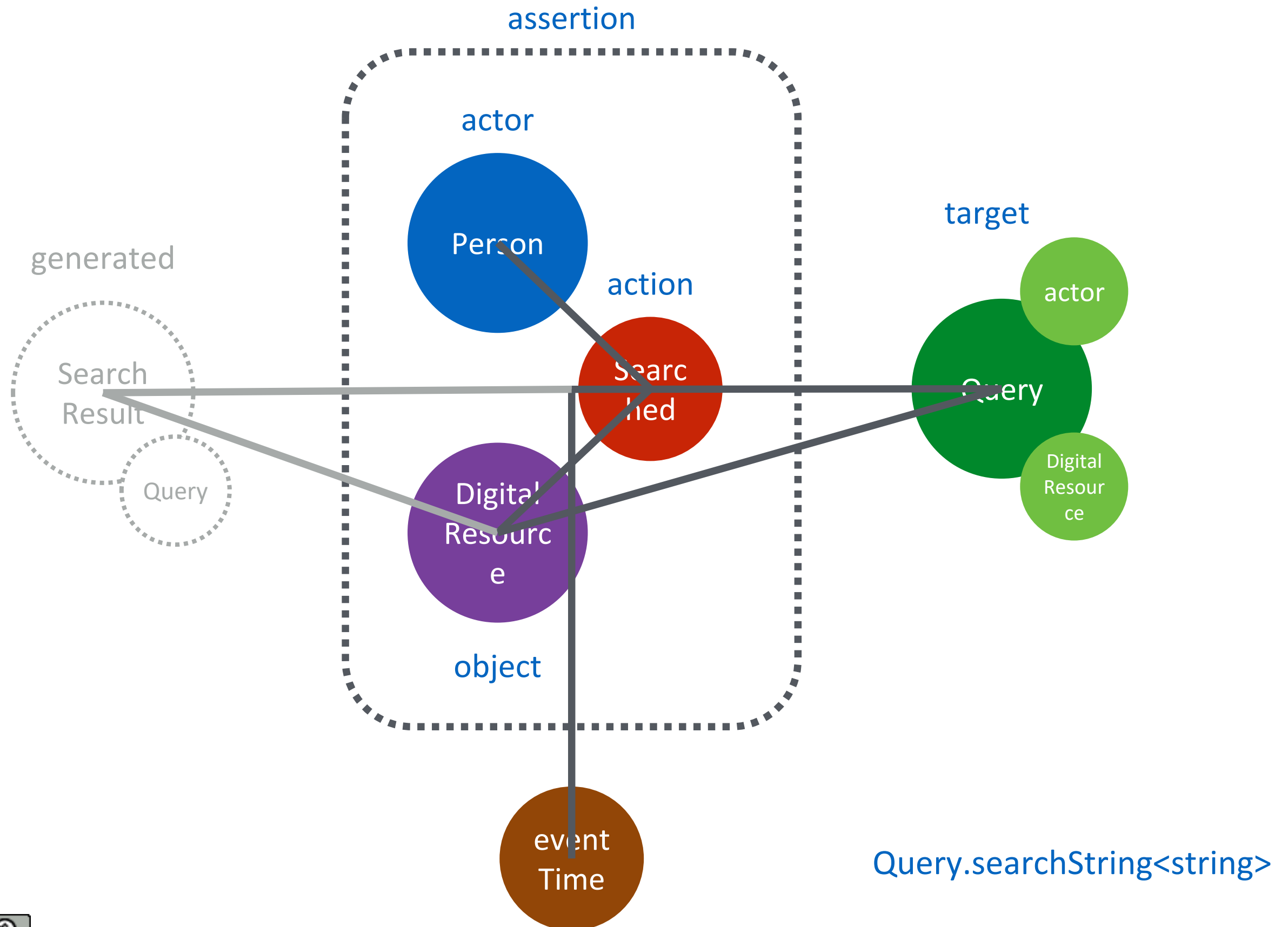
session {}

federatedSession {}

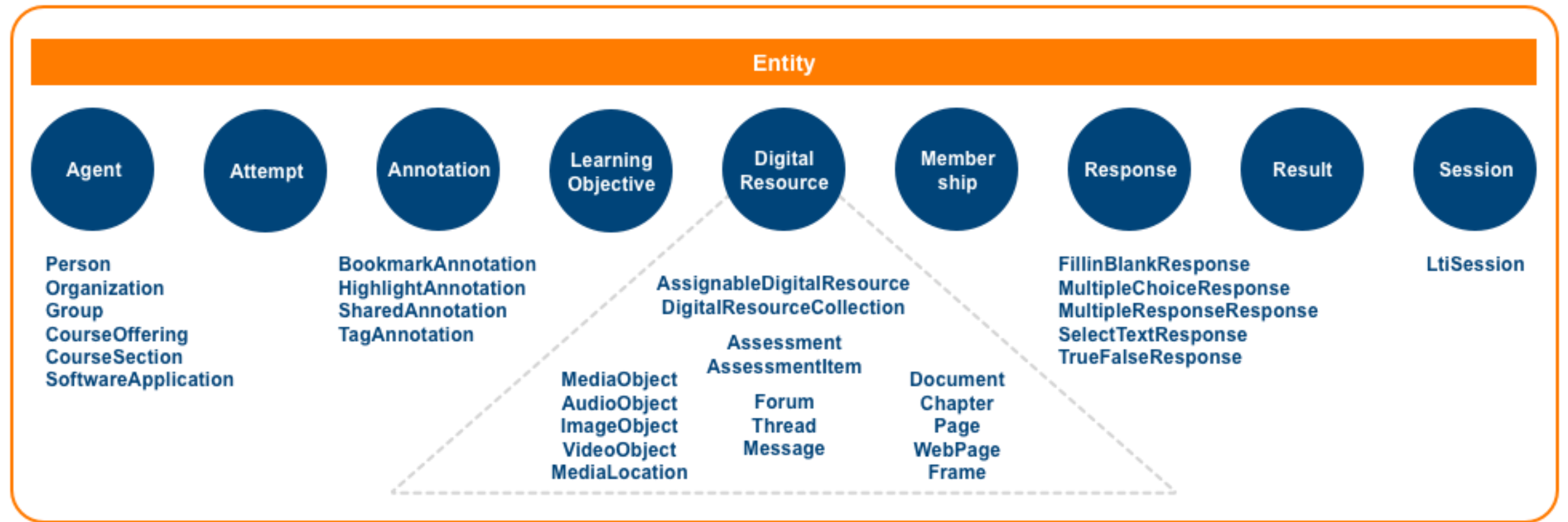
extensions {}

optional

Caliper 1.x SearchEvent (1.1 extension)



The Caliper Entity



A generic type that represents objects that participate in learning-related activities. Each

Caliper Profile: Media

MediaEvent

started / ended
changedSize
changedSpeed
changedResolution
changedVolume
enteredFullScreen / exitedFullScreen
forwardedTo
jumpedTo
muted / unmuted
openedPopout / closedPopout
paused / resumed
enabledClosedCaptioning / disabledClosedCaptioning

NavigationEvent

navigatedTo

ViewEvent

viewed

Person

MediaObject

Audio
Object

Image
Object

Video
Object

Media
Locati
on

Caliper Media Object

id
type
name
description
creators
mediaType
keywords
learningObjectives
isPartOf
