

IDLab
INTERNET & DATA LAB

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imec

Representing and enforcing policies with ODRL and DPV in decentralised systems

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Representing and enforcing policies with ODRL and DPV in decentralised systems

Changing the status quo from centralised to decentralised data

Representing policies with ODRL

Deterministic enforcement of policies

Towards legally-aligned policies with DPV

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Walled Gardens



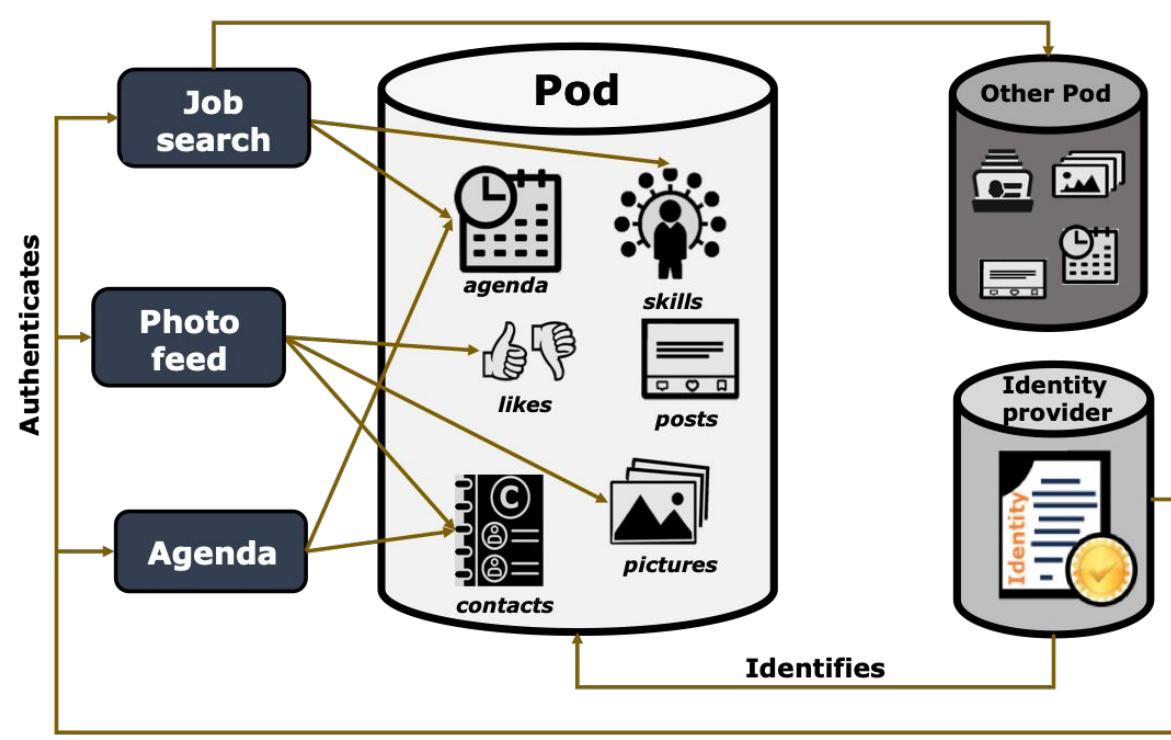
[THE BATTLE OF THE INTERNET: OPEN VS CLOSED – FURTHER EXPLORATION](#), Christopher Langley

Centralisation vs Decentralisation

Centralised Web environment



Decentralised Web environment



Personal Information Management Systems

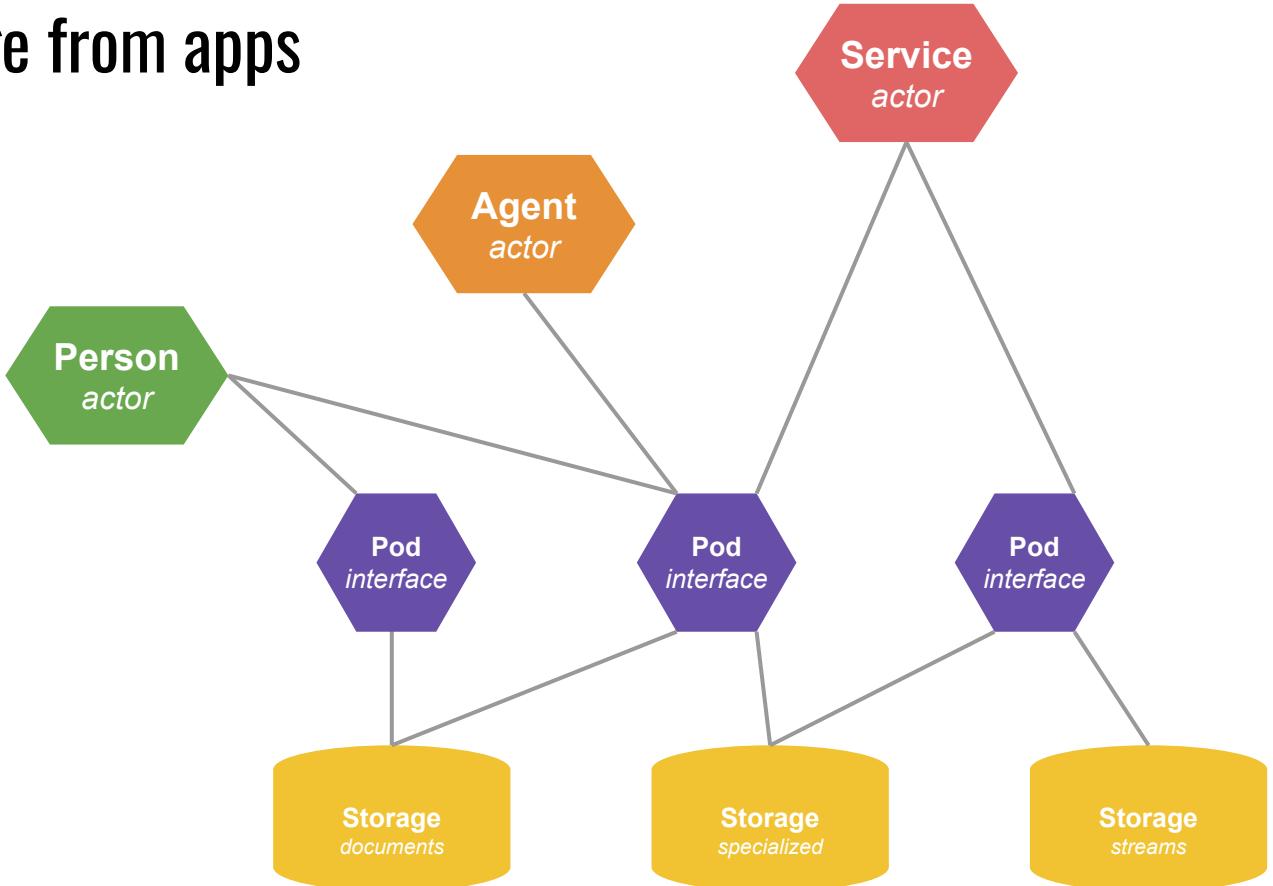
“PIMS provide features for individuals to be able to access their personal data, as well as to rectify or erase them, as provided for by the GDPR, either because the data are in repositories under their direct control or because all shared data are linked to a source, which is again in the control of the individual.”

EDPS TechDispatch #3/2020 – PIMS [1]

[1] https://www.edps.europa.eu/sites/default/files/publication/21-01-06_techdispatch-pims_en_0.pdf

Changing the *status quo*

Solid separates storage from apps



<https://solidproject.org/>

Solid Servers



Community Solid Server

An application is requesting access

Your WebID is <https://solidweb.me/besteves4/profile/card#me>

Do you trust this application to read and write data on your behalf?

Name: PodPro

ID: <https://podpro.dev/id>

Remember this client

Authorize

Cancel

Use a different WebID

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Connect to PodPro

This application wants to:

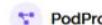
Know your WebID
Identify you using your WebID

Run in the background
To check for notifications or updates

[CANCEL](#)

[ALLOW](#)

ABOUT THIS APPLICATION



PodPro

[Developer Website](#)

Solid's Access Control

WAC – Web Access Control

```
...  
@prefix acl: <http://www.w3.org/ns/auth/acl#>.  
  
<#authz>  
  a acl:Authorization;  
  acl:agent <https://solidweb.me/besteves4/profile/card#me>;  
  acl:accessTo <https://providerX.org/userY/contacts>;  
  acl:mode acl:Read .
```

