Policy Transformation within The Eclipse Dataspace Connector (EDC)

Overview and Results

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Who are we?

Research team in Huawei Munich Research Center

Trustworthy Technology and Engineering Laboratory

R&D team from Security Forge

A spin-off startup of CNR Italy

Interested in:

Dynamic authorization

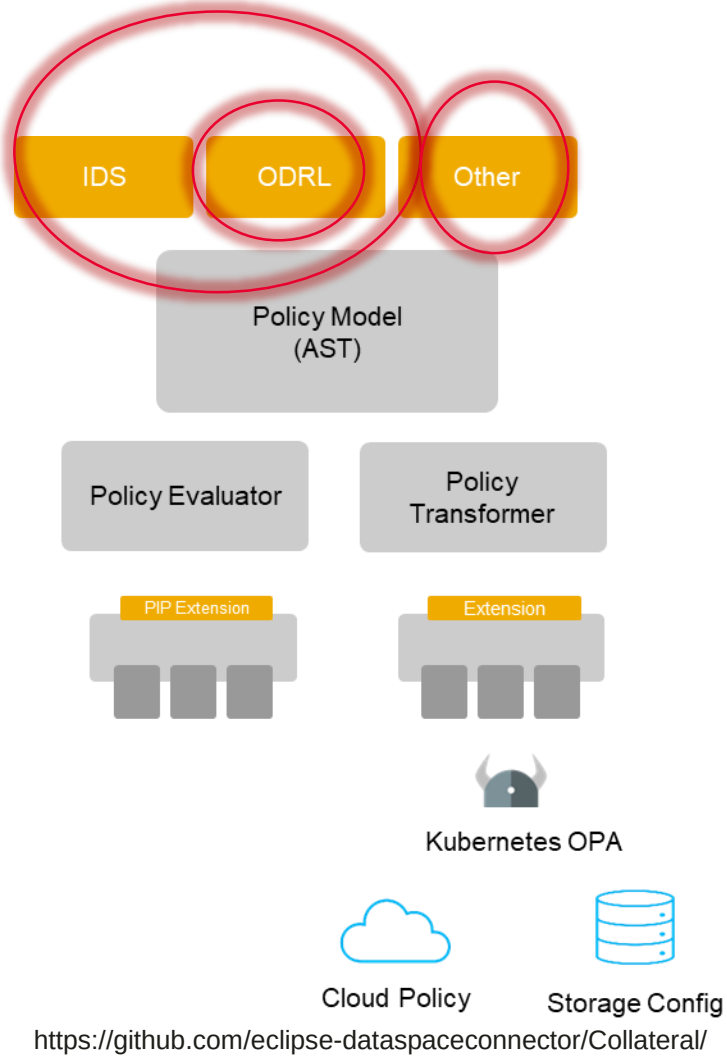
Identity and Access management systems

Privacy-enhancing technologies

Usage Control

EDC Policy Design

- EDC uses ODRL to express policies
  - ODRL and ABAC (XACMLv3) have been around for a while and the issue of how they relate to each other is important
  - ODRL models digital rights without a reference architecture and XACML is a security access/usage standard
- EDC Uses IDS/ODRL as declarative high-level language about rights and contracts and is open for extension
- How about interoperability, relation, refinement with other languages and standards?



https://github.com/eclipse-dataspaceconnector/Collateral/

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Background: Open Digital Rights Language (ODRL)*

- A rights with **vocabulary** for representing statements concerning the **rights** regarding **digital resources**
- A *Policy* contains ***Permissions*** and ***Prohibitions, Duties***
  - act on ***Action***, executed over an ***Asset*** by a ***Party***
  - can be limited by ***Constraints***
  - Constraints have a *name* (e.g. count), an *operator* (e.g. leq), a *right operand* (e.g. '5') and possibly an *status (e.g. '3')* "*The action may be exercised 5 times, and currently it has already been executed 3"*
- Provides with common vocabulary
  - 60 actions, to be used in permissions, prohibitions and duties: **copy**, **delete**, **modify**, **inform**
  - 30 constraints: **language**, **count**, **dateTime**, **industry**
  - 12 operators: **eq**, **gt**, **isPartOf**
  - 7 kinds of roles: **assigner**, **assignee**…
  - 6 scopes for the roles: **individual**, **all**, **group**,

*Based on: Víctor Rodríguez-Doncel, ODRL2.0: A Rights Expression Language and a Policy Language *Tutorial.*

Reflections on ODRL*

- High coupling of business and authorization logic in the enforcement engine
  - > E.g., an enum of 17 supported constraint in the IDS connector (see https://github.com/eclipse-dataspaceconnector/DataSpaceConnector/discussions/873)
  - > Constraints e.g., count, location are fixed in the standard
- Few (found only one) open-source evaluators
- Aspects of delegation, e.g. the revocation of rights, granting redistribution rights cannot be fully specified
  - > Expressions in ODRL provide terms for specifying expiration dates (constraint class) but do not consider updating activities
- Handling conflicts: ODRL provides a strategy to resolve conflicts that arise when merging policies due to policy inheritance. It uses the conflict property which can take either the **perm**, **prohibit** only
- Not all ODRL terms are part of the IDS Usage Control language as the requirements slightly differ
  - > "… the IDS Usage Control Language was initially defined as a **profile** of ODRL Language. So we could extend the ODRL concepts. Later on, IDS language grew even more and now they match in many cases, however, they have few differences."
    - https://github.com/International-Data-Spaces-Association/InformationModel/issues/523
    - https://github.com/eclipse-dataspaceconnector/DataSpaceConnector/discussions/873

