Aligning openCDE APIs with Linked Building Data through Constrained Containers in Common Data Environments

LDAC2024

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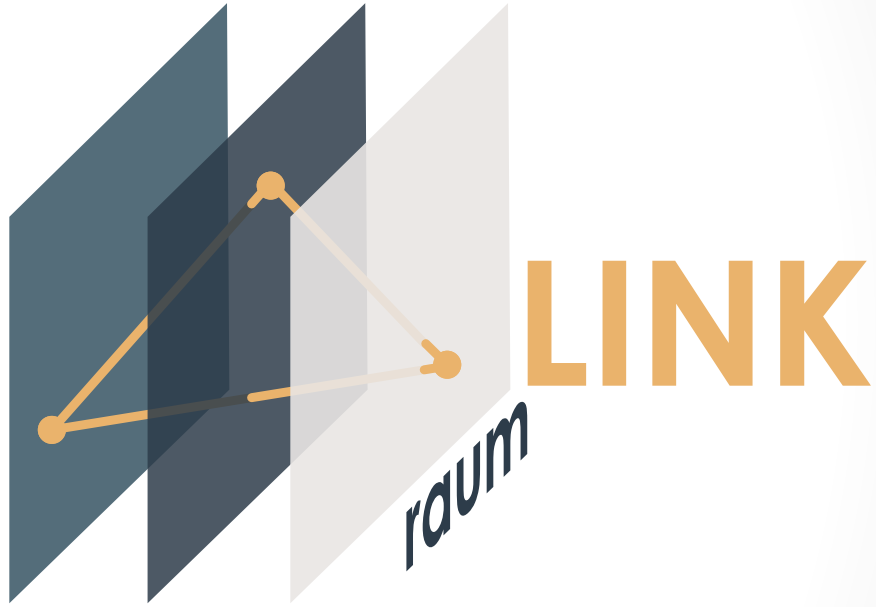
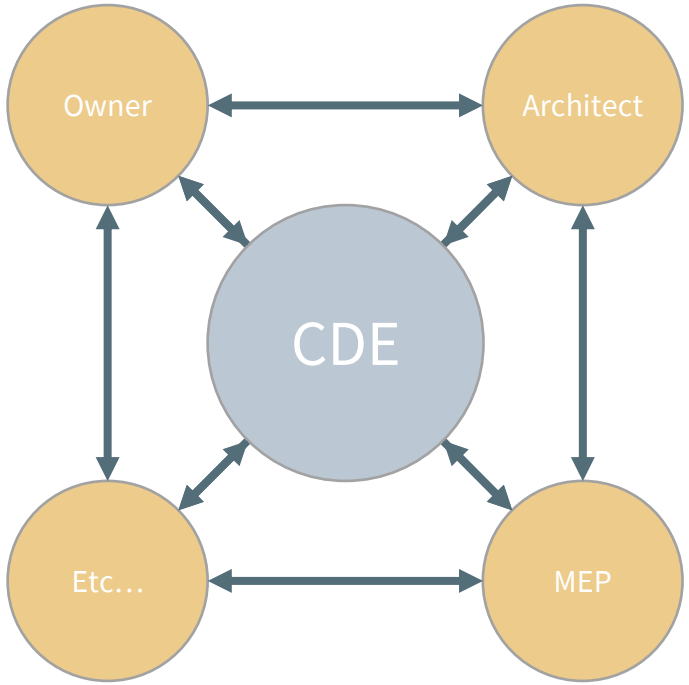