<https://solidproject.org/TR/wac>

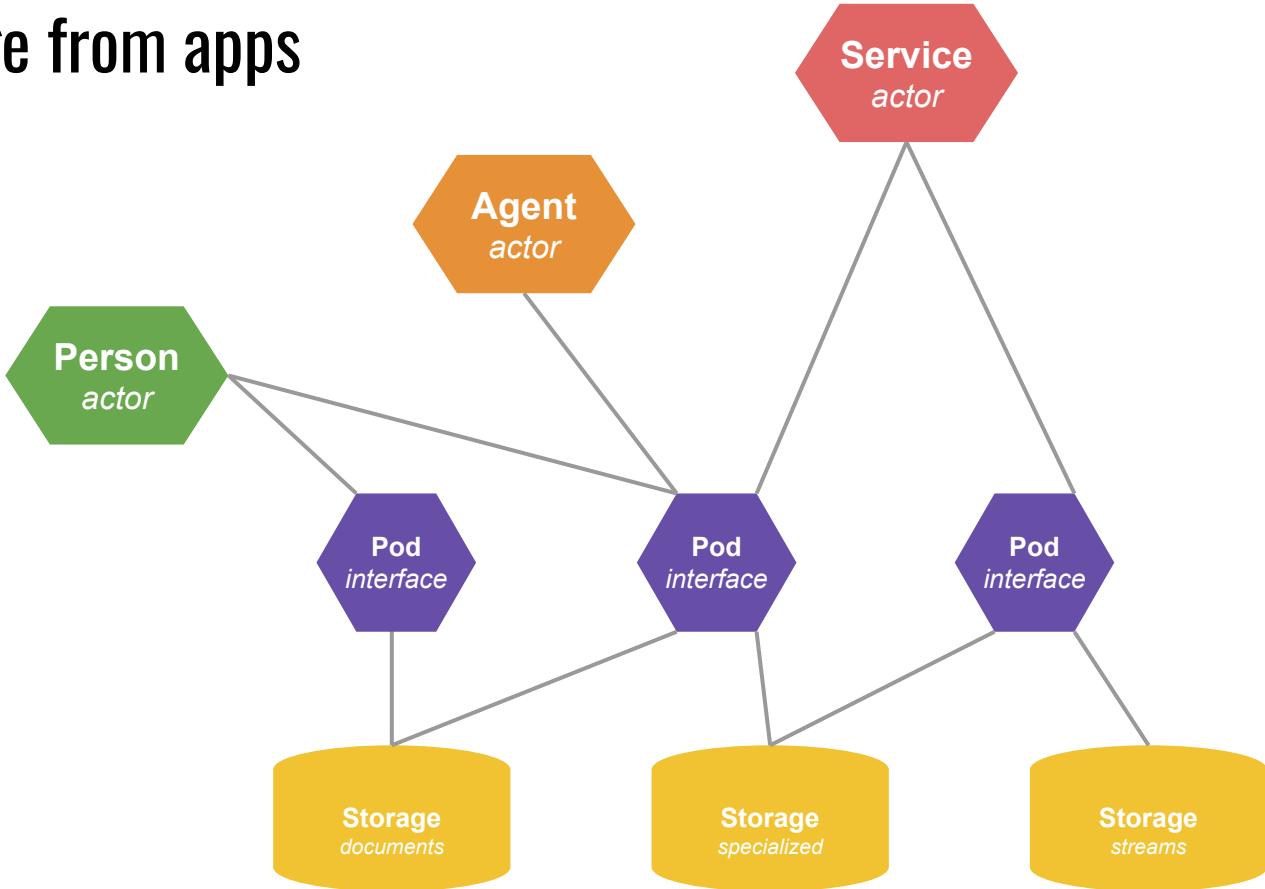
ACP – Access Control Policy

```
...  
@prefix acl: <http://www.w3.org/ns/auth/acl#>.  
@prefix acp: <http://www.w3.org/ns/solid/acp#>.  
  
<#acp> a acp:AccessGrant ;  
  acp:grant acl:Read ;  
  acp:context [  
    acp:agent <https://solidweb.me/besteves4/profile/card#me> ;  
    acp:target <https://providerX.org/userY/contacts> ;  
    acp:client <https://appZ.org>  
  ] .
```

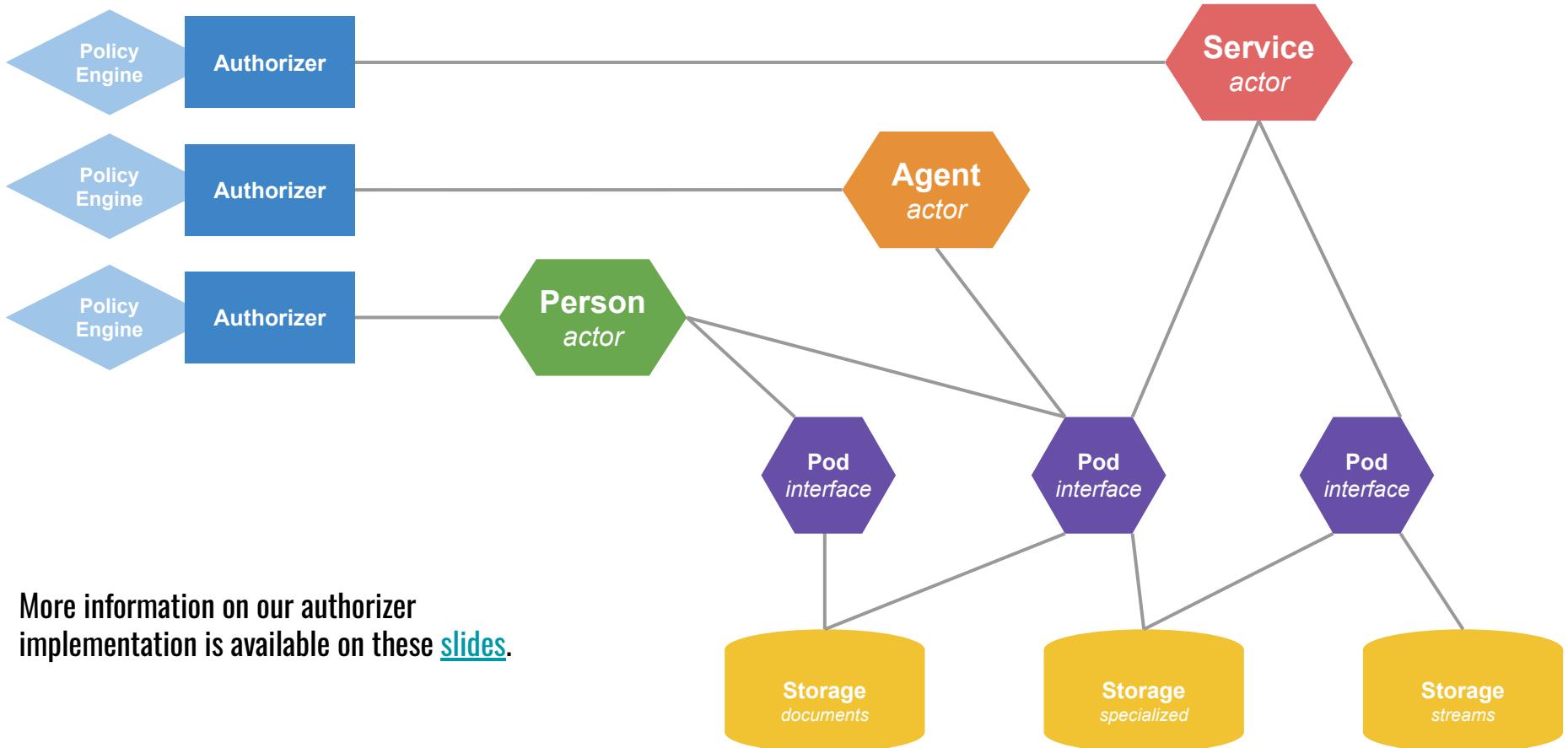
<https://solid.github.io/authorization-panel/acp-specification/>

Changing the *status quo*

Solid separates storage from apps



Separation of Concerns



More information on our authorizer implementation is available on these [slides](#).

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Compliance Monitoring

Evaluate the behavior of agents



Compliance Monitoring

Evaluate the behavior of agents

“a company needs to check if the behaviour of its employees is in accordance with the company’s rules”



Access Control

Determine who gets access to what



Access Control

Determine who gets access to what

*“I want my data to be used only for the purpose of research
and by Belgium universities”*



Licensing

How to use and integrate multiple resources
with distinct usage conditions



Licensing

How to use and integrate multiple resources
with distinct usage conditions

“I’m doing a project where I use a dataset with a Data Exploration Licence and a software library with an Academic Free License 3.0 license, can I do this at all?”

Who does what in which resource

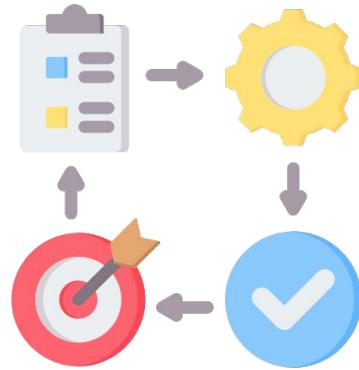


Involved entities

Who does what in which resource



Involved entities

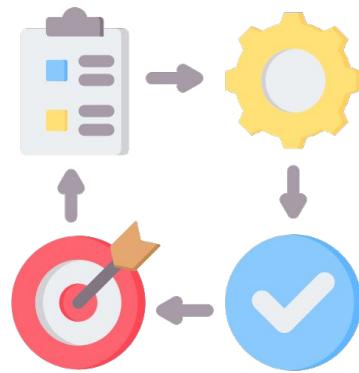


Involved action(s)

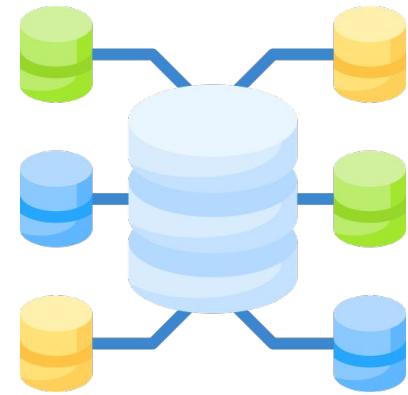
Who does what in which resource



Involved entities



Involved action(s)

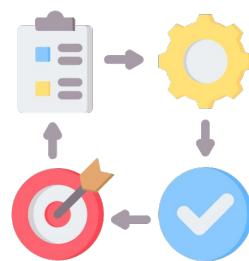


Involved resource(s)

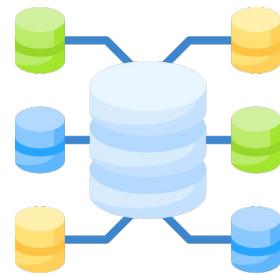
Who does what in which resource under certain conditions



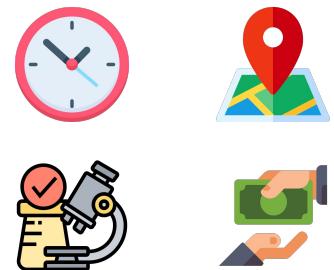
Involved entities



Involved action(s)