*More on limitations in: Milen G. KEBEDE et al., ODRL2.0: A critical reflection on ODRL. *https://enablingpersonalizedinterventions.nl/2020-12-09/AICOL2020.pdf*

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Scope, Goal, and Plan

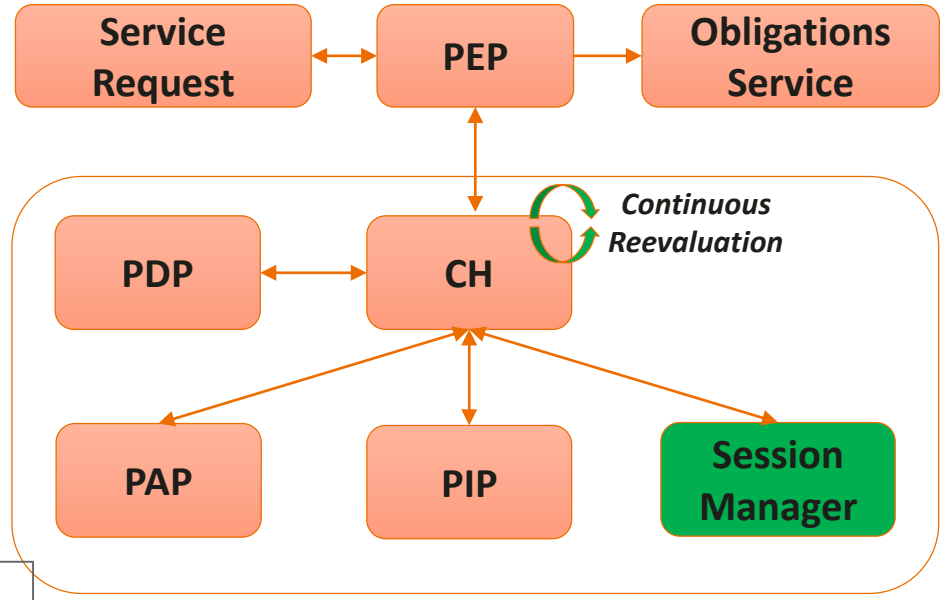
- Different sets of supported policy models
- Hard to design a comprehensive ODRL-ALFA transformation that is compliant with the adapted versions
  - > As a first step we will build a component that accepts ODRL policies, and do a translation based on a simplistic mapping to show how EDC-UCON can interface other languages

- A better integration of UCON within the EDC
  - > UCON understands native EDC policies
  - > Deal with some of the limitations
  - > Identify the relations and capabilities of the two languages

- Understand the mapping between the ODRL and XACML models
- Implement a PoC that outputs ALFA policies based on ODRL policies
- Demonstrate this with our EDC-UCON integration results from last hackathon

Background: Usage Control System: UCON Model

- The goal of Usage Control is to make sure that specified usage restrictions and obligations are realized even after access to data has been granted
- The Usage Control System implements the ABAC authorization model based on the eXtensible Access Control Markup Language (XACML) standard
  - Support usage control through continuous authorization
  - ALFA (profile) is less verbose and more compact than XACML
  - Faster parsing and evaluation



Commercial:
NTT / Axiomatics Federal
Axiomatics (Nordea, PayPal, BoA, Bell H, …)
Next Labs (SAP, BAE Systems, Siemens, Microsoft, …)
Oracle, Atos, Ping. Empower ID,, PlainID, Symphonic, WSO2

