

Interoperable Infrastructure for Universities, Enterprises and the Public Sector

FOSS North 2025
Hagen Echzell, Terje Sylvarnes

Who are we?

Terje Sylvarnes

The Norwegian Digitalisation
Agency

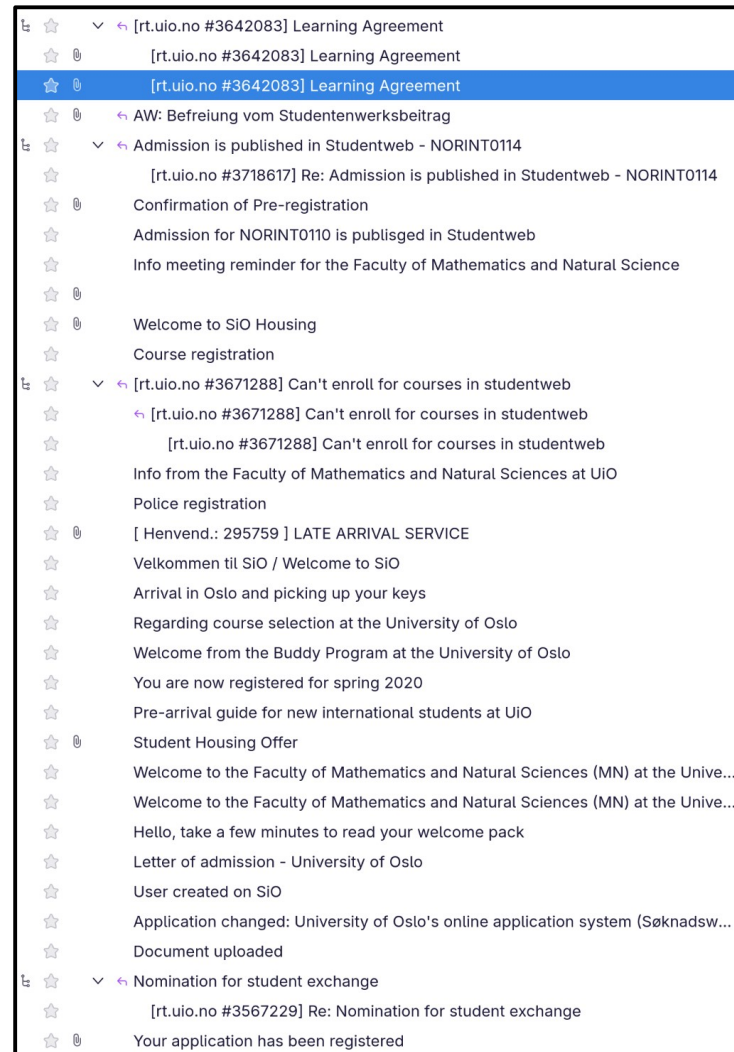


Hagen Echzell

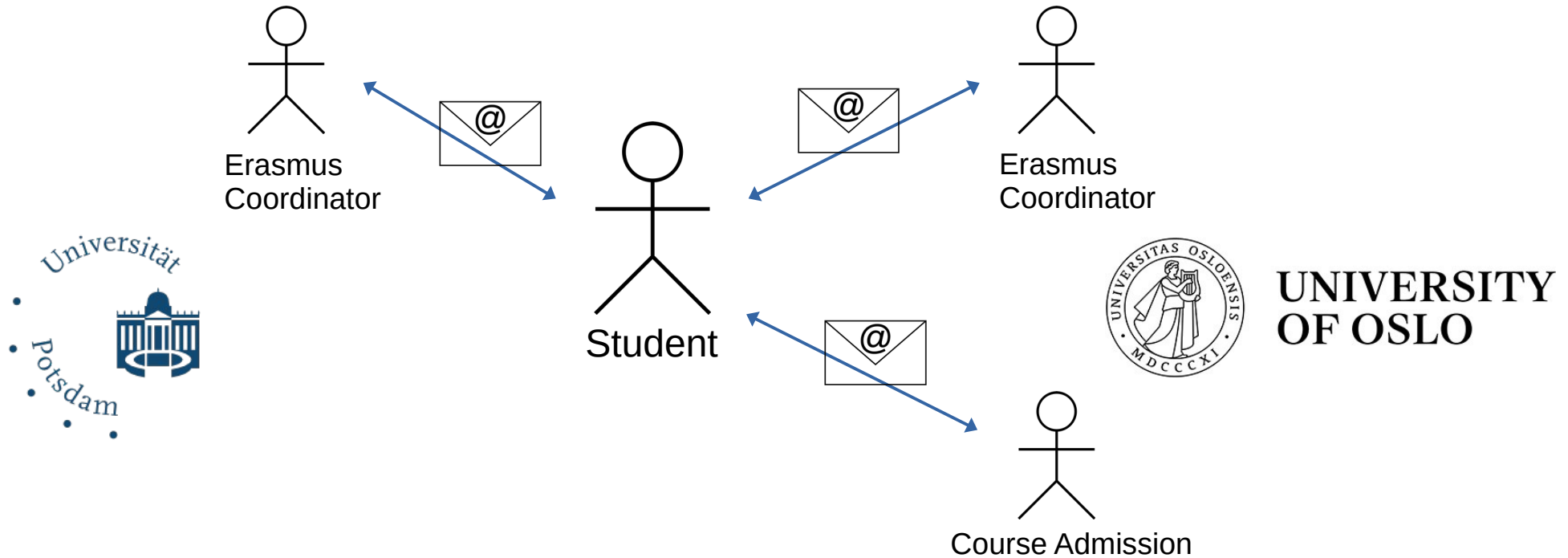
University of Oslo



Everything in this process is an email!