Involved
resource(s)

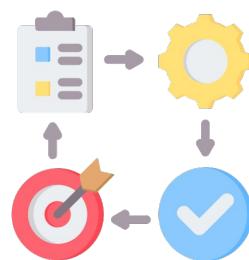


Time
Location
Purpose
Payment

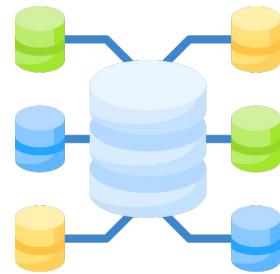
Health data sharing



My GP



Read



**Blood Test
Results**

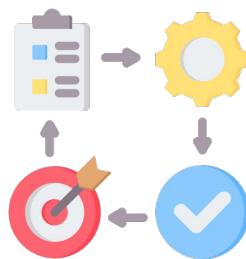


**During
consultation;
For clinical
diagnosis**

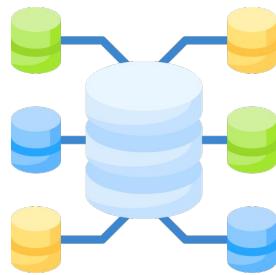
Financial data sharing



My bank



Read



**Bank account
statements**



**For loan
assessment**

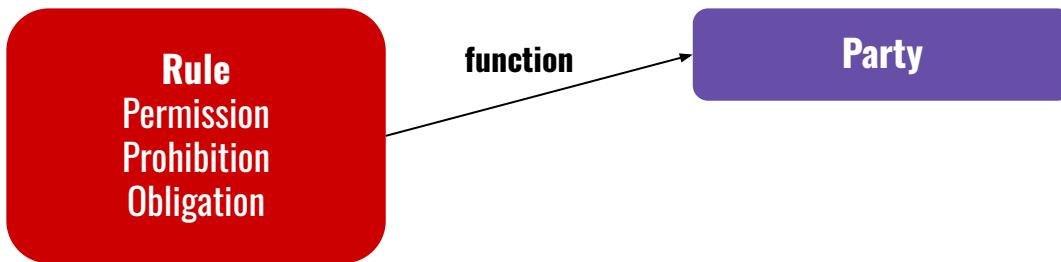
Open Digital Rights Language (ODRL)

- Standard for the expression of policies
 - [ODRL Information Model – W3C Recommendation](#)
 - [ODRL Core Vocabulary – W3C Recommendation](#)
- Maintained by the [W3C ODRL Community Group](#)
- Composed by several other specifications
 - [ODRL Implementation Best Practices](#)
 - [ODRL Profile Best Practices](#)
 - [ODRL Formal Semantics \[Under development\]](#)
 - [ODRL Community Vocabulary \[Under development\]](#)
- Easily extendable through the use of ODRL profiles

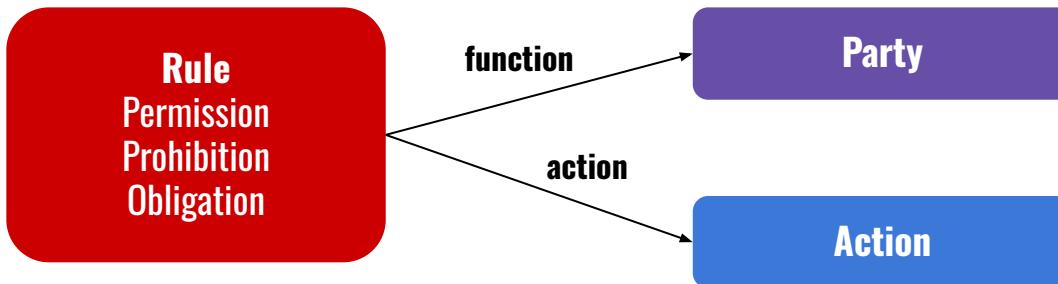
Who [can|cannot|must] act what in which resource how

Rule
Permission
Prohibition
Obligation

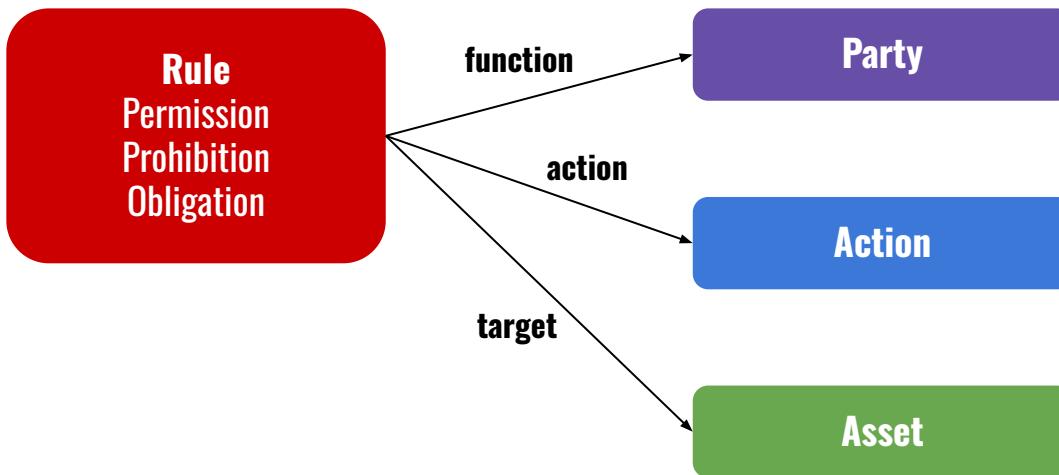
Who [can|cannot|must] act what in which resource how



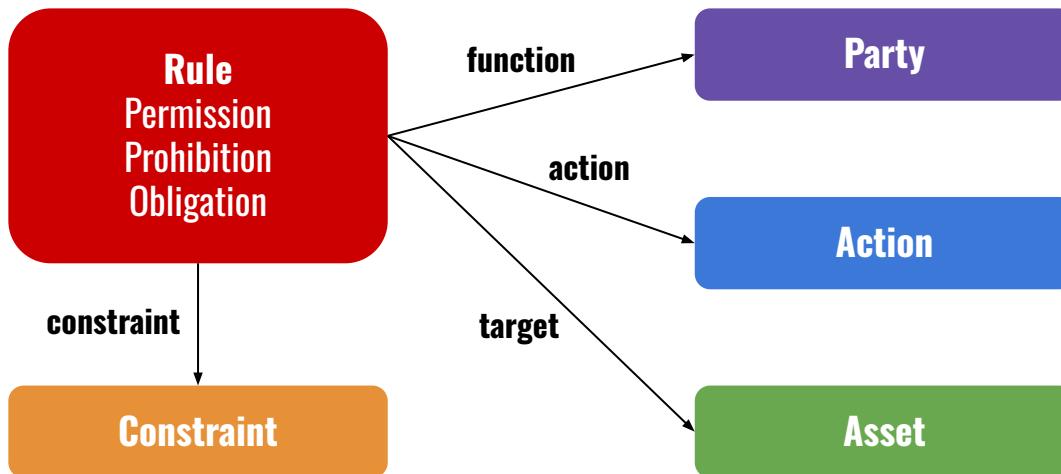
Who [can|cannot|must] act what in which resource how



Who [can|cannot|must] act what in which resource how

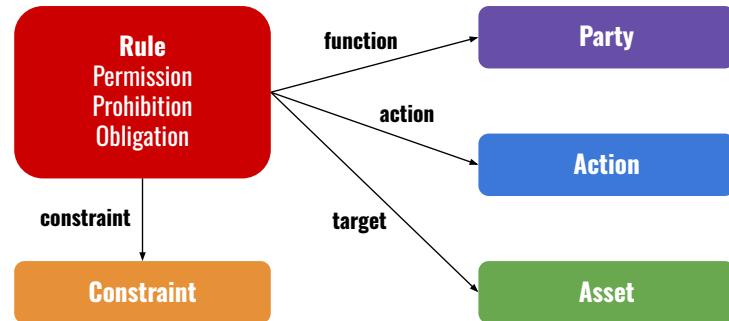


Who [can|cannot|must] act what in which resource how



Open Digital Rights Language (ODRL)

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Policies

Data can only be accessed once

Delete data after 1 week

Data can only be accessed by my GP

Purpose for access is service provision

Access for commercial purposes is prohibited

Resource can only be updated

Email address can be read by everyone

Open Digital Rights Language (ODRL)

```
@prefix dcterms: <http://purl.org/dc/terms/> .  
@prefix dpv: <https://w3id.org/dpv#> .  
@prefix dpv-odrl: <https://w3id.org/dpv/mappings/odrl#> .  
@prefix ex: <https://example.org/> .  
@prefix odrl: <http://www.w3.org/ns/odrl/2/> .  
  
ex:read-multiple-purposes a odrl:Set ;  
    odrl:uid ex:read-multiple-purposes ;  
    odrl:profile dpv-odrl: ;  
    dcterms:description "User A allows Company B to read to its contact details."@en ;  
    odrl:permission [  
        odrl:action odrl:read ;  
        odrl:target <https://example.org/userA/contacts> ;  
        odrl:assigner ex:userA ;  
        odrl:assignee faqir:companyB ;  
        odrl:constraint [  
            odrl:leftOperand dpv-odrl:Purpose ;  
            odrl:operator odrl:isAnyOf ;  
            odrl:rightOperand dpv:ServiceProvision, dpv:NonCommercialResearch ] ] .
```

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Representing policies with ODRL

