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A Preliminary Approach for Translating ODRL to Smart Policies

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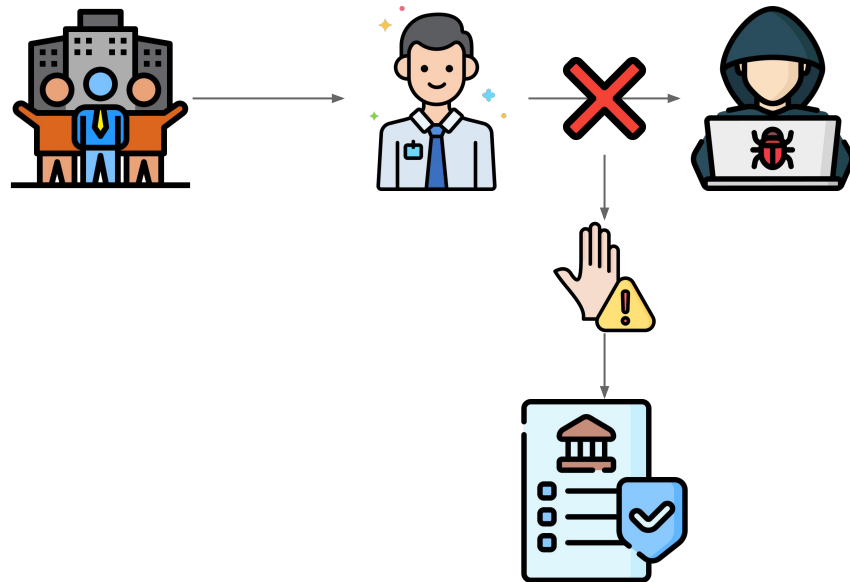
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Motivation: Unauthorized Disclosure

Industries handling sensitive data are vulnerable to **unauthorized disclosure** of sensitive information.

Self-Sovereign Identity (SSI)

systems provide enhanced security and privacy, but **improper policy enforcement** may still lead to data leaks.



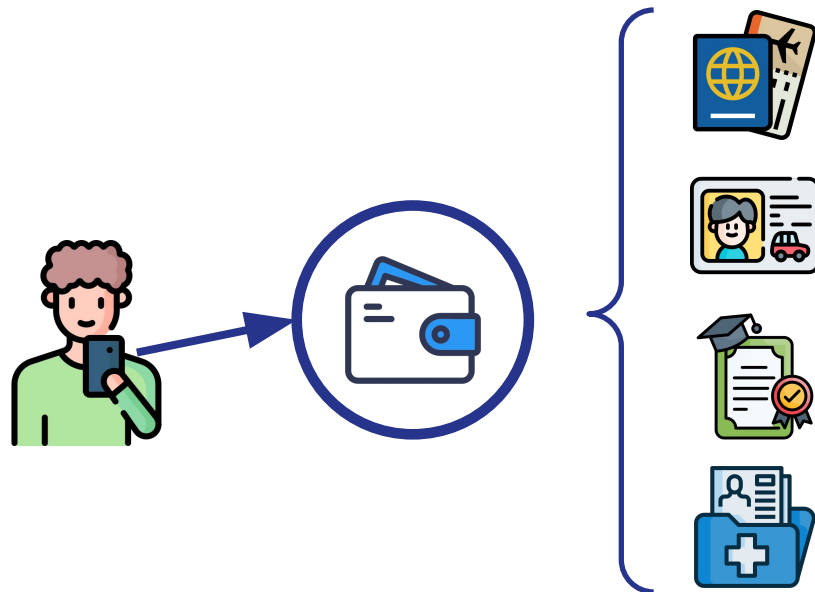
Stefano Bistarelli, Chiara Luchini, and Francesco Santini. “Policy-based Credential Disclosure in SSI by Using ORCON-based Access Control.”
6th Distributed Ledger Technologies Workshop (DLT2024), 14-15 May 2024, Torino (TO), Italy.

Terms Of Use

Terms of use may be used by the **issuer** or **holder** to specify the conditions under which a verifiable credential or verifiable presentation has been issued.



If the recipient (a holder or verifier) is **not willing to adhere** to the specified terms of use, then they do so on their **own responsibility** and might incur **legal liability** if they violate the stated terms of use.