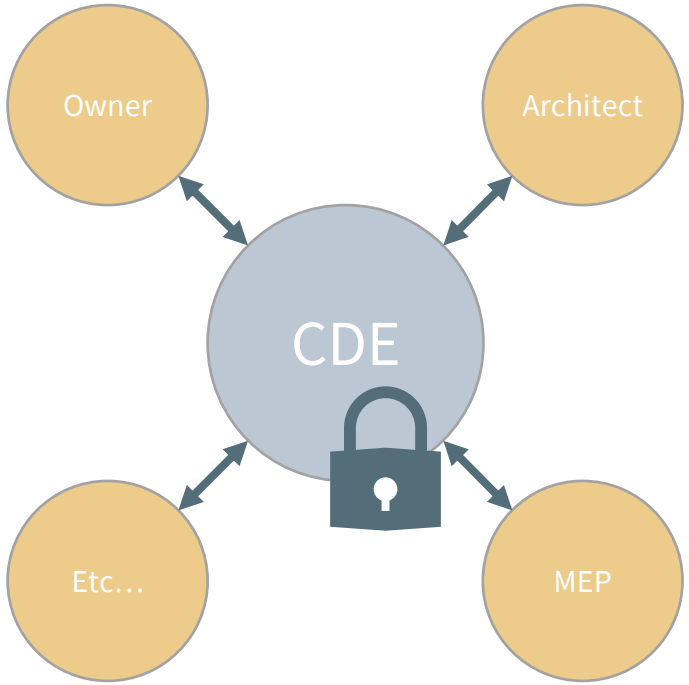
Common Data Environments (CDEs)

- CDEs facilitate the communication between stakeholders in construction projects.
- Single source of information to make communication and data exchange less error-prone.



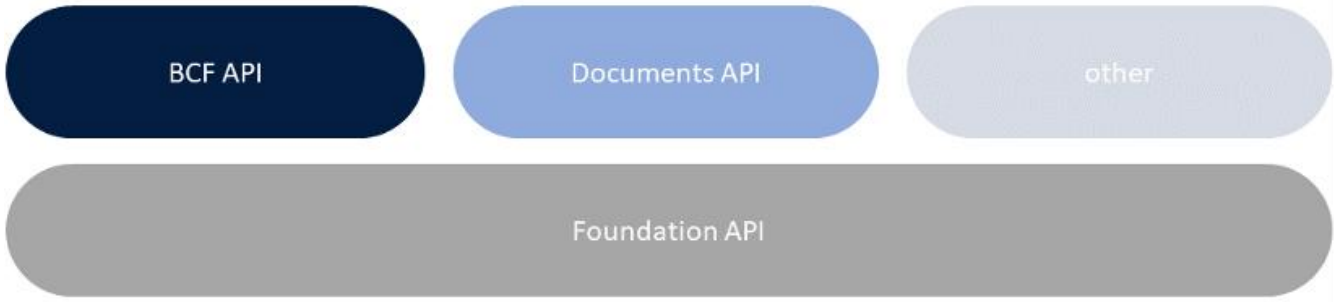
Motivation

- **Problem:** They are often isolated solutions tailored to a vendor-specific product.
  - Data Silos
  - Limited interoperability
- **Current Solution:** openCDE APIs offer a standardised method to access parts of the CDE data.
- **Goal:** integrating Linked Data with openCDE APIs
  - Enhance data accessibility and interoperability



openCDE APIs

- Set of APIs provided and maintained by buildingSMART
- Widely adopted in the AEC industry