Deterministic enforcement of policies

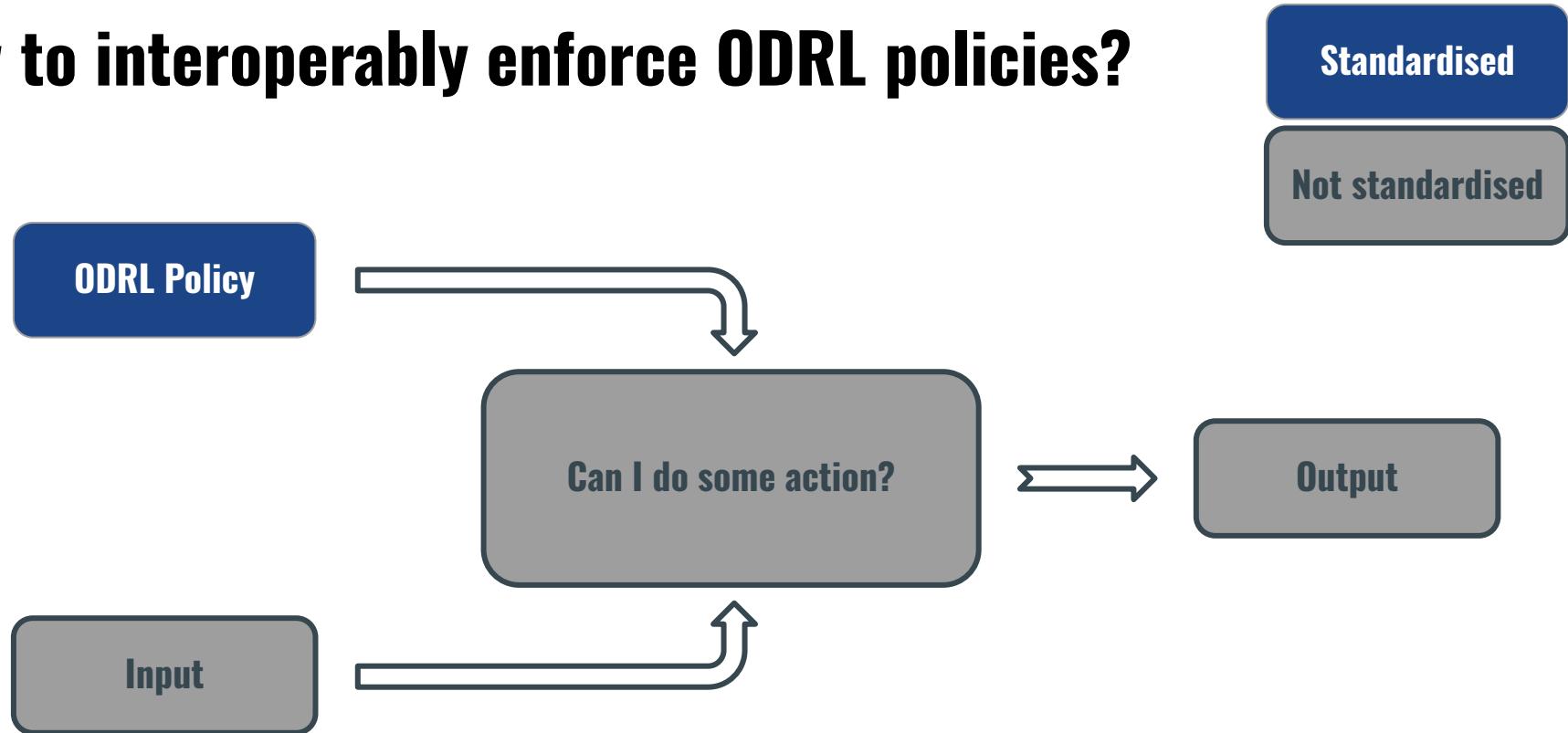
Towards legally-aligned policies with DPV

How to interoperably enforce ODRL policies?

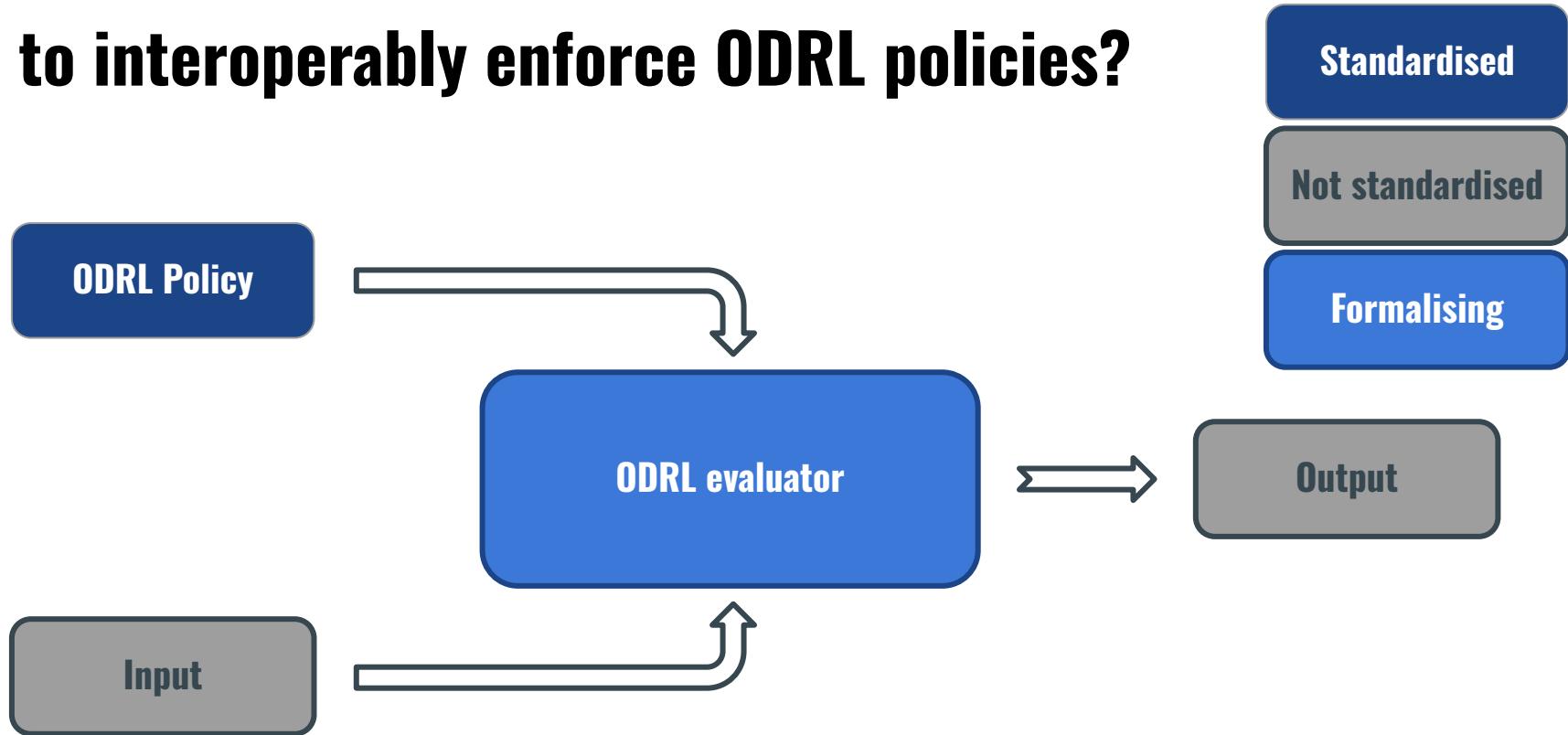
Standardised

ODRL Policy

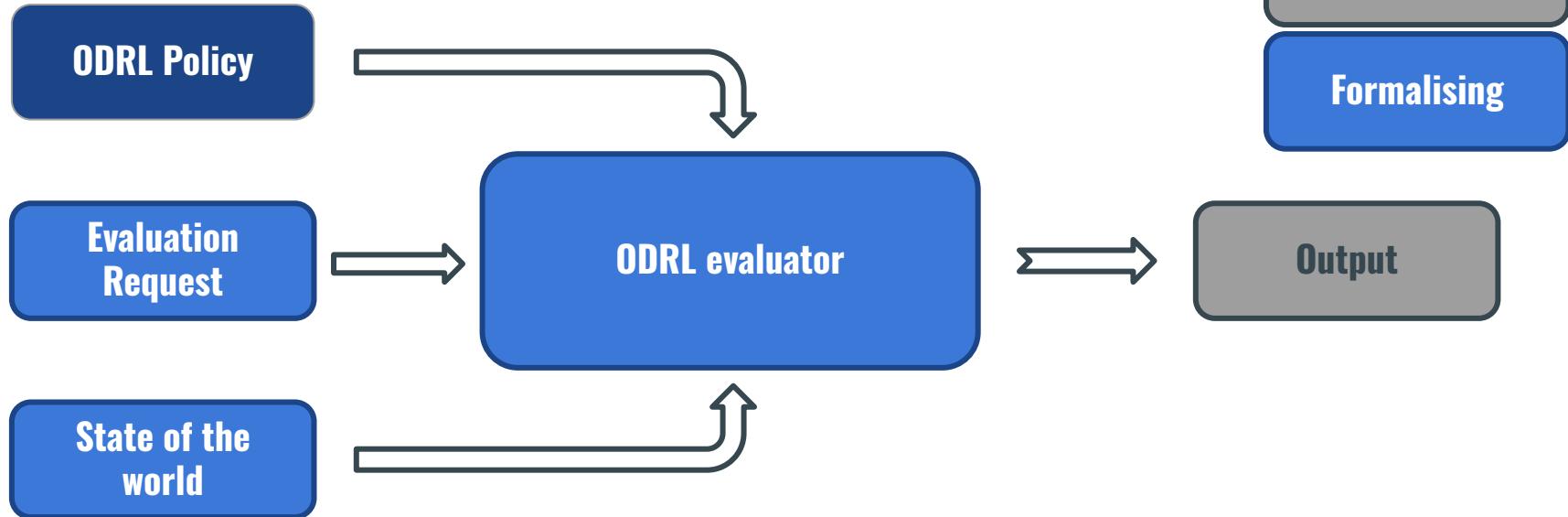
How to interoperably enforce ODRL policies?