The student is relaying all these scans of signed documents



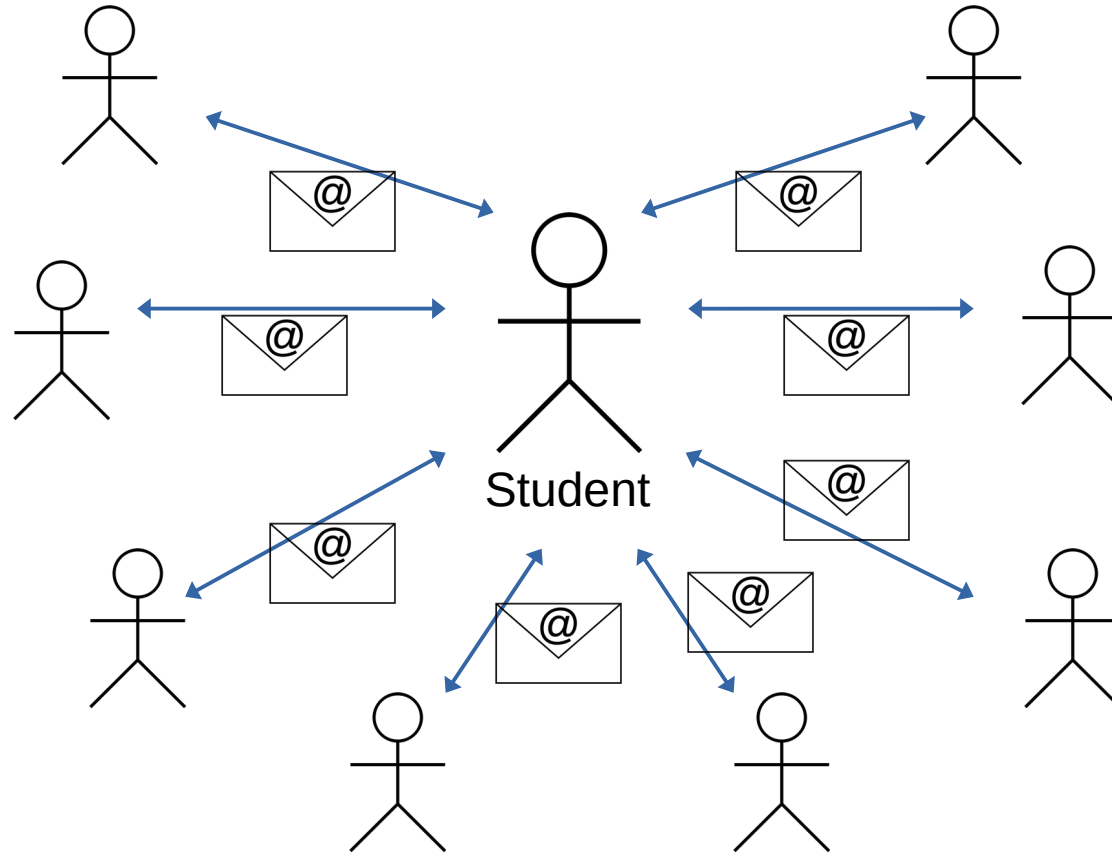


President Macron gives speech on new initiative for Europe

Posted on 26 September 2017

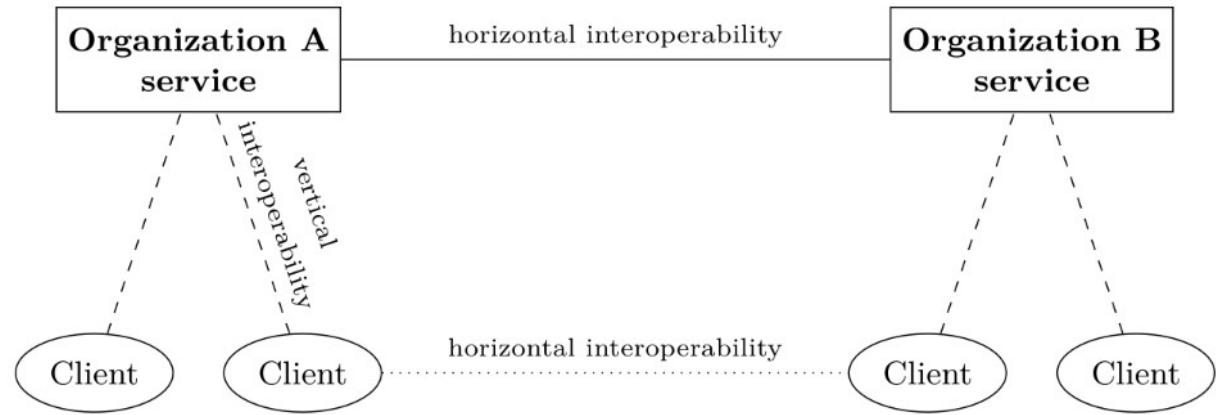
→ We must create European universities, **networks of universities which allow students to study abroad** and follow classes in at least two languages. In high school, we must set up a streamlining or mutual recognition process for secondary education diplomas (just like in higher education).