Open source:
Balana, AuthZForce, FIWARE IDM, …

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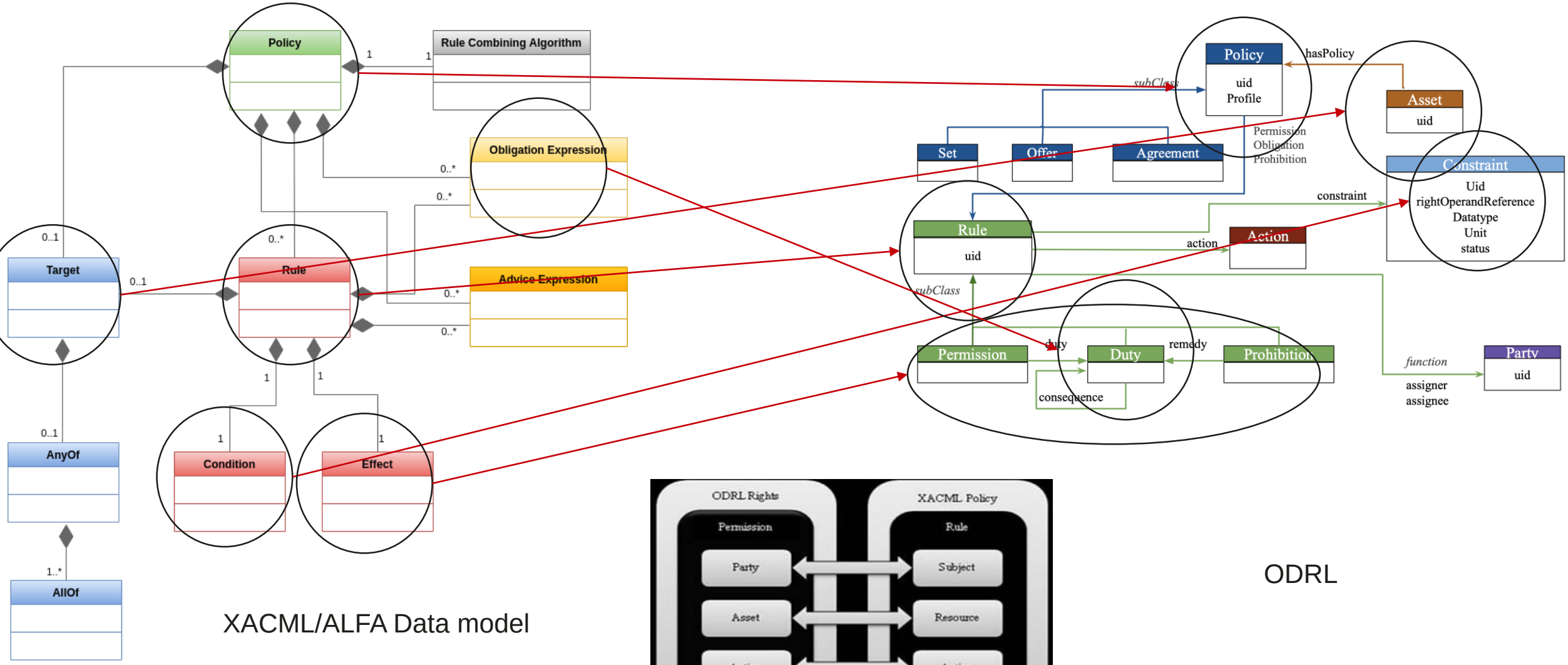
The mapping



XACML/ALFA Data model

ODRL

https://medium.com/identity-beyond-borders/a-beginners-guide-to-xacml-6dc75b547d55

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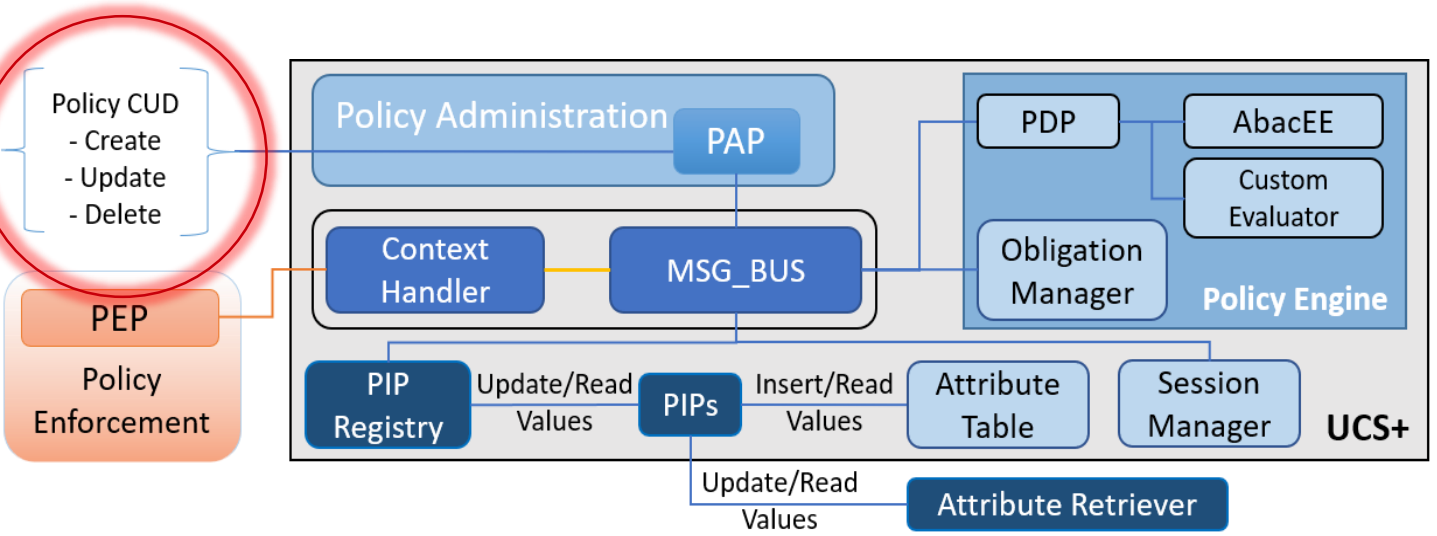
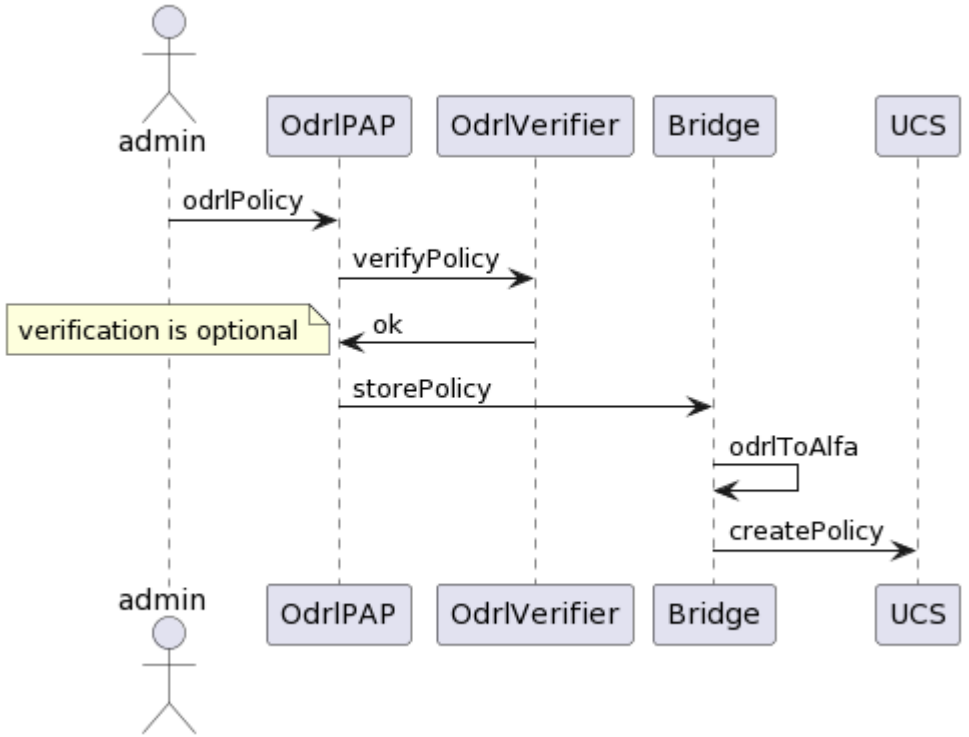
Usage Control System Plus (UCON+)