How to interoperably enforce ODRL policies?



How to interoperably enforce ODRL policies?



Standardised

Not standardised

Formalising

Output

Esteves, Beatriz, Wout Slabbinck, Yassir Sellami, Andrea Cimmino, Víctor Rodríguez-Doncel, and Ruben Verborgh. 'Capturing Requests and Context for ODRL-Based Access and Usage Control'. Joint Proceedings of the 16th Workshop on Ontology Design and Patterns and the 1st Workshop on Bridging Hybrid Intelligence and the Semantic Web (WOP-HAIBRIDGE 2025) Co-Located with the 24th International Semantic Web Conference (ISWC 2025), 2025. <https://ceur-ws.org/Vol-4093/paper5.pdf>.

Evaluation Request

Definition 1 (Evaluation Request). *Formal description of a requested action by an assignee on a target asset, which can be enriched with further contextual information.*

CQR1. What is the requested action?

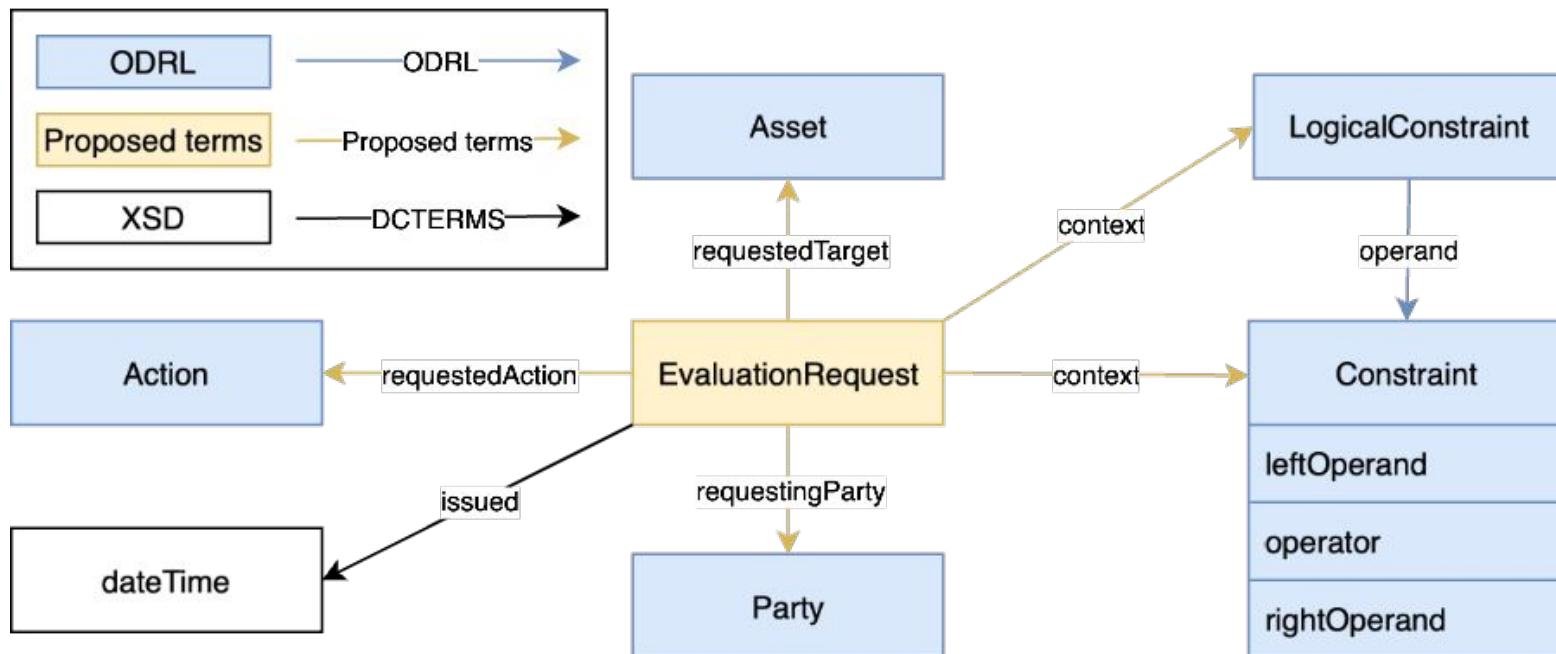
CQR2. Who is the party issuing the evaluation request?

CQR3. What is the target asset of the evaluation request?

CQR4. When was the evaluation request issued?

CQR5. What additional contextual information can be included in the evaluation request to further constrain it?

Evaluation Request



State of the world

Definition 2 (State of the World). *Knowledge representing real-world information aiding the evaluation of ODRL Policies.* (Adapted from Slabbinck *et al.* [16]).

CQS1. What is the current time?

CQS2. What is the location of a party?

CQS3. What assets are part of the asset collection of the policy that is being evaluated?

CQS4. Which parties are part of the party collection of the policy that is being evaluated?

CQS5. What actions were already performed or attempted?

CQS6. How many times has a rule been exercised?

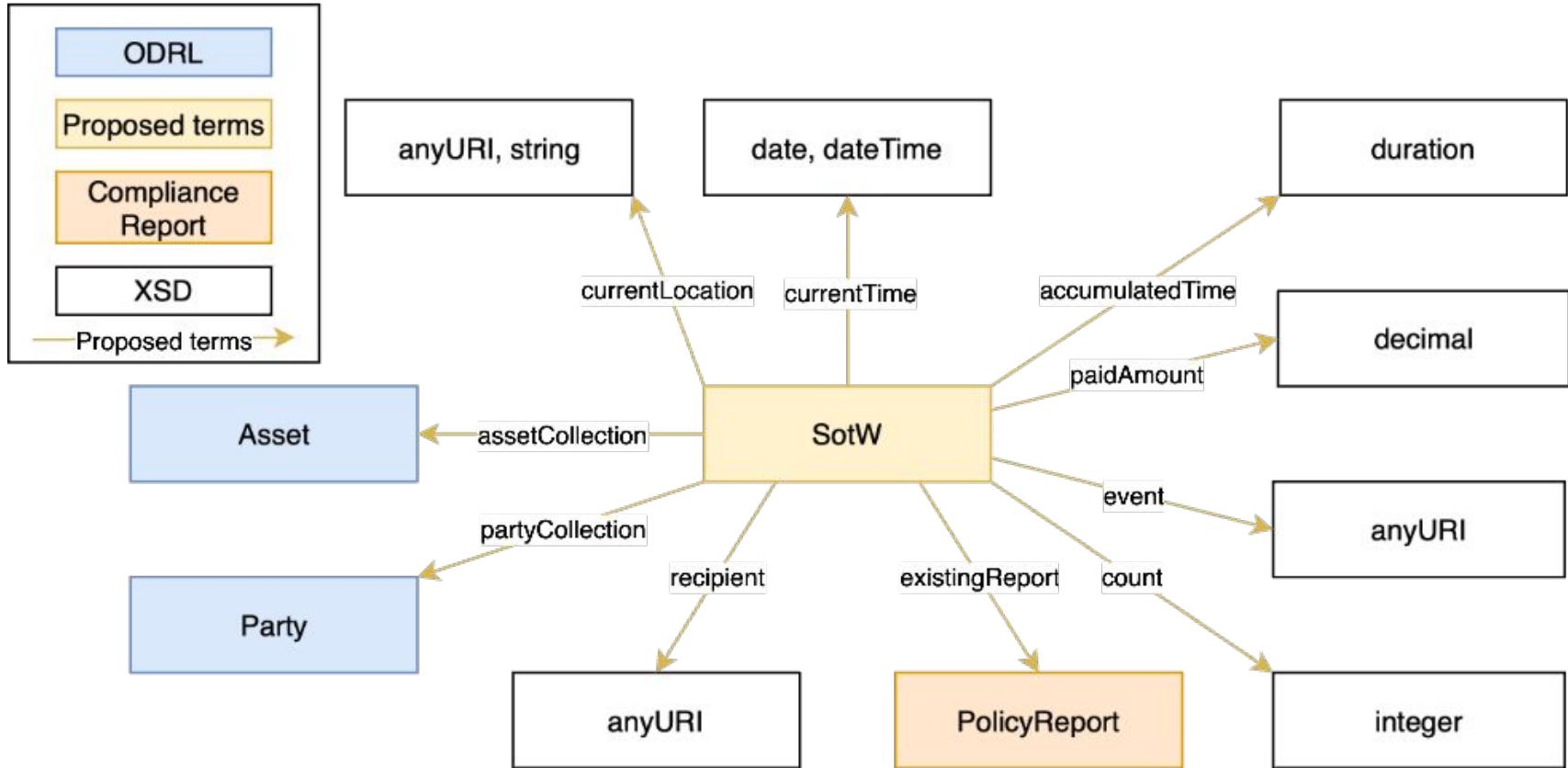
CQS7. What information is available about an event that has occurred?

CQS8. How long has a rule been exercised?