With email, course admission will look somewhat like this:



Why is email so popular?

- Everyone has it
- It's «**interoperable**»



The Interoperable Europe Act

- «interoperability solutions»
- legal, organizational
- semantic and technical

SMTP is a technical interoperability solution

13.00 - 14.00	Interoperable Europe Act: A real game changer? Lina Ceballos
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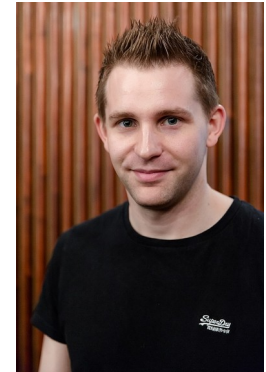
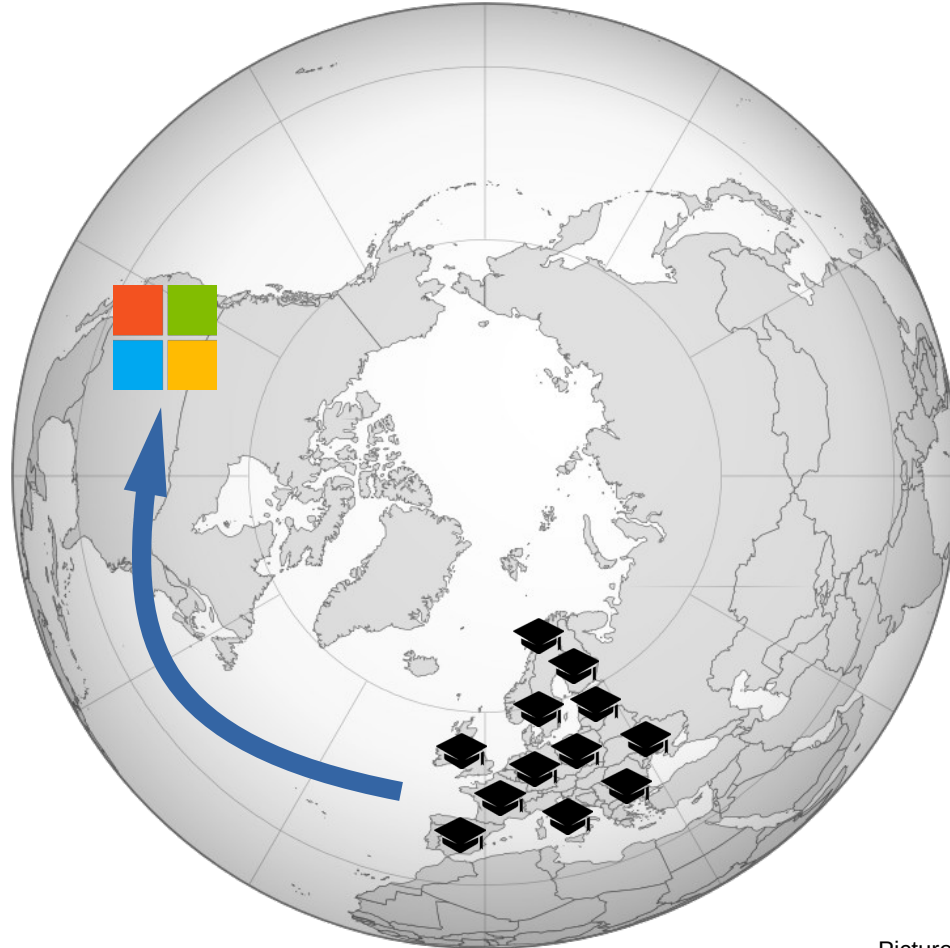
Can't we just all use MS Teams?

Microsoft 365 offers several options for collaborating with people outside your organization:

- 1:1 and group chat in Teams with people outside your organization
- Teams meetings with people outside your organization

- Does that make MS Teams an interoperability solution?