- Incorporates an ABAC baseline and extends it with:
  - **Policy-based** and **codeless** behaviour
  - **Continuous monitoring** of context and resource access





- PAP: policy administration point that receives ODRL

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Hackathon#2 → 3: Bringing Usage Control (UCON+) into EDC

✓EDC-UCS extension

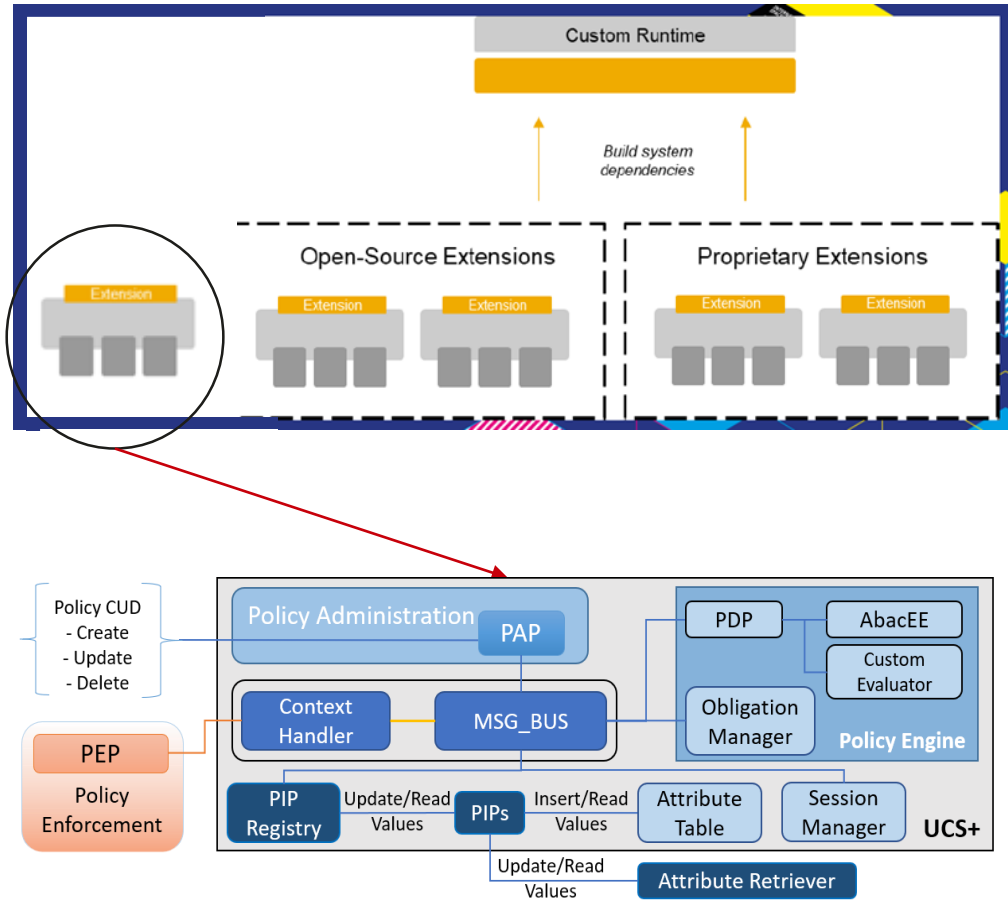
- ✓ EDC has an access control mechanism that directly evaluates ODRL policies. We extended it with UCON+ to enforce ALFA