Terms of Use



“termsOfUse is insufficiently specified”¹

Verifiable Credentials Data Model v1.1

```
"termsOfUse": [{  
  "type": "HolderPolicy",  
  "id": "http://example.com/policies/credential/6",  
  "profile": "http://example.com/profiles/credential",  
  "prohibition": [{  
    "assigner": "did:example:ebf...c21",  
    "target": "http://example.edu/credentials/3732",  
    "action": ["3rdPartyCorrelation"]  
  }]  
}]
```



Verifiable Credentials Data Model v2.0

```
"termsOfUse": {  
  "type": "TrustFrameworkPolicy",  
  "trustFramework": "Employment&Life",  
  "policyId": "https://policy.example/policies/125",  
  "legalBasis": "professional qualifications directive"  
}
```

¹World Wide Web Consortium (W3C), termsOfUse is insufficiently specified, <https://github.com/w3c/vc-data-model/issues/1010>, 2023.

[D. Longley M. Sporny and D. Chadwick. "Verifiable credentials data model v1.0". Technical report, W3C, 2022.](#)

[D. Longley M. Sporny and D. Chadwick. "Verifiable credentials data model v2.0". Technical report, W3C, 2025.](#)

Our contribution



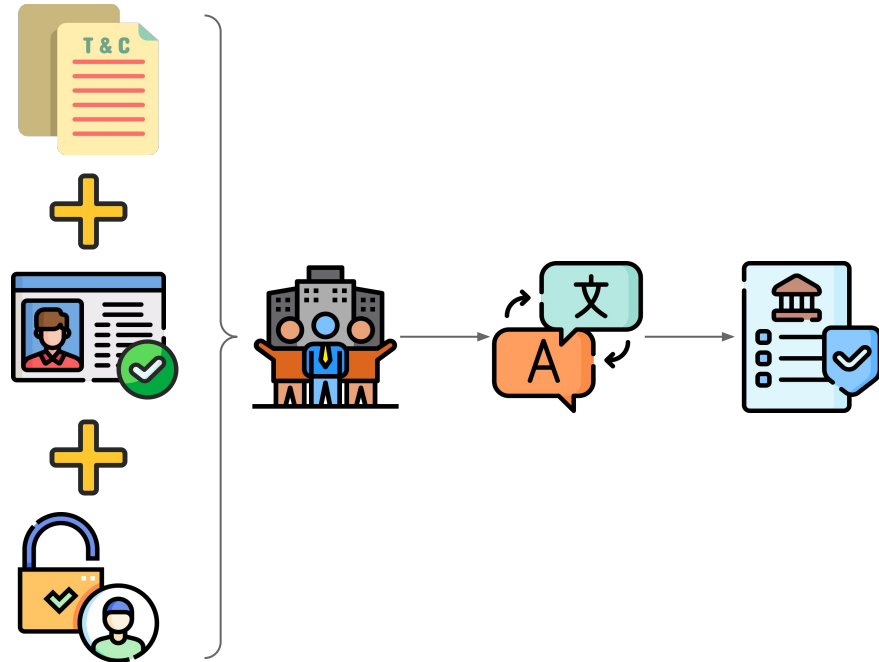
Idea: combining ToU, VC and AC.



Research Gap: Manual translation of ODRL policies to smart contracts can be error-prone and inefficient.



Solution: Define a translator from ODRL-ABAC policies to (Solidity) smart contract.



Stefano Bistarelli, Chiara Luchini and Francesco Santini, "A Preliminary Approach for Translating ODRL to Smart Policies," 2025 IEEE International Conference on Pervasive Computing and Communications Workshops and other Affiliated Events (PerCom Workshops), Washington DC, DC, USA, 2025, pp. 44–49, doi: 10.1109/PerComWorkshops65533.2025.00039.