Centralization is a bad idea



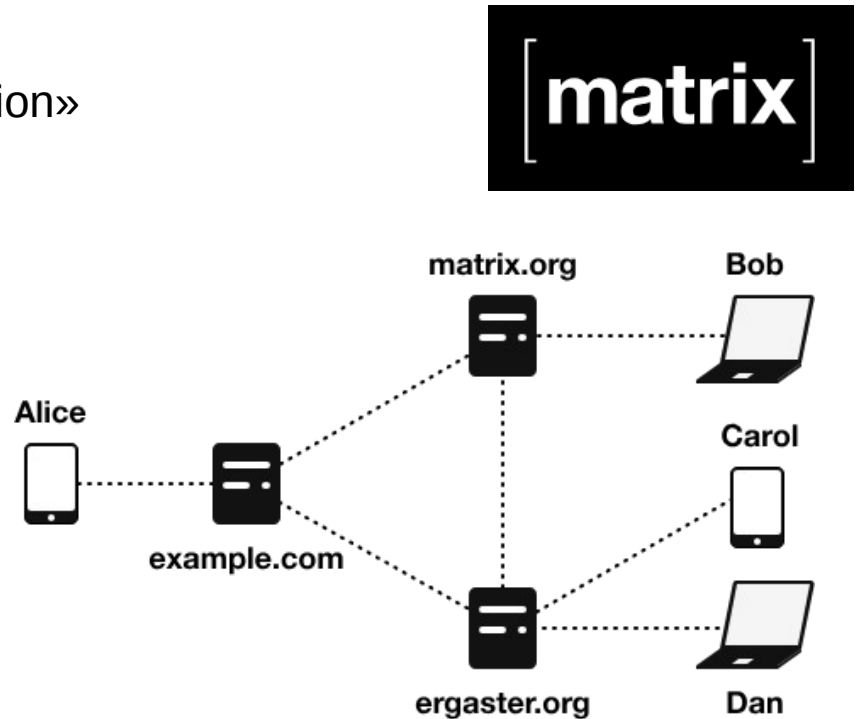
University Alliances are a case for interoperability

- Basic messaging
- Sharing files
- Domain-specific solutions
 - Common semantics

Matrix is an interoperability solution for messaging

- «set of open APIs for decentralized communication»
 - Client-Server-API
 - **Server-Server-API**
- «**Federation**»
- Federated User IDs
 - *@derhagen:matrix.org*
 - *@fuzzklang:matrix.org*
- Supports E2EE

<https://spec.matrix.org/v1.14/>



H

Search

Ctrl K



CS3 sciencemesh/community



79



Home



> People



Rooms



opencloud

Slack bridge room

CS3 sciencemesh/community

Low priority

H hagen

smesterhelde (Sandro Mesterhelde) joined the room

Tue, Feb 14, 2023

pferreir (Pedro Ferreira) left the room

ub|k changed their display name to Pedro Ferreira

Thu, Feb 16, 2023

David Antoš joined the room

Fri, Mar 10, 2023

michielbdejong (Michiel de Jong) changed their display name to Michiel de Jong (Ponder Source)

Michiel de Jong (Ponder Source) changed their profile picture

Thu, Mar 16, 2023

mickenordin (Mikael Nordin)

Can anyone remind me of who it was that was running JupyterHub with Nextcloud integration via the sync client?

Michiel de Jong (Ponder Source)

I think Marcin from SoftwareMind is doing Jupyter on top of Reva. I don't remember who had the direct Jupyter-Nextcloud integration, but maybe it was Daniel-WWU-IT (Daniel Müller) ?

Daniel-WWU-IT (Daniel Müller)

Nope, not us

Deaddy (Marcel Wunderlich)

We have a rclone based hack currently being tested on the first vic^h^h^husers

24 replies Micke Nordin (Sunet) What is your email, I can send you an invite?

Deaddy (Marcel Wunderlich)

Michiel de Jong (Ponder Source): do I understand it correctly that now most of the stuff we needed for sciencemesh to work is merged into oC 10.12? It looks to me like it is what we wanted but you probably have a better understanding what has been merged from your branch :D

2 replies Deaddy (Marcel Wunderlich) Thanks!

Mon, Mar 20, 2023

labkode (Hugo G. Labrador)

Hello, I plan to apply to free Open Source Docker version for the entire CS3Org, if you have anything against that please raise your concern before Thursday noon

1 reply Michiel de Jong (Ponder Source) no objections, great!



Send a message...



OpenCloudMesh (OCM) enables interoperable file sharing

- Server-Server-API
- Authorization flow for WebDAV* resources
- Federated OCM Address:
 - *username@example-organization.com*

<https://github.com/cs3org/OCM-API>



OPENCLOUDMESH



📄 Type 📅 Modified 👥 People

☐ Name ▲

☐ 📁 hagen-media ...

☐ 📁 media ...

☐ 📄 slides-foss-north-interoperability-first-draft.odp ...