- Now, we **added** an interface that gets ODRL and then transform it to ALFA

✓Custom Policy Enforcement Points (PEP) and privacy-preserving obligation for 1 EDC samples

- ✓ File transfer

- Achieved the goal of capturing the commonality between ODRL and ALFA which allows for interoperability and better integration of existing systems, **BUT**
  - > in a limited scope, and with a simplistic mapping
  - > this can be achieved with more comprehensive approaches, e.g., using template, using an editor



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Demo: step1 ODRL to ALFA converter

- Analyze ODRL policy
- Convert permission / prohibition, constraints and obligations into ALFA

```
{
    "@context": "http://www.w3.org/ns/odrl.jsonld",
    "@type": "Offer",
    "uid": "anon",
    "profile": "http://example.com/odrl:profile:01",
    "permission": [{
        "uid" : "anonymize",
        "obligation" : [{
                "uid" : "http",
                "url" : "http://localhost:8181/api/anonymize",
                "method" : "POST",
                "body" : "{\\\"type\\\" : \\\"partial-user-email-anonymize\\\"
, \\\"source\\\" : \\\"\\\", \\\"destination\\\" : \\\"\\\"}",
                "headers" : "Content-Type:application/json"
        }]
    }]
}
```

```
policy anon {
        apply denyOverrides
        rule anonymize {
                permit

                on permit {
                        obligation http {
                                url = 'http://localhost:8181/api/anonymize'
                                body = '{\"type\" : \"partial-user-email-anony
mize\", \"source\" : \"\", \"destination\" : \"\"}'
                                headers = 'Content-Type:application/json'
                                method = 'POST'
                        }
                }
        }
}
```

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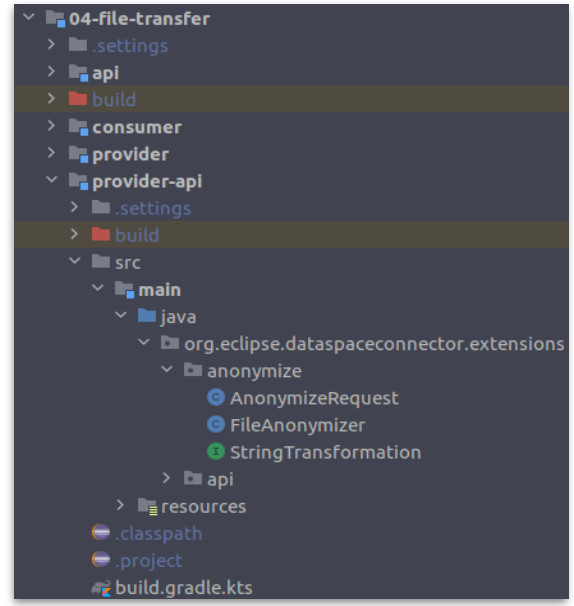
Demo: step2 Anonymizing emails in File Transfer sample