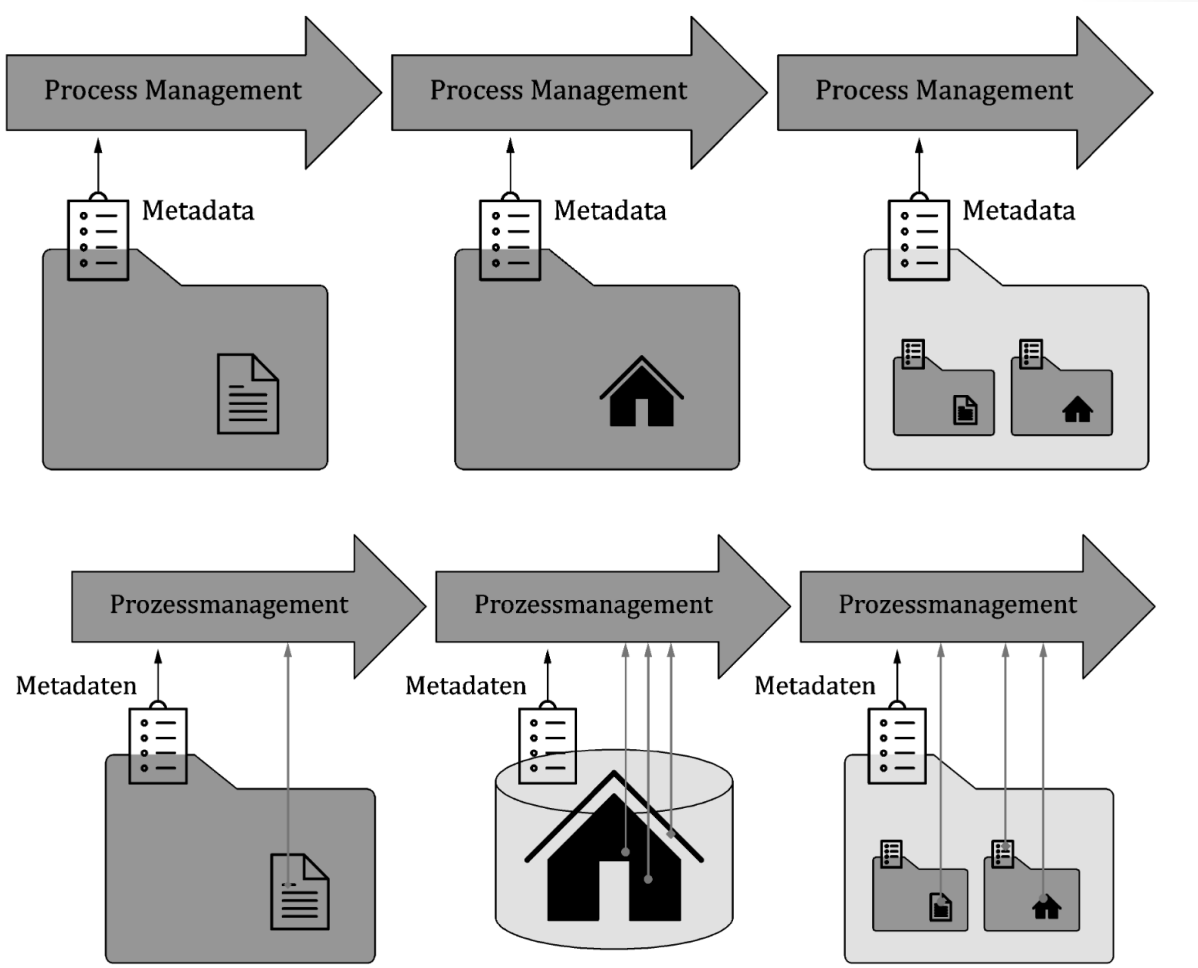


Source: Oraskari et al. 2022

Information Container

DIN SPEC 91391:
"…smallest storage unit for a file or a model and logical construct for file or model management within a CDE"

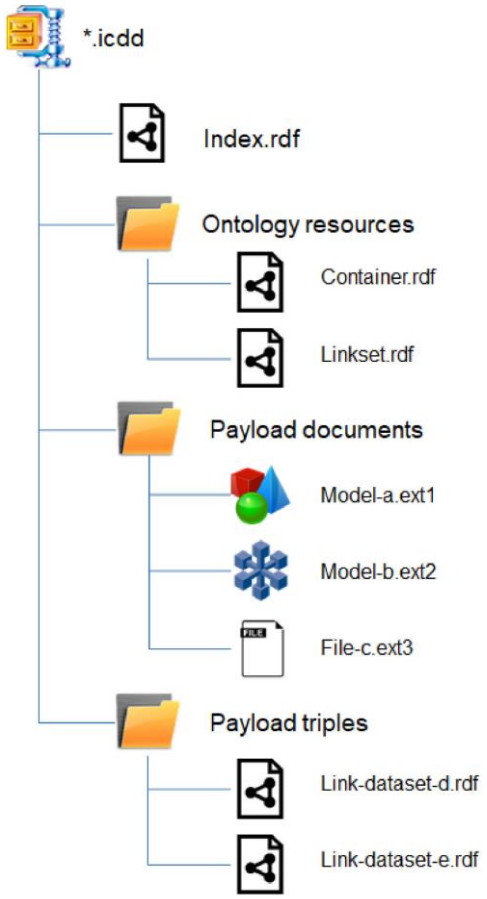
ISO 19650: *"…named persistent set of information (…) retrievable from within a file, system or application storage hierarchy"*



Source: DIN SPEC 91391

Information Container for linked Document Deliver (ICDD)