1 file and 2 folders

5,4 MB 34 minutes ago

⚡
Activity

🔗
Sharing

Search for share recipients

Name, email, or Federated Cloud ID ... ▼

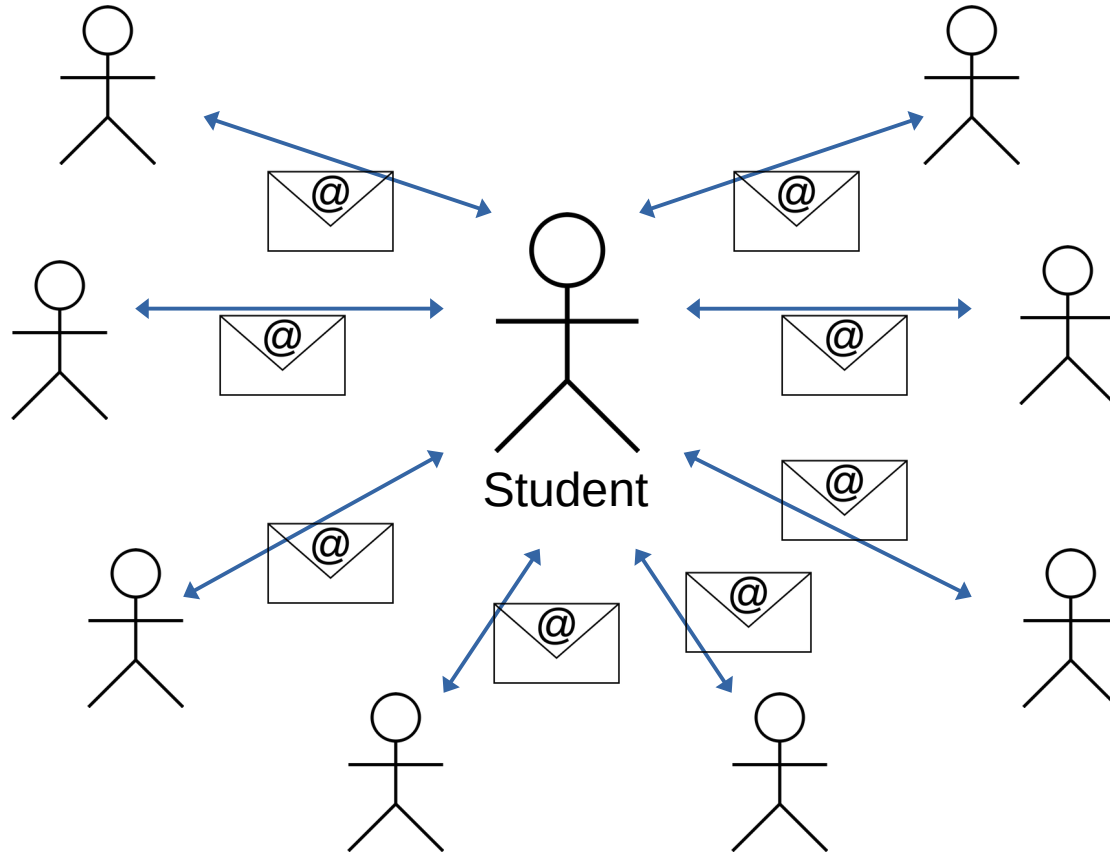
🔗 Share link +

👤 terje@cloud **example**.net (remote) ...
Can edit ▼

⋮ Others with access ▼

📄 Internal link
Only works for people with access to this folder 📄

Data Sharing



A scenario

Courses

University of Interop

The goal

All available courses

Including courses from University Alliance

Interop 101

A course for people interested in technical and semantic interoperability.

10 ECTS

Offered by University of Interop

Distributed Systems

Federation, distributed systems and systems interactions.

20 ECTS

Offered by The Federated University

IT Management

How to manage organizations in a complex and digital world.

10 ECTS

Offered by Interoperable Business School

[Feat]: Include university alliance courses in catalog #1

Edit

New issue



Open



overworked-developer opened 1 minute ago · edited by overworked-developer

Edits ...

Management decision - Top priority

All courses from partner universities should be displayed as part of our course catalog.

- Uni 1 ...
- Uni 2 ...
- Uni 3 ...
- Uni 4 ...
- Uni 5 ...
- Uni 6 ...
- Uni 7 ...
- Uni 8 ...
- Uni 9 ...

Assignees



overworked-developer

Labels



TOP PRIORITY enhancement

Projects



No projects

Milestone



No milestone

Relationships



None yet

[Feat]: Include university alliance courses in catalog #1

Edit

New issue



Open



overworked-developer opened 2 minutes ago · edited by overworked-developer

Edits ...

Management decision - Top priority

All courses from partner universities should be displayed as part of our course catalog.

- Uni 1 ...
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- Uni 5 ...
- Uni 6 ...
- Uni 7 ...
- Uni 8 ...
- Uni 9 ...

Assignees



overworked-developer

Labels



TOP PRIORITY

enhancement

Projects



No projects

Milestone



No milestone

Relationships



None yet

University of Schminterop

JSON API

```
{  
  "noName": "Interoperability 123",  
  "english_title": "Teknisk Samhandling 123",  
  "dspt": "A course on interoperability",  
  "bskrvls": "Et kurs om samhandling",  
  "x": 10,  
  "y": 5  
}
```

Documentation?