duration
dateCreated
dateModified
datePublished
version
extensions

Caliper and Linked Data

- **The basic triple: actor verb object**
- **Caliper uses JSON-LD as the serialisation**
- **JSON-LD provides context to statements**
- **Caliper also provides an ontology**
- **Caliper is designed so that JSON-LD awareness is optional**

<https://json-ld.org/primer/latest/>

Triples in Caliper and xAPI

Caliper event

@context type id

actor {} action object {}

eventTime

optional

target {} generated {} referrer {}

edApp {} group {} membership {}

session {} federatedSession {}

extensions {}

xAPI statement

actor {} verb object {}

id (recommended)

stored (set by LRS)

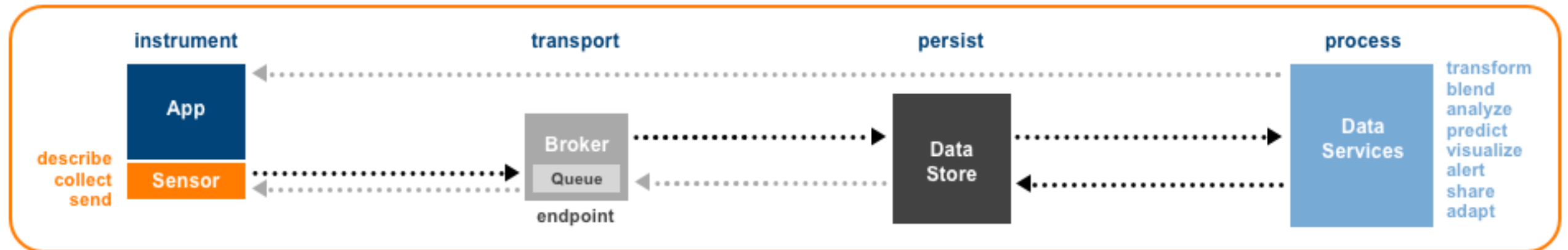
context {} result {}

authority {} attachments []

timestamp

version (not recommended)