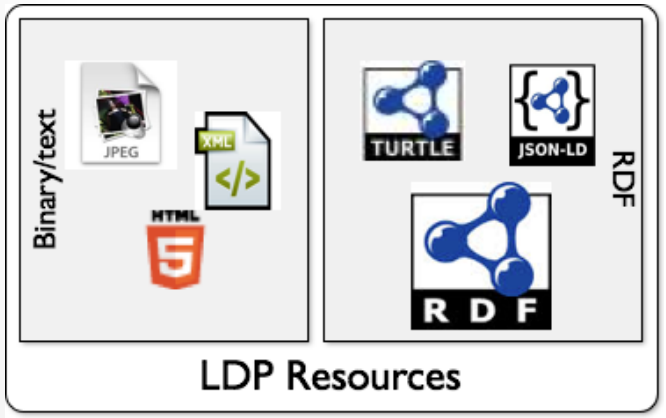
- Defined in ISO 21597
- File-based approach to exchange (ZIP) container
- Can establish links between documents and content of documents



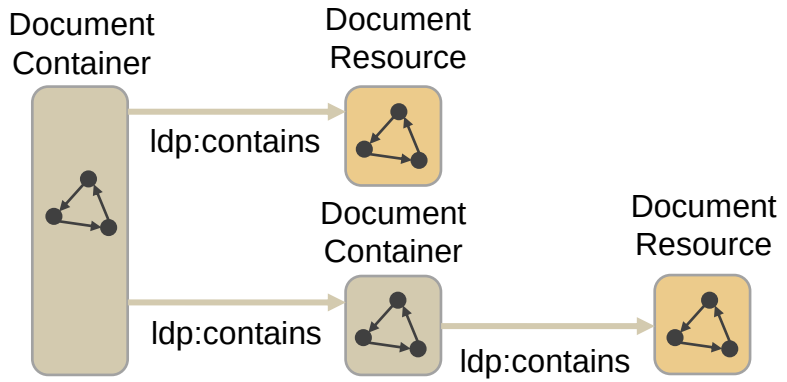
Source: ISO 21597

Linked Data Platform (LDP)

- W3C recommendation
- Web-based approach
- Main concepts are Resources and Container



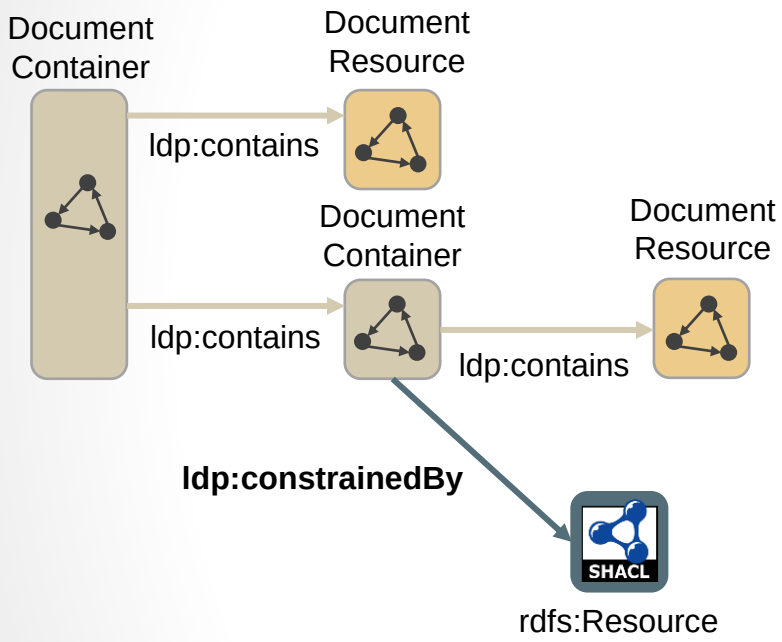
Source: Linked Data Platform 1.0 Primer



Source: Linked Data Platform 1.0 Primer

```
<.../ldp/Container_1> a ldp:Container;
        ldp:contains <Resource1>,
                     <Resource2>, <Resource3> .

<Resource1> a ldp:Resource .
```