<https://uni-of-schminterop.org/api/course-catalog/docs>

404 Not Found

We are so sorry, we could not find the page you are looking for...

Meanwhile, enjoy this smiley

: -)

<mailto:help@uni-of-schminterop.org>

What the **** is "x"

I came across your API but could not find any documentation. Please help!

Best
Overworked Developer

1 week later:

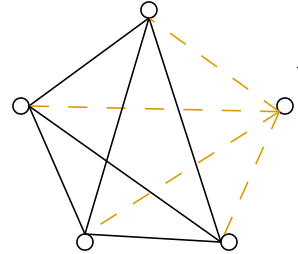
Sorry for the late reply

I have got no idea. I will ask our developers

Best,
Overworked Admin. staff

Issues

- Scaling
- Brittle
- Ambiguity



– are we talking about the same thing?

What if...

- Uni of Schminterop assign each key a definition
- from a common vocabulary
- which is included in the JSON object

```
{  
  "noName": "Interoperability 123",  
  "english_title": "Teknisk Samhandling 123",  
  "dspt": "A course on interoperability",  
  "bskrvls": "Et kurs om samhandling",  
  "x": 10,  
  "y": 5  
}
```

[Schema.org/Course](https://schema.org/Course)

Name
Description
Number of Credits

```
{
```

```
  "noName": "Interoperability 123",  
  "english_title": "Teknisk Samhandling 123",  
  "dspt": "A course on interoperability",  
  "bskrvls": "Et kurs om samhandling",  
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```

```
}
```

```
{
  "@context": {
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    "y": {"@id": "https://schema.org/numberOfCredits", "@type": "https://schema.org/Integer"},
    "x": {"@id": "http://my-vocab.com/course-iterations", "@type": "https://schema.org/Integer"}
  },
  "@id": "http://uni-of-interop.com/courses/interop_1234",
  "@type": "https://schema.org/Course",
  "noName": "Interoperability 123",
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  "x": 10,
  "y": 5
}
```

Schema.org/Course

A description of an
educational course (...)

```
{
  "@context": {
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  "@id": "http://uni-of-interop.com/courses/interop_1234",
  "@type": "https://schema.org/Course",
  "noName": "Interoperability 123",
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  "x": 10,
  "y": 5
}
```

Schema.org/Course

name	Text
------	------

The name of the item.

```
{
  "@context": {
    "noName": {"@id": "https://schema.org/name", "@language": "en"},
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    "y": {"@id": "https://schema.org/numberOfCredits", "@type": "https://schema.org/Integer"},
    "x": {"@id": "http://my-vocab.com/course-iterations", "@type": "https://schema.org/Integer"}
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  "x": 10,
  "y": 5
}
```

Schema.org/Course

description Text or TextObject

A description of the item.


```
{
  "@context": {
    "noName": {"@id": "https://schema.org/name", "@language": "en"},
    "english_title": {"@id": "https://schema.org/name", "@language": "no"},
    "dspt": {"@id": "https://schema.org/description", "@language": "en"},
    "bskrvls": {"@id": "https://schema.org/description", "@language": "no"},
    "y": {"@id": "https://schema.org/numberOfCredits", "@type": "https://schema.org/Integer"},
    "x": {"@id": "http://my-vocab.com/course-iterations", "@type": "https://schema.org/Integer"}
  },
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  "@type": "https://schema.org/Course",
  "noName": "Interoperability 123",
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  "@type": "https://schema.org/Course",
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  "dspt": "A course on interoperability",
  "bskrvls": "Et kurs om samhandling",
  "x": 10,
  "y": 5
}
```

Schema.org/Course

numberOfCredits Integer or StructuredValue

The number of credits or units awarded by a Course or required to complete an EducationalOccupationalProgram.

```
{
  "@context": {
    "noName": {"@id": "https://schema.org/name", "@language": "en"},
    "english_title": {"@id": "https://schema.org/name", "@language": "no"},
    "dspt": {"@id": "https://schema.org/description", "@language": "en"},
    "bskrvls": {"@id": "https://schema.org/description", "@language": "no"} ,
    "y": {"@id": "https://schema.org/numberOfCredits", "@type": "https://schema.org/Integer"},
    "x": {"@id": "http://my-vocab.com/course-iterations", "@type": "https://schema.org/Integer"}
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  "@id": "http://uni-of-interop.com/courses/interop_1234",
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  "bskrvls": "Et kurs om samhandling",
  "x": 10,
  "y": 5
}
```

Make-your-own-vocab.org ?