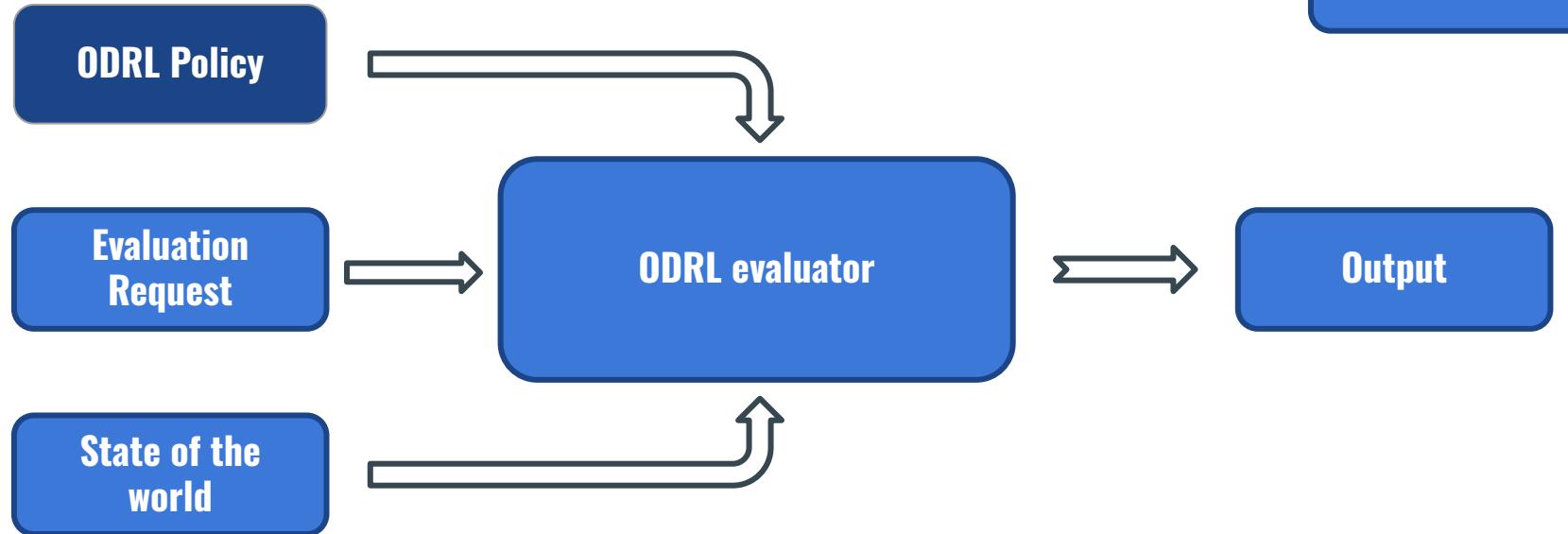
CQS9. Which recipients or categories of recipients can receive the result of the rule that has been exercised?

CQS10. Has a financial payment been made? What was the amount paid?

State of the world



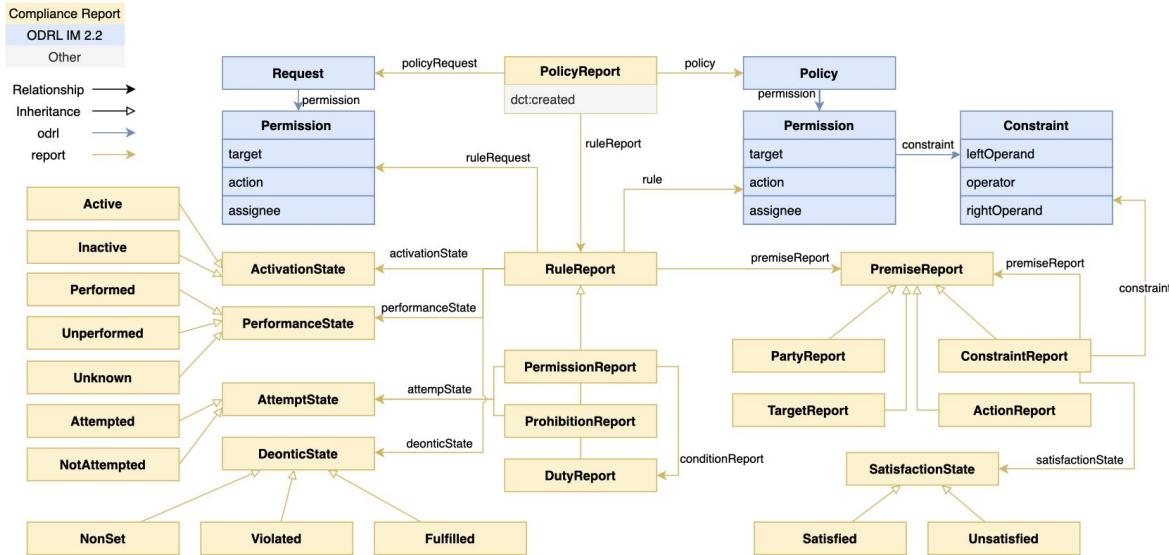
How to interoperably enforce ODRL policies?



Standardised

Formalising

Interoperable Interpretation and Evaluation of ODRL Policies

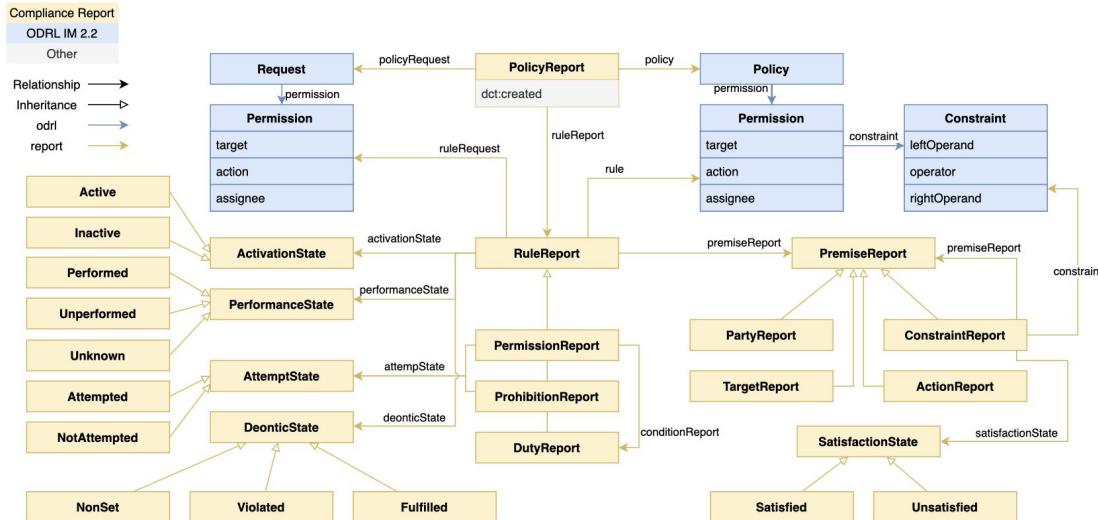


<https://w3id.org/force/compliance-report>

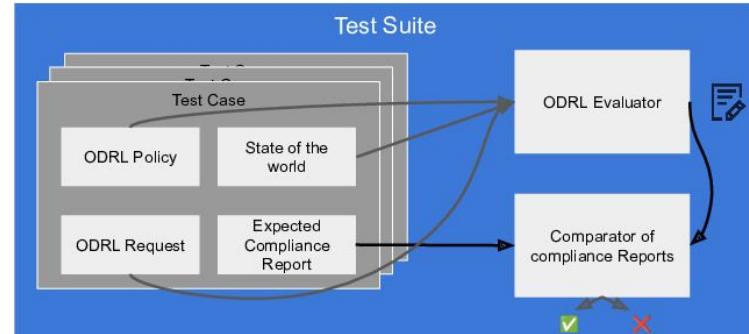


ESWC 2025
Best Resource Nominee

Compliance Report Model & Test Suite



<https://w3id.org/force/compliance-report>



<https://w3id.org/force/test-suite>

**Company X allows employees to access
documents during weekdays only, from the EU**

Policy

Company X allows employees to access documents during weekdays only, from the EU

```
@prefix dcterms: <http://purl.org/dc/terms/> .  
@prefix loc: <https://w3id.org/dpv/loc#> .  
@prefix ex: <https://example.org/> .  
@prefix odrl: <http://www.w3.org/ns/odrl/2/> .  
@prefix ncal: <http://www.semanticdesktop.org/ontologies/2007/04/02/ncal#> .  
  
ex:read-documents a odrl:Set ;  
    odrl:uid ex:read-documents ;  
    dcterms:description "Company X allows employees to access documents during weekdays only, from the EU."@en ;  
    odrl:permission [  
        odrl:action odrl:read, odrl:modify ;  
        odrl:target ex:document-companyX ;  
        odrl:assigner ex:companyX ;  
        odrl:assignee ex:companyX-employees ;  
        odrl:constraint [  
            odrl:leftOperand odrl:datetime ;  
            odrl:operator odrl:isA ;  
            odrl:rightOperand ncal:Weekday ], [  
            odrl:leftOperand odrl:spatial ;  
            odrl:operator odrl:eq ;  
            odrl:rightOperand loc:EU ] ] .
```

Request

Company X allows employees to access documents during weekdays only, from the EU

```
@prefix dcterms: <http://purl.org/dc/terms/> .  
@prefix ex: <https://example.org/> .  
@prefix odrl: <http://www.w3.org/ns/odrl/2/> .  
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .  
@prefix : <https://w3id.org/force/sotw#> .  
  
ex:request a :EvaluationRequest ;  
    dcterms:issued "2025-11-03T10:20:10.999Z"^^xsd:dateTime ;  
    :requestedAction odrl:read ;  
    :requestingParty ex:employeeY ;  
    :requestedTarget ex:document-companyX ;  
    :context [  
        odrl:leftOperand odrl:purpose ;  
        odrl:operator odrl:eq ;  
        odrl:rightOperand "Perform task A" ] .
```