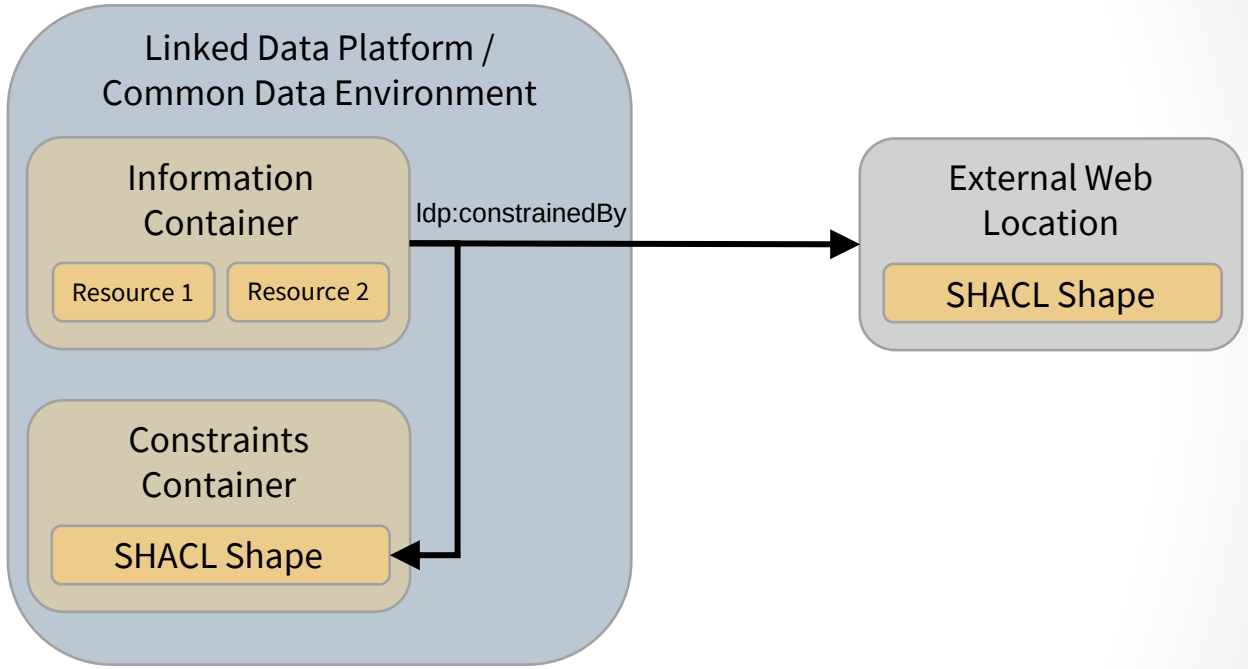
Constraining LDP



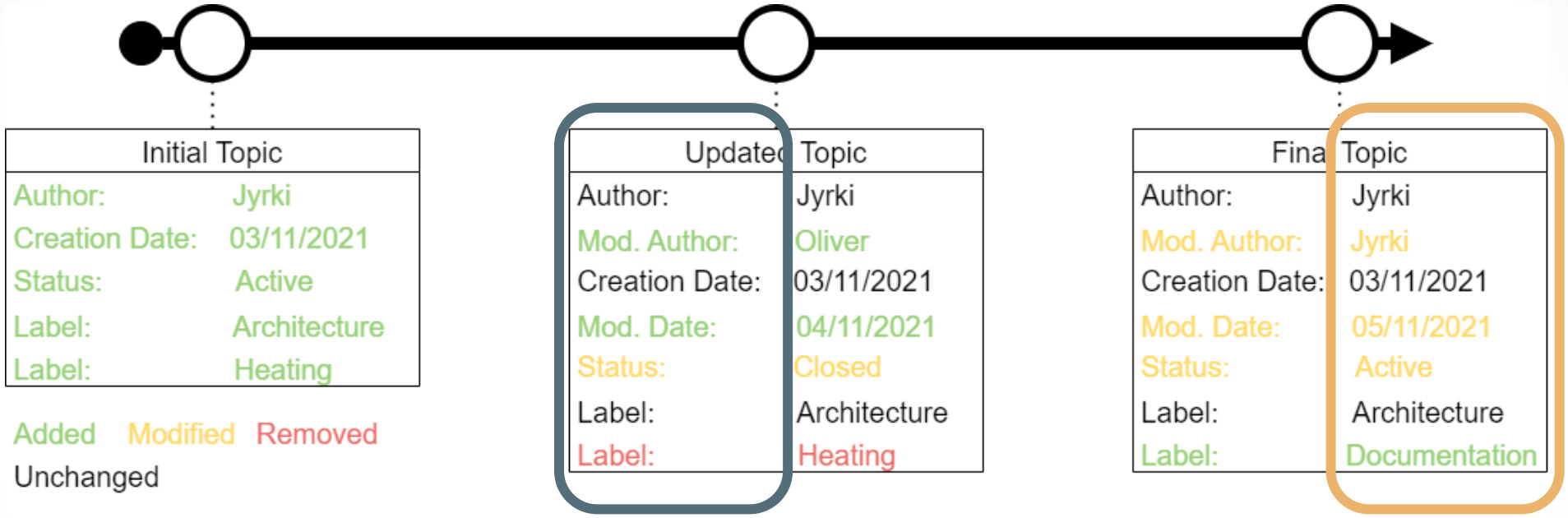

```
<Container_1> a ldp:Container;
        ldp:constrainedBy <SimpleConstraint>;
        ldp:contains <Resource1>.

<Resource1> a ldp:Resource, ex:ExampleClass .

<SimpleConstraint> a sh:NodeShape ;
    sh:targetClass ex:ExampleClass ;
    sh:property [
        ...
    ].
```

Constraint Locations for CDEs

- Project data resides in Information containers