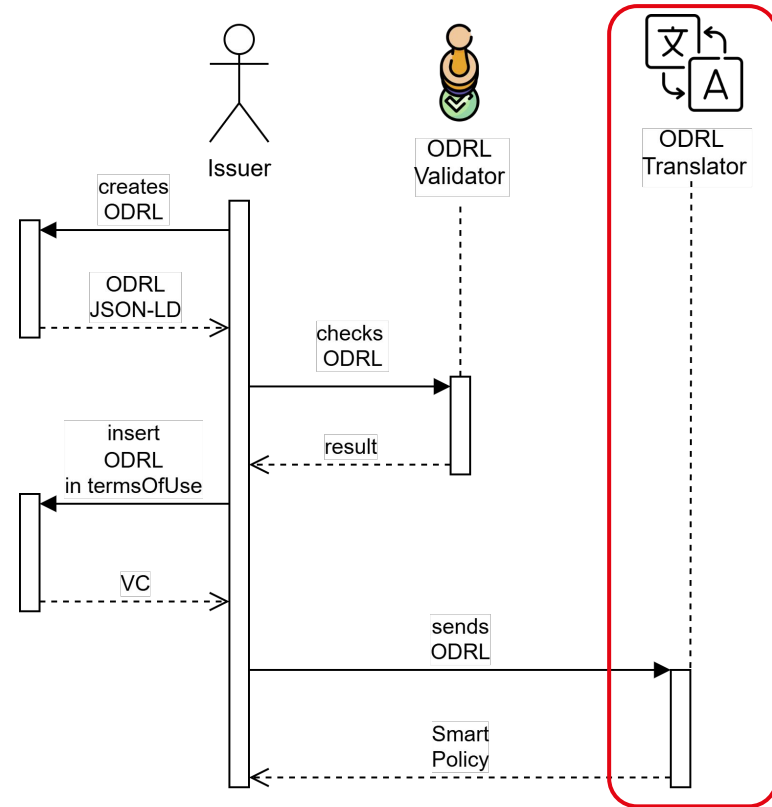
Proposed Model: ODRL-ABAC for Smart Policies

Key Idea

- ODRL-ABAC policies define the **Terms of Use** in VCs.
- These policies are **translated** into **Smart Contracts** for automatic enforcement.
- Users do not need programming expertise—they write policies in ODRL.

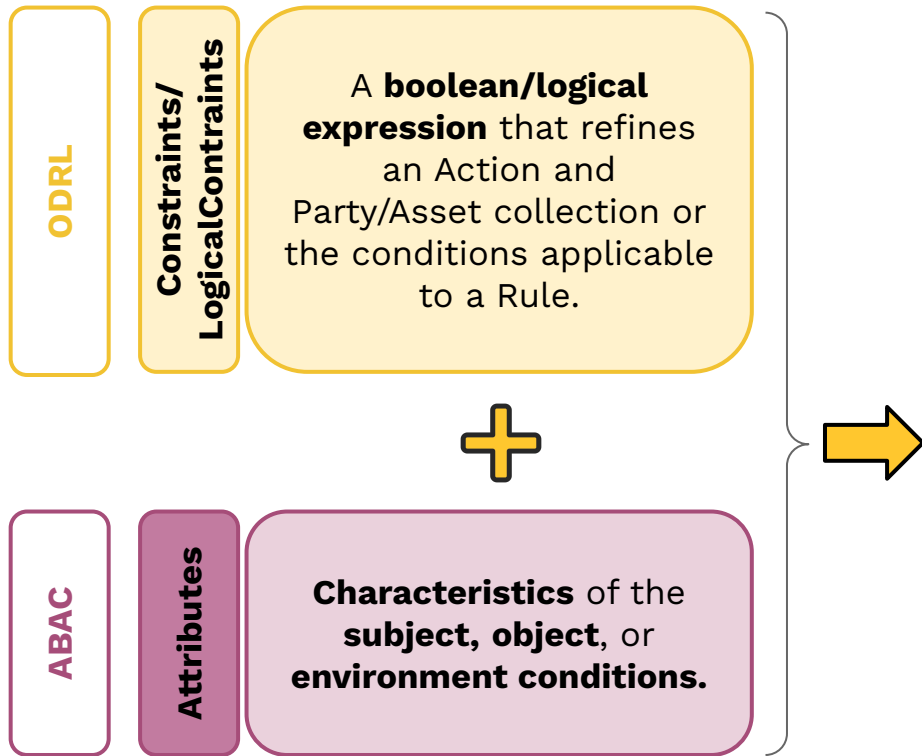
Translation Process

1. Issuer creates an ODRL policy specifying constraints and permissions.
2. The policy is validated and sent to an ODRL-to-Smart Policy Translator.
3. A Solidity Smart Contract is generated to enforce the policy.
4. The VC Terms of Use now include a reference to this Smart Policy.