State of the World

Company X allows employees to access documents during weekdays only, from the EU

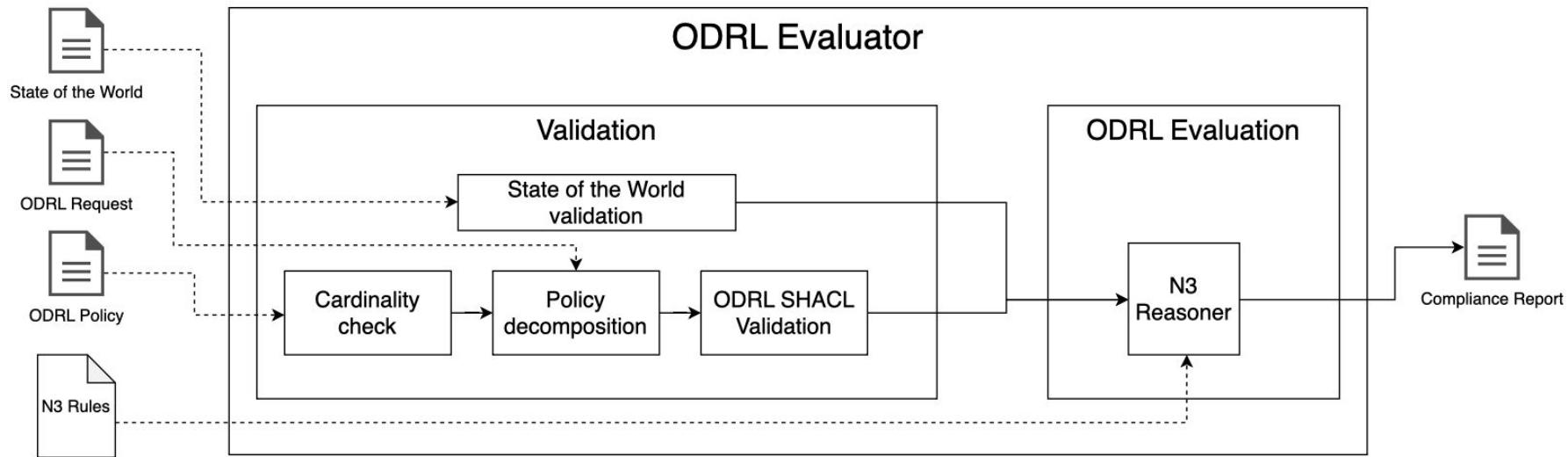
```
@prefix dcterms: <http://purl.org/dc/terms/> .  
@prefix loc: <https://w3id.org/dpv/loc#> .  
@prefix ex: <https://example.org/> .  
@prefix odrl: <http://www.w3.org/ns/odrl/2/> .  
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .  
@prefix ncal: <http://www.semanticdesktop.org/ontologies/2007/04/02/ncal#> .  
@prefix : <http://w3id.org/force/sotw#> .  
  
ex:sotw a :SotW ;  
    :currentLocation loc:BE ;  
    :currentTime ex:date ;  
    :partyCollection ex:employeeY .  
  
loc:BE skos:broader loc:EU .  
ex:date a ncal:Weekday ;  
    rdf:value ncal:Weekday .  
ex:employeeY odrl:partOf ex:companyX-employees .
```

Compliance Report

Company X allows employees to access documents during weekdays only, from the EU

```
@prefix odrl: <http://www.w3.org/ns/odrl/2/> .  
@prefix ex: <https://example.org/> .  
@prefix report: <https://w3id.org/force/compliance-report#> .  
  
ex:report report:PolicyReport ;  
    report:ruleReport ex:rule-report .  
  
ex:rule-report a report:PermissionReport ;  
    report:attemptState report:Attempted ;  
    report:premiseReport ex:target-report, ex:party-report, ex:action-report,  
        ex:time-constraint, ex:location-constraint ;  
    report:activationState report:Active .  
  
ex:target-report a report:TargetReport ;  
    report:satisfactionState report:Satisfied .  
  
ex:party-report a report:PartyReport ;  
    report:satisfactionState report:Satisfied .  
  
ex:action-report a report:ActionReport ;  
    report:satisfactionState report:Satisfied .  
  
ex:time-constraint a report:ConstraintReport ;  
    report:satisfactionState report:Satisfied .  
  
ex:location-constraint a report:ConstraintReport ;  
    report:satisfactionState report:Satisfied .
```

Interoperable Interpretation and Evaluation of ODRL Policies



<https://w3id.org/force/demo>

Slabbinck, Wout, Julián Rojas Meléndez, Beatriz Esteves, Ruben Verborgh, and Pieter Colpaert. 'May the FORCE Be with You? A Framework for ODRL Rule Compliance through Evaluation'. Posters, Demos, Workshops, and Tutorials at SEMANTiCS 2025, 2025. <https://ceur-ws.org/Vol-4064/NXDG25-paper6.pdf>.

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Changing the status quo from centralised to decentralised data

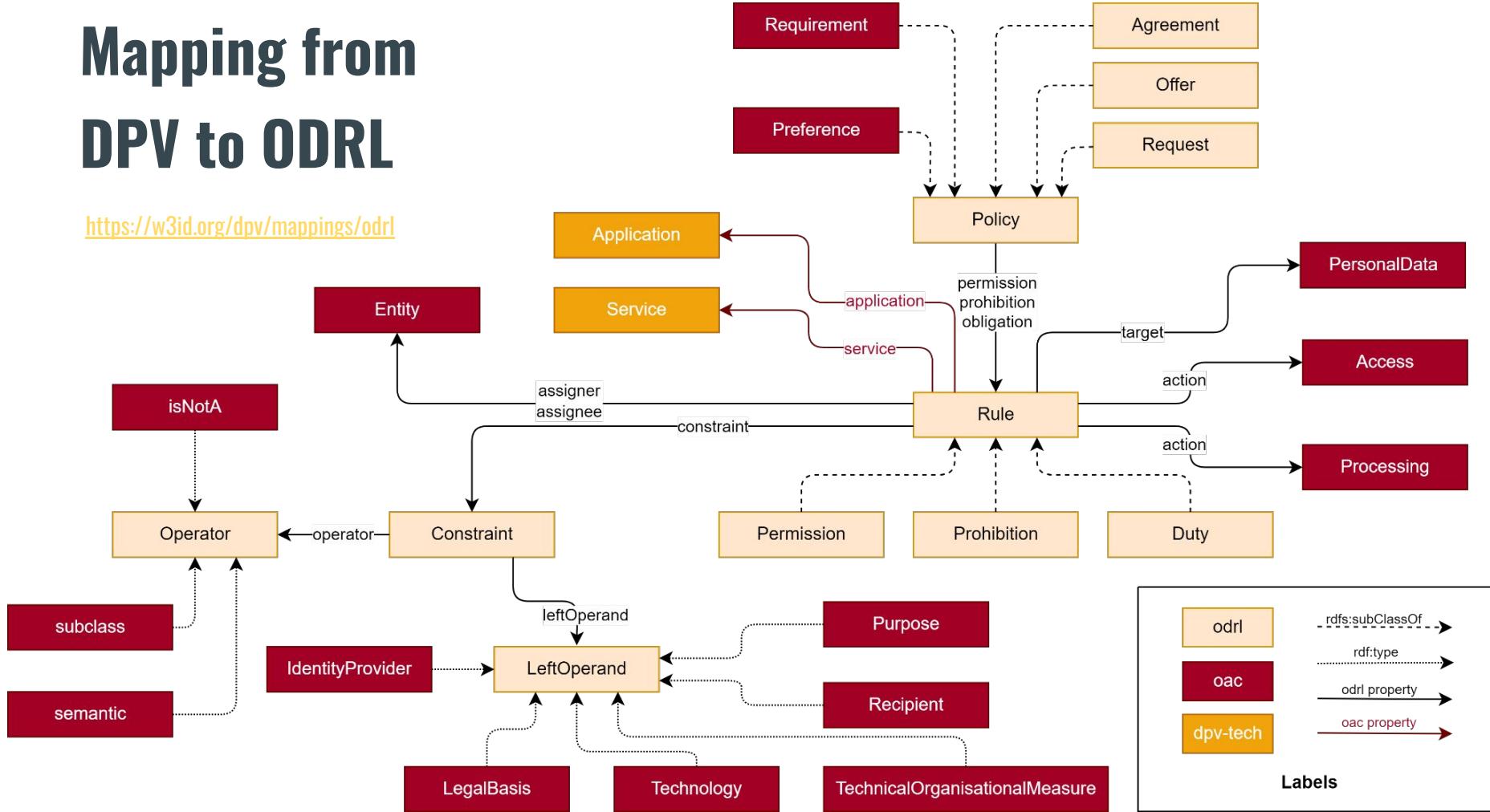
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Mapping from DPV to ODRL