- Project specific constraints are stored on the LDP
- Container can point to external constraints



Use Case: Issue Management



Source: Oraskari et al. 2022

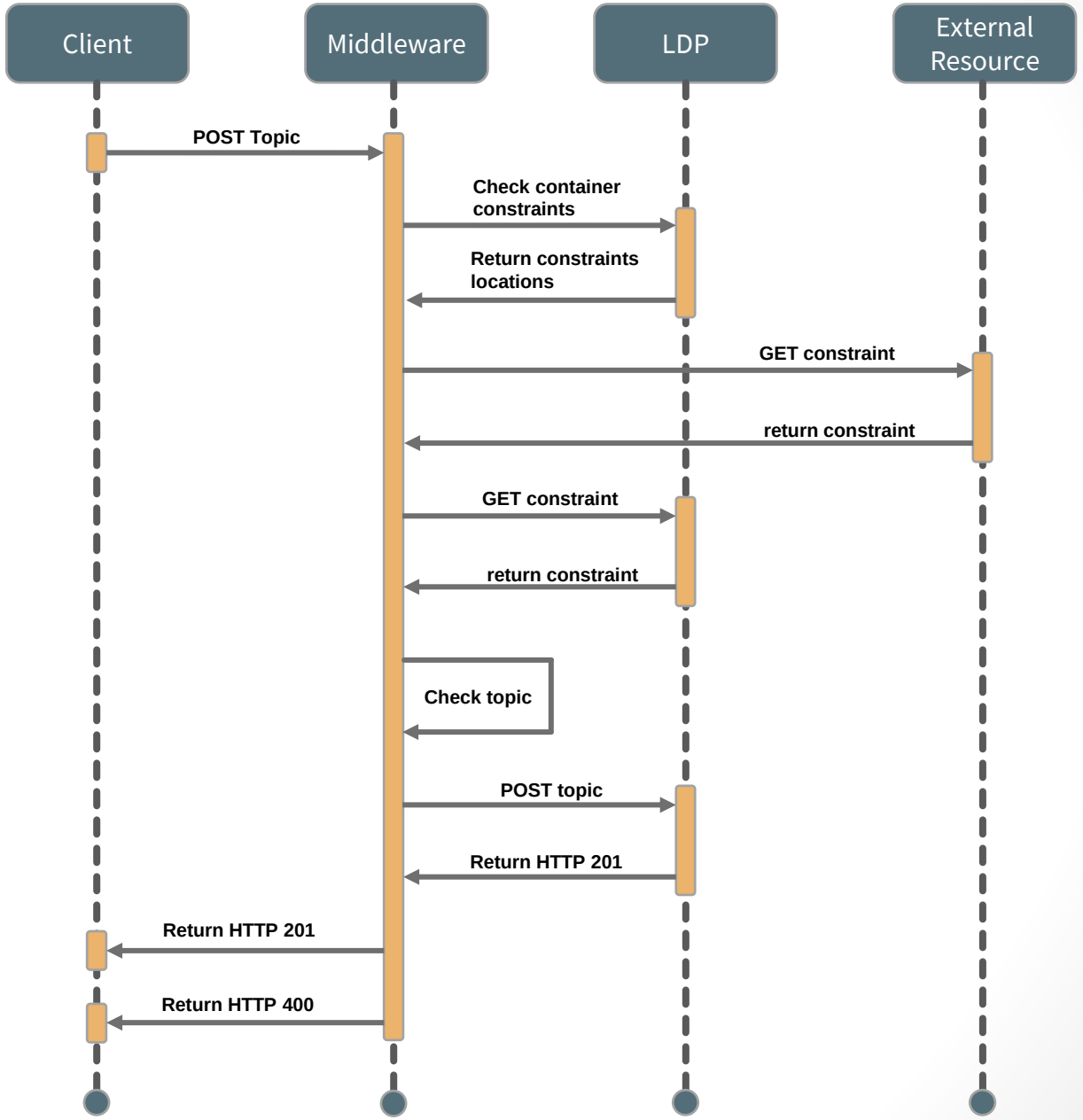
Application

```
<...external-url/TopicShape> a
sh:NodeShape;
    sh:targetClass bcfOWL:Topic ;
    sh:property [
        sh:path bcfOWL:hasTitle
    ;
        sh:minCount 1;
        sh:maxCount 1;
    ];
    sh:property [
        sh:path
        bcfOWL:hasTopicStatus;
        sh:maxCount 1;
     ].
```

```
<.../cde/project_1/constraints/TopicShape> a
sh:NodeShape ;
    sh:targetClass bcfOWL:Topic ;
    sh:property [
        sh:path bcfOWL:hasTopicStatus ;
        sh:in ("Resolved" "Active" "Closed")
        ;
    ];
     sh:property [
        sh:path bcfOWL:hasLabel ;
        sh:in (project:Architecure
        project:MEP
                project:Documentation) ;
    ].
```