```
{
  "@context": {
    "noName": {"@id": "https://schema.org/name", "@language": "en"},
    "english_title": {"@id": "https://schema.org/name", "@language": "no"},
    "dspt": {"@id": "https://schema.org/description", "@language": "en"},
    "bskrvls": {"@id": "https://schema.org/description", "@language": "no"} ,
    "y": {"@id": "https://schema.org/numberOfCredits", "@type": "https://schema.org/Integer"},
    "x": {"@id": "http://my-vocab.com/course-iterations", "@type": "https://schema.org/Integer"}
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  "dspt": "A course on interoperability",
  "bskrvls": "Et kurs om samhandling",
  "x": 10,
  "y": 5
}
```

URI: global, persistent and unique

```
{
  "@context": {
    "noName": {"@id": "https://schema.org/name", "@language": "en"},
    "english_title": {"@id": "https://schema.org/name", "@language": "no"},
    "dspt": {"@id": "https://schema.org/description", "@language": "en"},
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    "x": {"@id": "http://my-vocab.com/course-iterations", "@type": "https://schema.org/Integer"}
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  "x": 10,
  "y": 5
}
```

JSON-LD 1.1

A JSON-based Serialization for Linked Data



W3C Recommendation 16 July 2020

`jsonld.expand({ ...Course Data... })`



JSON-LD 1.1

A JSON-based Serialization for Linked Data

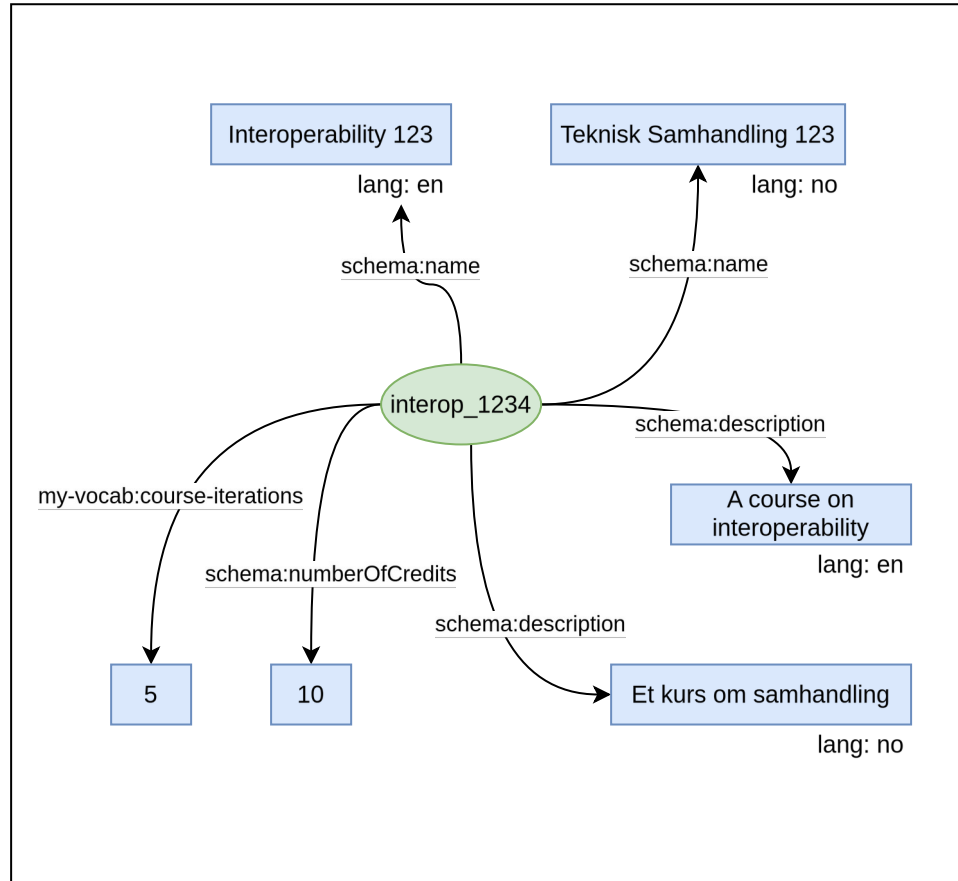


W3C Recommendation 16 July 2020

<https://www.w3.org/TR/json-ld/>

```
{
  "@id": "http://uni-of-interop.com/courses/interop_1234",
  "@type": "https://schema.org/Course",
  "https://schema.org/name": [
    {"@value": "Interoperability 123", "@language": "en" },
    {"@value": "Teknisk Samhandling 123", "@language": "no"}
  ],
  "https://schema.org/description": [
    {"@value": "A course on interoperability", "@language": "en"},
    {"@value": "Et kurs om samhandling", "@language": "no"}
  ],
  "http://my-vocab.com/course-iterations": {"@value": 10, "@type": "https://schema.org/Integer"},
  "https://schema.org/numberOfCredits": {"@value": 5, "@type": "https://schema.org/Integer"}
}
```

Course data as a graph



(also known as RDF)

JSON-LD Frame:

```
{
  "@context": {
    "name": {
      "@id": "https://schema.org/name",
      "@language": "en",
      "description": {
        "@id": "https://schema.org/description",
        "@language": "en",
        "credits": {
          "@id": "https://schema.org/numberOfCredits",
          "@type": "https://schema.org/Integer"
        }
      }
    },
    "@explicit": true,
    "@omitDefault": true,
    "@type": "https://schema.org/Course",
    "name": {"@value": {}, "@language": "en"},
    "description": {"@value": {}, "@language": "en"},
    "credits": {}
  }
}
```



`jsonld.frame({ ...Course Data... }, { ... Frame ... })`



```
{
  "@context": {
    ...
  },
  "@id": "http://uni-of-interop.com/courses/interop_1234",
  "@type": "https://schema.org/Course",
  "description": "A course on interoperability",
  "name": "Interoperability 123",
  "credits": 5
}
```

JSON-LD 1.1

A JSON-based Serialization for Linked Data

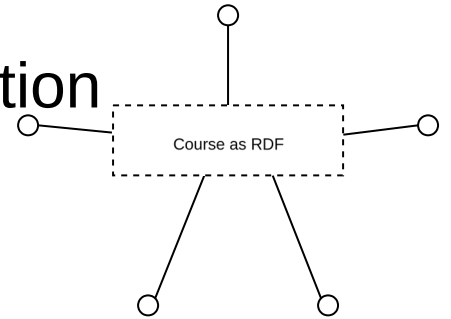


W3C Recommendation 16 July 2020

<https://www.w3.org/TR/json-ld/>

Benefits

- “Built-in” documentation – Better DevX
- Shared model (here: <https://schema.org/Course>)
 - More robust: Handles changes in the JSON API
 - Scales better: uniform “interface” for consumption
- Still ordinary JSON
- Local flexibility + Better interoperability



«Light-weight» standardization

- As an alternative to one-size-fits-all solutions
- When creating software: define your concepts early
 - What does our data *mean*
- Shared understanding of domain concepts
 - Domain experts more easily included

Interoperability Solutions



OPENCLOUD**MESH**

JSON-LD 1.1

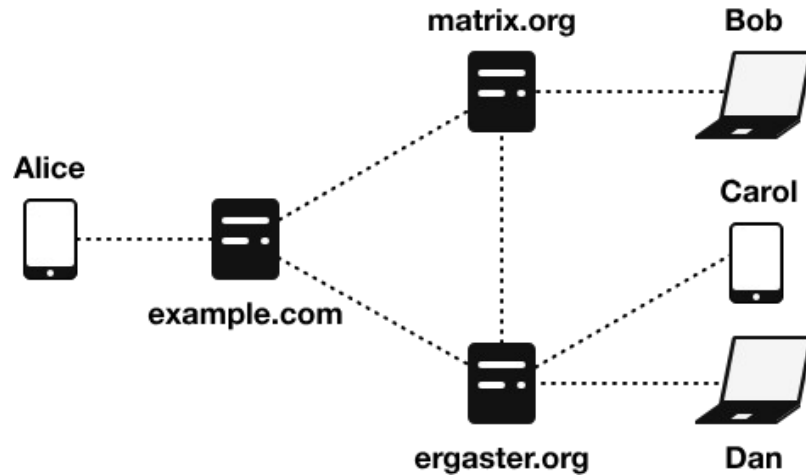
A JSON-based Serialization for Linked Data

W3C Recommendation 16 July 2020



Shared Vocabulary?

Interoperability first?



Interoperable Infrastructure for Universities, Enterprises and the Public Sector

Hagen Echzell¹ and Terje Sylvarnes²

¹ USIT, University of Oslo
hagene@iio.no

² The Norwegian Digitalisation Agency
terje.sylvarnes@digdir.no

Abstract. Many organizational processes cross the boundaries of individual organizations. This is especially true for the academic sector where mobility programs like “Erasmus+” enable students to be enrolled with different universities throughout their studies. However, the technical means to enable the necessary collaboration between different institutions and their administrations are often not adequate. Many tools for group messaging, file exchange, or domain-specific applications do not work or lack functionality as soon as users or data from outside an organization are involved, such that E-Mail is a widely used fall-back. Based on terminology from the recent *Interoperable Europe Act (IEA)* [7] we will present technical and semantic *interoperability solutions* to address these issues.

On the technical side, we present two existing protocols: OpenCloudMesh is an open file sharing protocol implemented by open-source solutions like Nextcloud and ownCloud. The Matrix protocol enables secure, decentralized group and instant messaging, but might also support further use cases like video conferences in the future.

On the semantic side, we present a case study where we, based on existing vocabularies, model a university course catalog in the *Resource Description Framework (RDF)* serialization format JSON-LD. The RDF representation of the course data introduces a semantic context to the course data, making the exchange of the catalog data independent of specific APIs, thus enabling interoperability across heterogeneous data structures and university-specific systems.

The introduced technical and semantic interoperability solutions enable public sector bodies like universities and enterprises to improve their cross-organizational collaboration without giving up their digital sovereignty to a centralized, commercial actor.

Keywords: Interoperability · Federation · OpenCloudMesh · Matrix · RDF · JSON-LD