<https://w3id.org/dpv/mappings/odrl>





```
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix dpv: <https://w3id.org/dpv#> .
@prefix ex: <https://example.org/> .
@prefix odrl: <http://www.w3.org/ns/odrl/2/> .
@prefix dpv-odrl: <https://w3id.org/dpv/mappings/odrl#> .
@prefix eu-gdpr: <https://w3id.org/dpv/legal/eu/gdpr#> .

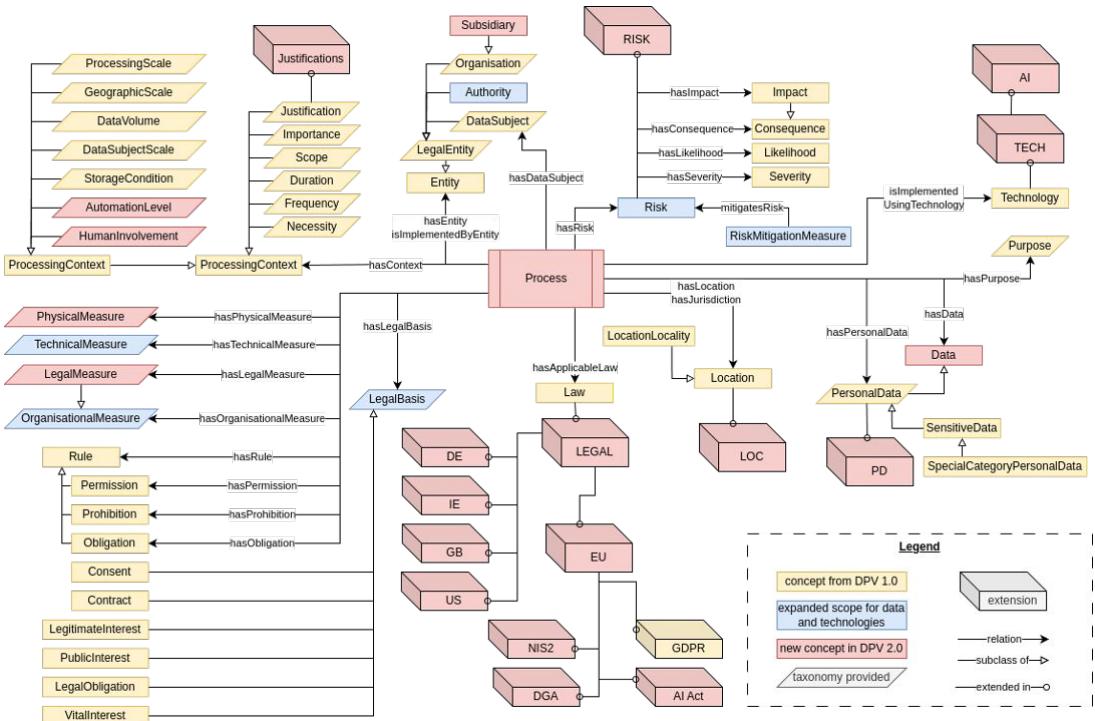
ex:read-preferences a odrl:Agreement ;
  odrl:uid ex:read-preferences ;
  odrl:profile dpv-odrl: ;
  dcterms:description "Company X is allowed to read preferences for service personalisation based on consent."@en ;
  odrl:permission [
    odrl:action odrl:read ;
    odrl:target ex:preferences ;
    odrl:assigner ex:beatrix ;
    odrl:assignee ex:companyX ;
    odrl:constraint [
      odrl:leftOperand dpv-odrl:Purpose ;
      odrl:operator odrl:isA ;
      odrl:rightOperand dpv:ServicePersonalisation ], [
        odrl:leftOperand dpv-odrl:LegalBasis ;
        odrl:operator odrl:eq ;
        odrl:rightOperand eu-gdpr:A6-1-a ] ] .
```

- Developed by the W3C Data Privacy Vocabularies and Controls Community Group (DPVCG)
- Defines a **jurisdiction-agnostic** ontology for expressing metadata about the processing of personal data
- Provides **hierarchical taxonomies**, from abstract to more specific concepts, to instantiate specific concepts in practical use-cases
- Has law-specific extensions

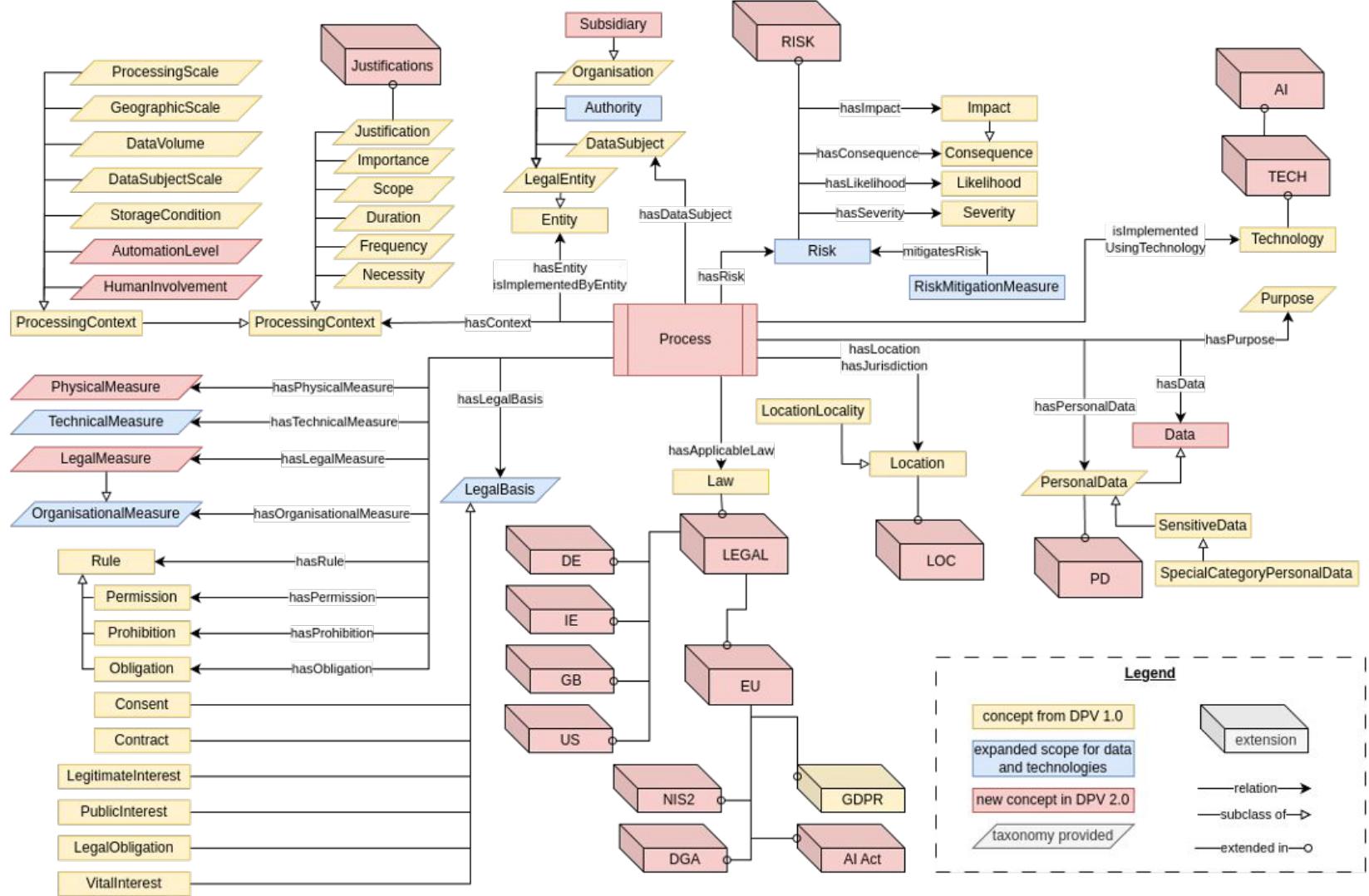
<https://w3id.org/dpv>

<https://w3id.org/dpv/primer>

Data Privacy Vocabulary (DPV)



Harshvardhan J. Pandit, Beatriz Esteves, Georg P. Krog, Paul Ryan, Delaram Golpayegani, and Julian Flake. **Data Privacy Vocabulary (DPV) – Version 2.0**. In *The Semantic Web – ISWC 2024*, pages 171–93. Cham: Springer Nature Switzerland, 2024. doi: [10.1007/978-3-031-77847-6_10](https://doi.org/10.1007/978-3-031-77847-6_10).



General Data Protection Regulation (GDPR)



W3C Community Group
Final Report

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- 2. Mapping GDPR concepts to DPV**
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version 2.2

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Abstract

This document lists the various guides created by the DPVCG and the community providing guidance for the adoption and use of DPV in terms of its concepts and serialisations, or regarding the application of DPV for specific applications or domains.

The DPVCG invites contributions regarding additional guides as well as updates to existing guides.

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Harshvardhan J. Pandit (AI Accountability Lab (AIAL), Trinity College Dublin)
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Beatrix Esteves, Victor Rodriguez-Doncel, and Ricardo Longares. Automating the Response to GDPR's Right of Access. In *Legal Knowledge and Information Systems*, pages 170–175. IOS Press, 2022. doi: [10.3233/FAIA220462](https://doi.org/10.3233/FAIA220462).

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Guide for using DPV for Rights Exercise and Management

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Abstract

This document will provide a guide for using DPV for Rights Exercise and Management. Currently, it is a work in progress.

ISSUE 191: Create a guide for Machine-Actionable Rights [rights](#) [guide](#) [WIP](#) [eu-odpr](#)

Beatrix Esteves, Harshvardhan J. Pandit, Georg P. Krog, and Paul Ryan. How to Manage My Data? With Machine-Interpretable GDPR Rights! In *Legal Knowledge and Information Systems*, 269–74. IOS Press, 2024. doi: [10.3233/FAIA241254](https://doi.org/10.3233/FAIA241254).

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  odrl:permission [
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    odrl:target ex: dataset_location ;
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      odrl:operator odrl:eq ;
      odrl:rightOperand eu-gdpr:A6-1-a ] ] .

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<https://w3id.org/dpv/legal/eu/dga>

Beatrix Esteves, Víctor Rodríguez-Doncel, Harshvardhan J. Pandit, and Dave Lewis. Semantics for Implementing Data Reuse and Altruism Under EU's Data Governance Act. In *Knowledge Graphs: Semantics, Machine Learning, and Languages*, pages 210–226. IOS Press, 2023. doi: [10.3233/SSW230015](https://doi.org/10.3233/SSW230015).

European Health Data Spaces (EHDS)



W3C Community Group
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Contributors: (ordered alphabetically) **Arthit Suriyawongkul** (ADAPT Centre, Trinity College Dublin), **Beatriz Esteves** (IDLab, IMEC, Ghent University). NOTE: The affiliations are informative, do not represent formal endorsements, and may be outdated as this list is generated automatically from existing data.

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ISO/IEC TS 27560:2023

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**IEEE Approved Draft Standard for Machine
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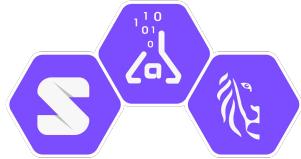
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