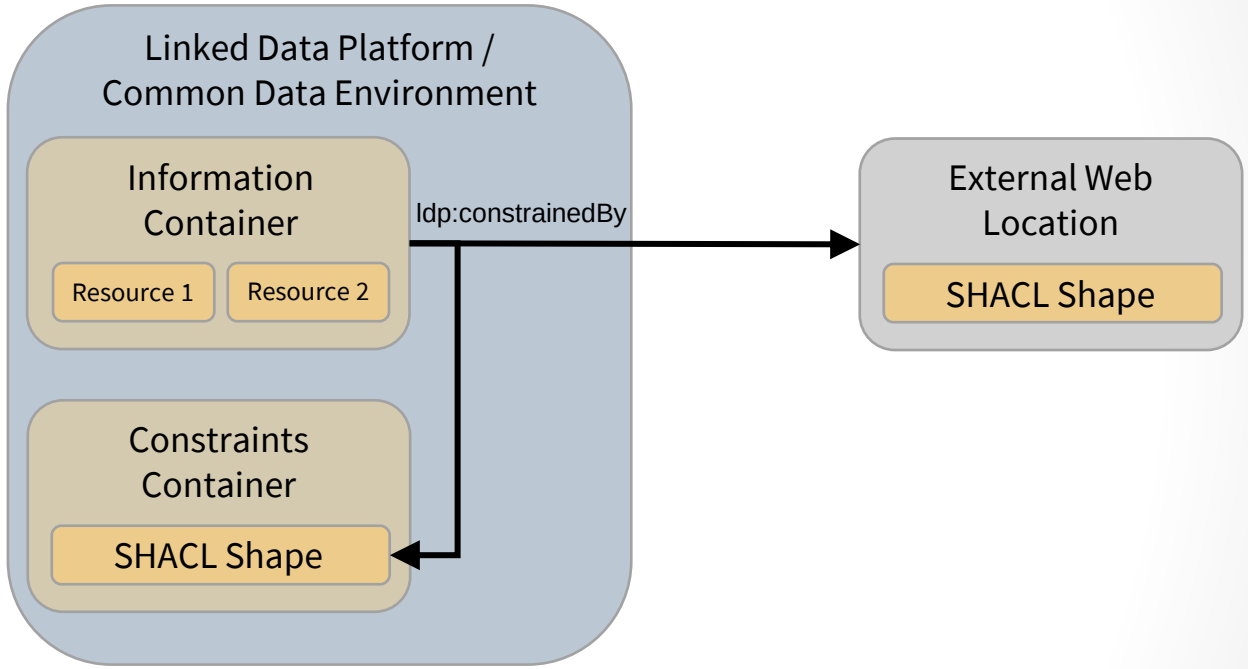
Conceptional Implementation

- LDP itself has no checking mechanism
- Middleware can check the constraints by
  - Fetching them from external and internal locations
  - Returning results to the client



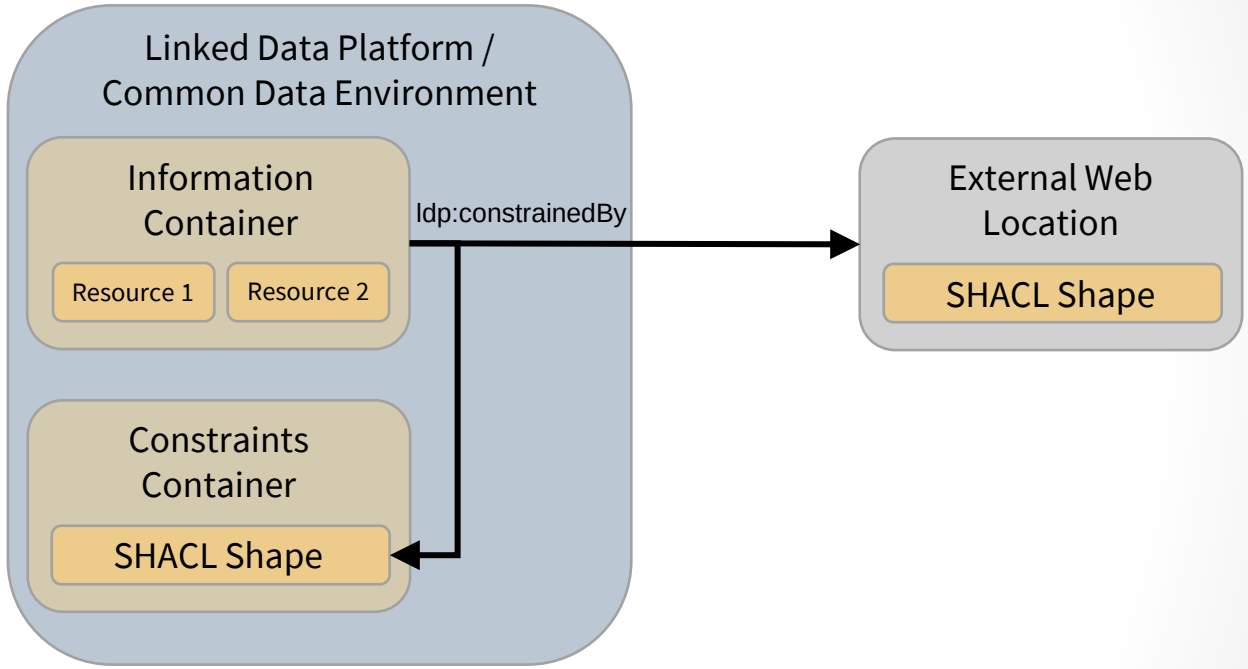
Conclusion

- Constraining LDP Containers allows us to ensure compatibility with openCDE APIs.
- It is well suited to reflect project-specific and schema-specific (external) constraints.
- LDP does not provide any solution to enforce this behaviour.



Future Work

- Have a prototypical implementation of the constrained LDP
- Investigating openCDE APIs in connection with JSON-LD
- Using the constraints in conjunction with project specific agreements
  - BIM Execution Plan
  - Exchange Information Requirements



Thank you for your attention

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