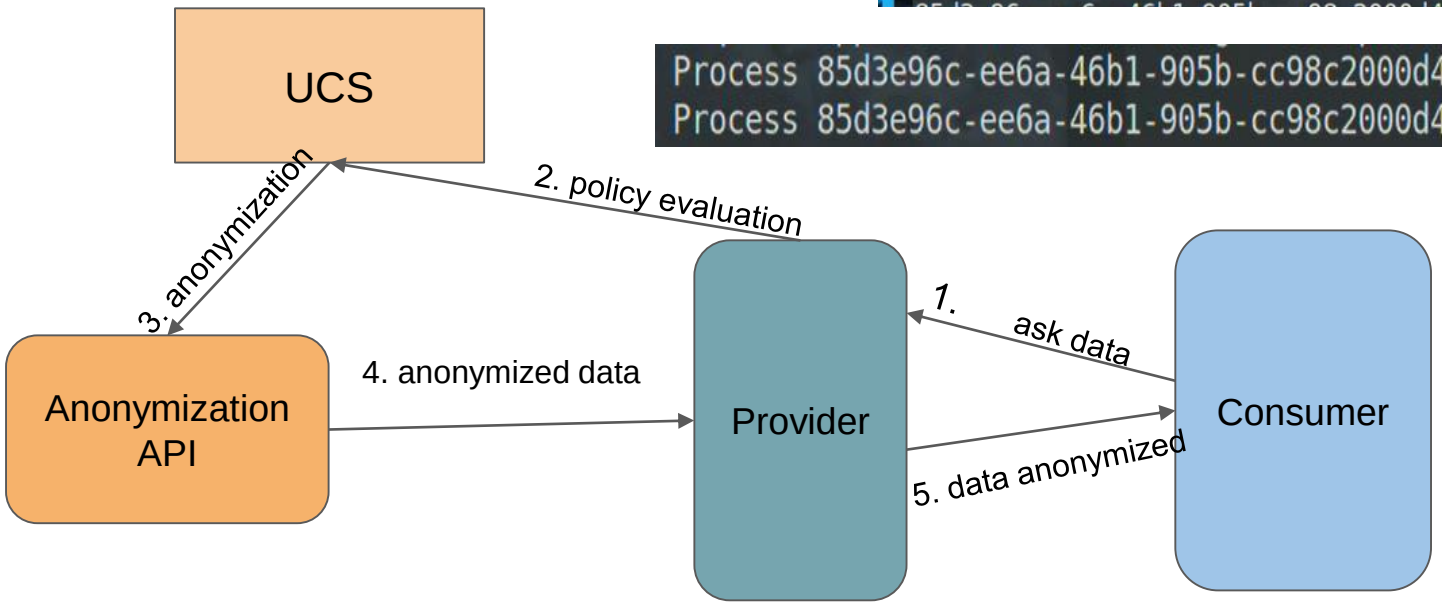
- The file contents will be anonymized by anonymizing any email text with a regex
  alice@company.it -> ali***@***

```
{
    "@context": "http://www.w3.org/ns/odrl.jsonld",
    "@type": "Offer",
    "uid": "anon",
    "profile": "http://example.com/odrl:profile:01",
    "permission": [{
        "uid" : "anonymize",
        "obligation" : [{
                "uid" : "http",
                "url" : "http://localhost:8181/api/anonymize",
                "method" : "POST",
                "body" : "{\\\"type\\\" : \\\"partial-user-email-anonymize\\\"
, \\\"source\\\" : \\\"\\\", \\\"destination\\\" : \\\"\\\"}",
                "headers" : "Content-Type:application/json"
        }]
    }]
}
```

```
roarc at static in ~/workspace
./run-file-transfer-curl.sh
```




```
Process 85d3e96c-ee6a-46b1-905b-cc98c2000d42 is now IN_PROGRESS
Process 85d3e96c-ee6a-46b1-905b-cc98c2000d42 is now COMPLETED
```




```
acm***@acme.com
cia***@sec.com
hel***@hello.it
```

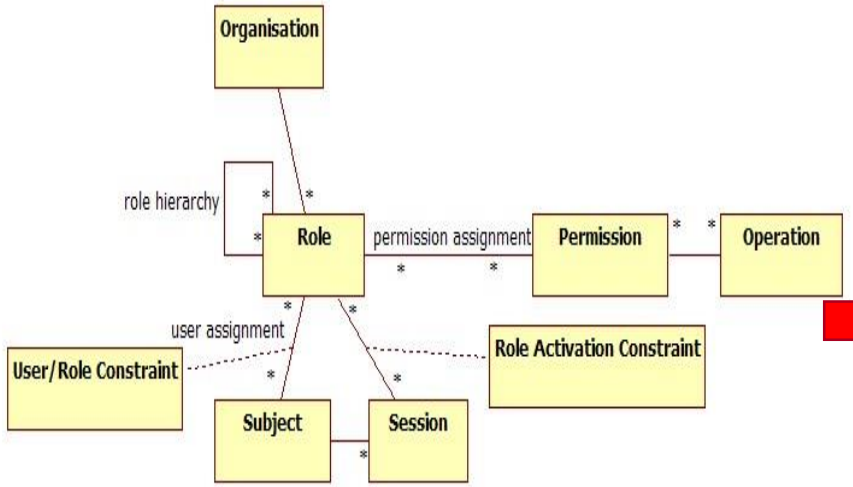
Thank you.

Bring digital to every person, home and organization for a fully connected, intelligent world.

Back-up Content

Access management from Role Based to UCON

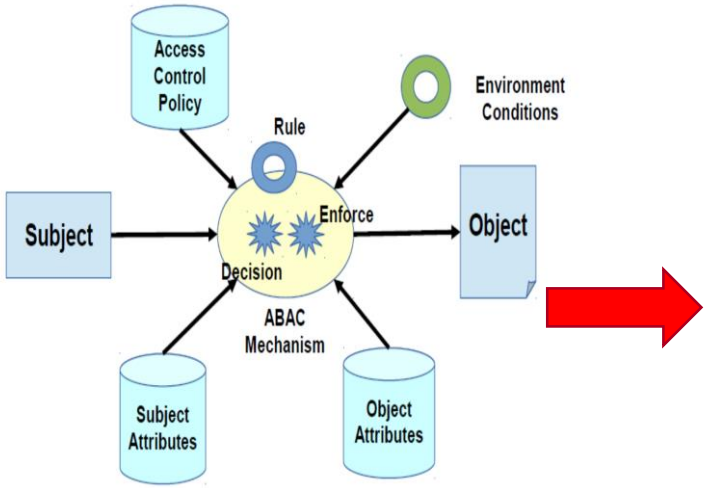
RBAC
Role Based Access Control



Access decisions are made based on:

- User role in organization
- Role permissions
- Role relationships

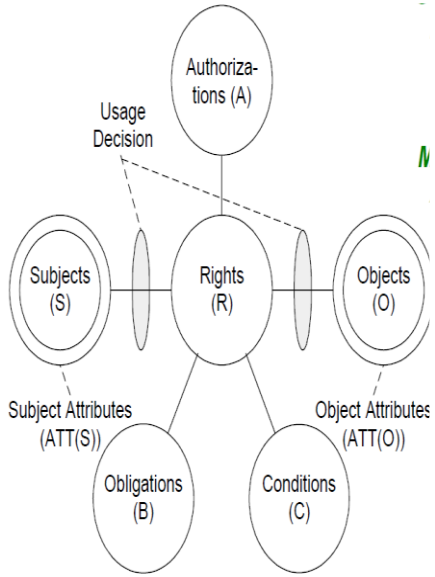
ABAC
Attribute Based Access Control



Access decisions are made based on:

- Subject attributes
- Object attributes
- Environment conditions

UCON
Usage Control ABAC



UCON is ABAC Plus:

- Continuity
  - Decisions can be made during usage for continuous enforcement
- Mutability
  - Attributes can be updated as side-effect of subject actions

The goal of Usage Control is to make sure that specified usage restrictions and obligations are realized even after access to data has been granted

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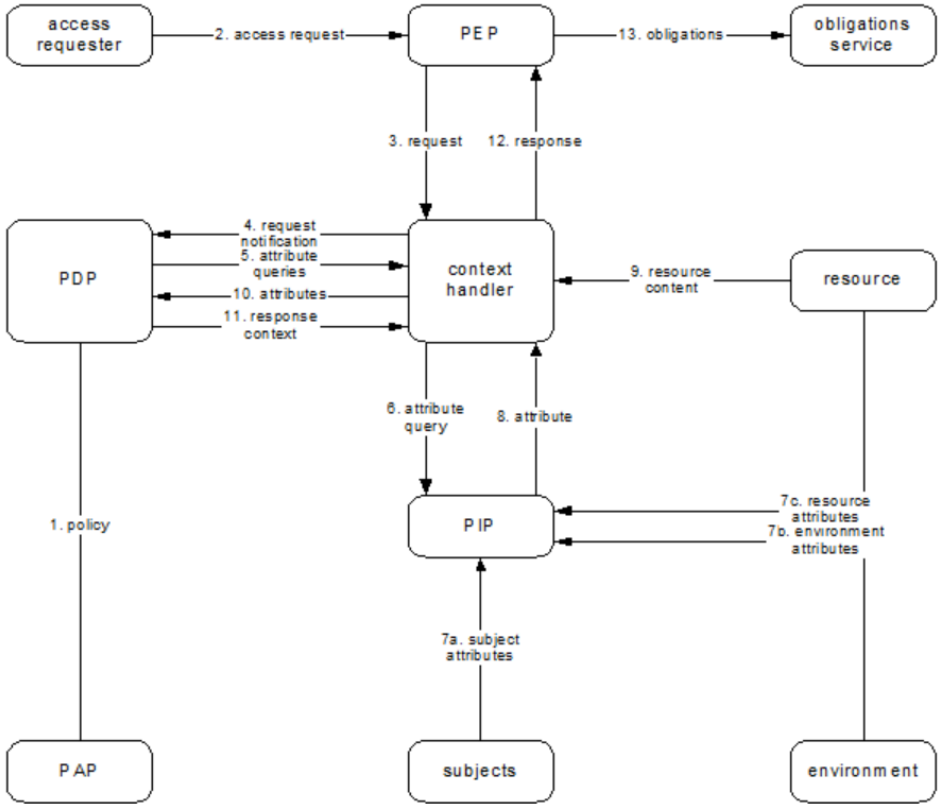
Background: ABAC



- **PAP** (Policy Administration Point): administer policies
- **PEP** (Policy Enforcement Point)
  - PEPA: request/enforce authorizations
  - PEPO: enforce obligations
- **PDP** (Policy Decision Point): evaluate ABAC policies
- **PIP** (Policy Information Point): collect attribute values
- **CH** (Context Handler): context enrichment

NIST National Institute of Standards and Technology U.S. Department of Commerce

ETSI

OASIS Advancing open standards for the information society

2002:
- First industrial applications of ABAC: Sun, Entrust, Oracle, IBM and others

2003:
- ABAC is standardized in XACML V1.0

2005:
- XACMLV2.0 and seven profiles (including SAML, RBAC, Privacy, etc.)

2009
- XPSA Profiles for Healthcare

2013
- Updated with major features to XACML v3.0

2014
- Updated profiles including drafts for REST, JSON, Administration & Delegation
- New profiles for Export Control, Intellectual Property, etc.
- NIST & NCCoE report endorses ABAC

2015:
- ALFA profile (draft)

2017:
- XACML v3.0 update

2019:
- XACML REST & JSON profile updates
- NIST & NCCoE reports re-endorses ABAC

Commercial:
NTT / Axiomatics Federal
Axiomatics (Nordea, PayPal, BoA, Bell H, …)
Next Labs (SAP, BAE Systems, Siemens, Microsoft, …)
Oracle, Atos, Ping. Empower ID,, PlainID, Symphonic, WSO2

Open source:
Balana, AuthZForce, FIWARE IDM, …

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ALFA/XACMLv3

XACML v3.0 : Current OASIS/NIST standard

Pros:

- Industry standard
- Widely used (NIST, NTT, Axiomatics, Oracle, PayPal, WSO2, etc)
- Baseline for many other standards in eHealth, eGov, etc.
- XML based
- Machine readable
- Extensible
- Clearly defined schema (programmable meta-model)
- Can support many complex scenarios

Cons:

- Verbose / long policies
- XML parsing overhead
- Complex data structures

ALFA: emerging industry standard & OASIS draft profile

Pros:

- Emerging industry standard profile (DRAFT)
- Supported by industry leader Axiomatics
- Can be translated to XACML v3.0 automatically
- Fast to parse and process
- Concise and optimized for common/typical access scenarios
- Easy to understand by developers
- Similar spirit to Rego policy language of OPA incubator of CNF

Cons:

- Few implementations
- No independent schematic representation (programmable meta-model)

```
<xacml3:Rule RuleId="f6637b3f-3690-4cce-989c-2ce9c053d6fa" Effect="Deny">
    <xacml3:Description>Use it or lose it: this policy denies access if lastLogin is more than 30 days away from today's
date</xacml3:Description>
    <xacml3:Target/>
    <xacml3:Condition >
        <xacml3:Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:any-of">
            <xacml3:Function FunctionId="urn:oasis:names:tc:xacml:1.0:function:dateTime-greater-than"/>
            <xacml3:Apply FunctionId="urn:oasis:names:tc:xacml:3.0:function:dateTime-add-dayTimeDuration">
                <xacml3:Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:dateTime-one-and-only">
                    <xacml3:AttributeDesignator Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
AttributeId="com.acme.user.lastLogin" DataType="http://www.w3.org/2001/XMLSchema#dateTime" MustBePresent="false"/>
                </xacml3:Apply>
                <xacml3:AttributeValue DataType="http://www.w3.org/2001/XMLSchema#dayTimeDuration">P30D</xacml3:AttributeValue>
            </xacml3:Apply>
            <xacml3:AttributeDesignator Category="urn:oasis:names:tc:xacml:3.0:attribute-category:environment"
AttributeId="urn:oasis:names:tc:xacml:1.0:environment:current-dateTime" DataType="http://www.w3.org/2001/XMLSchema#dateTime"
MustBePresent="false"/>
        </xacml3:Apply>
    </xacml3:Condition>
</xacml3:Rule>
```

```
namespace example{
    policy article{
        target clause itemType=="article"
        apply firstApplicable
        rule editArticle{
            target clause actionId == "edit" and userRole == "editor"
            permit
            condition userId == owner
        }
    }
}
```

Resources about UCON+

- T. Dimitrakos, T. Dilshener, A. Kravtsov, A. La Marra, F. Martinelli, A. Rizos, A. Rosett, A. Saracino, "Trust Aware Continuous Authorization for Zero Trust in Consumer Internet of Things," 2020 IEEE 19th International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom), 2020, pp. 1801-1812
- A. Hariri, S. Bandopadhyay, A. Rizos, T. Dimitrakos, B. Crispo, and M. Rajarajan, "SIUV: A Smart Car Identity Management and Usage Control System Based on Verifiable Credentials," in ICT Systems Security and Privacy Protection, vol. 625, A. Jsang, L. Futcher, and J. Hagen, Eds. Cham: Springer International Publishing, 2021, pp. 36-50. doi: 10.1007 /978-3-030-78120-0_3.
- S. Bandopadhyay et al., "DataPAL: Data Protection and Authorization Lifecycle framework," 2021 6th South-East Europe Design Automation, Computer Engineering, Computer Networks and Social Media Conference (SEEDA-CECNSM), 2021, pp. 1-8, doi: 10.1109/SEEDA-CECNSM53056.2021.9566212.

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Pointers about ODRL In EDC

- EDC is trying to extend the support has also some differences
  - https://github.com/eclipse-dataspaceconnector/DataSpaceConnector/discussions/873
  - https://github.com/eclipse-dataspaceconnector/DataSpaceConnector/blob/5ee32800072a267260d2867a32adbe0426de0f5a/docs/Policies.md
- EDC transforms IDS to EDC policies
  - https://github.com/eclipse-dataspaceconnector/DataSpaceConnector/tree/e200d9ec52c501bb803f57fa66441a54f04abba0/data-protocols/ids/ids-transform-v1/src/main/java/org/eclipse/dataspaceconnector/ids/transform
- New EDC take on policies
  - https://github.com/eclipse-dataspaceconnector/DataSpaceConnector/issues/855
- IDSA Model Templates
  - https://github.com/International-Data-Spaces-Association/InformationModel/tree/develop/examples/contracts-and-usage-policy/templates

ODRL resources

- W3C standard for describing digital rights:
  - ODRL Information Model https://www.w3.org/TR/odrl-model/
  - ODRL Vocabulary and Expression https://www.w3.org/TR/odrl-vocab/
  - ODRL Best practices https://w3c.github.io/odrl/bp/
  - ODRL validator -http://odrlapi.appspot.com/ Java code
  - ODRL evaluator - https://github.com/nitmws/odrl-wprofile-evaltest1

https://wiki.acumos.org/pages/viewpage.action?pageId=20547401