Serialising and sending Caliper events: the sensor API



*Implementing the **Sensor** provides instrumented platforms, applications and services with a transport interface for communicating with data consumers.*

*A Caliper **Endpoint** **MUST** be capable of receiving Caliper data sent over HTTP by a Caliper **Sensor** using the standard POST request method. The connection **MUST** be secured with Transport Layer Security (TLS) and a valid TLS certificate provided.*

*The **Envelope** allows for transporting multiple events in batch mode*

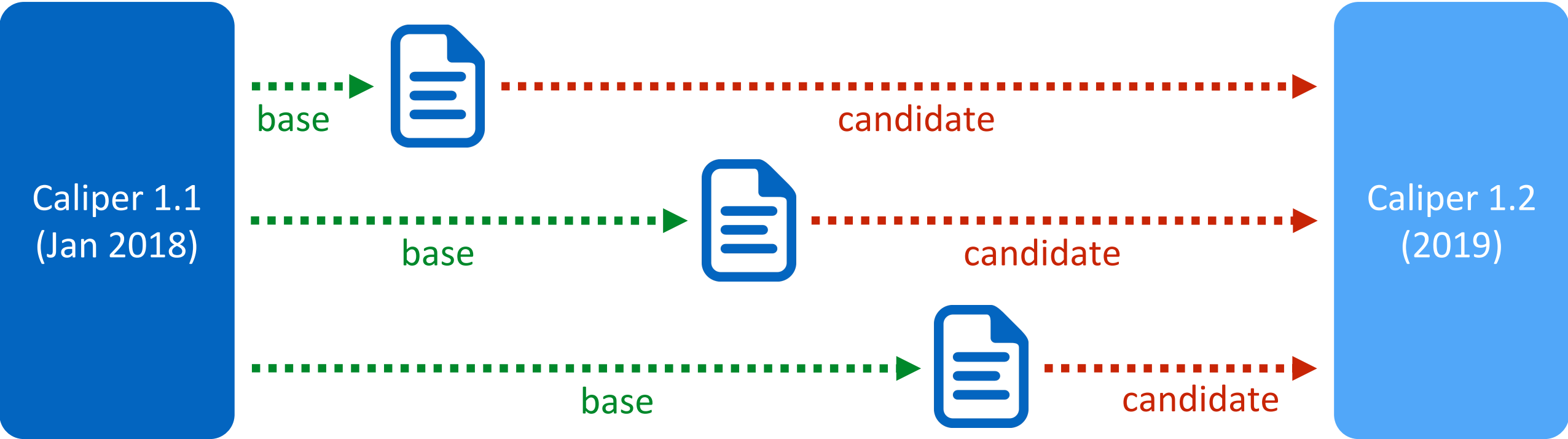
4. Caliper Future & Next Steps

Caliper 1.2

- Timeline: Spring 2018
- Endpoint behaviours and certification
- Additional semantic profiles
- Learning Tools Interoperability® (LTI®) Caliper Analytics® Endpoint Service

<https://github.com/IMSGlobal/caliper-central/issues>

Caliper standalone profile releases



| Phase | Stability | Visability | Contract |
|-------------|-----------|----------------------|--|
| Base (beta) | unstable | contributing members | vocabulary additions removable at any time |
| Candidate | stable | public | vocabulary additions included in next point release |
| Final | Stable | Public | Vocabulary additions rolled into Final Vocabulary/Syntax spec. |

Caliper: upcoming profiles

Place

Rubric

Case Item



Tool Launch
Profile



Search
Profile



QTI
Profile



Survey
Profile



Feedback
Profile



Mastery
Profile



Badging
Profile



Participation
Profile



Resource Mgmt
Profile



Social
Profile

...

Caliper ↔ xAPI harmonisation

- IMS POV: content is king
- Data roundtrippability/vocabulary management
- Sensor / Activity Provider API
- Transport protocols, security models
- Endpoint/LRS Queries



Thank you!

Markus Gylling
Solutions Architect | Head, IMS Europe
mgylling@imglobal.org