ODRL validator: <https://odrlapi.appspot.com/>.

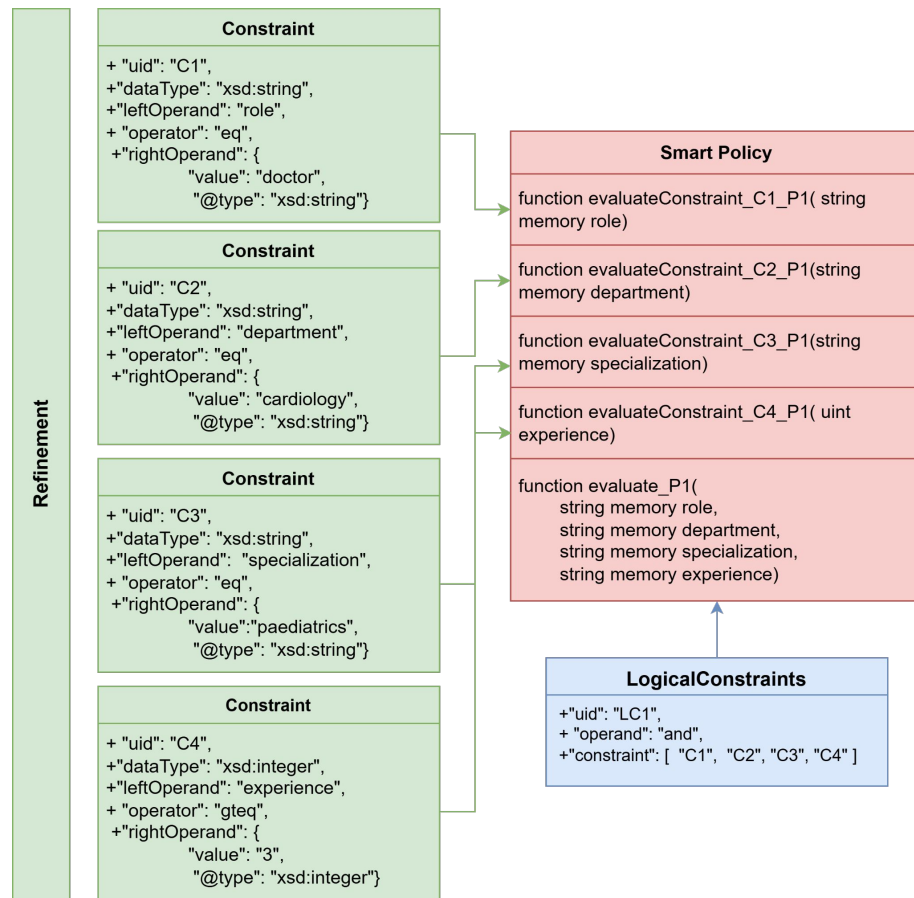
ODRL-ABAC policy



```
{
  "@context": "http://www.w3.org/ns/odrl.jsonld",
  "@type": "Offer",
  "uid": "Policy:84112",
  "permission": [
    {
      "uid": "P1",
      "target": "http://vc.com/document:8541",
      "assigner": "http://issuer.com/org:616",
      "action": "read",
      "constraint": [
        {
          "uid": "C1",
          "leftOperand": "dateTime",
          "operator": "gteq",
          "rightOperand": {
            "value": "09:00:00",
            "@type": "xsd:time"
          },
          "uid": "C2",
          "leftOperand": "dateTime",
          "operator": "lteq",
          "rightOperand": {
            "value": "17:00:00",
            "@type": "xsd:time"
          }
        }
      ]
    }
  ]
}
```

ODRL Policy Translation

- A hospital issues a VC containing a patient's medical history.
- Access is restricted to:
 - *Certified medical practitioners with >3 years of experience, from cardiology dept and with a specialization in pediatric.*
- Implementation:
 - ODRL defines who can access patient records and under what conditions.
 - Translated into a Smart Contract, enforcing rules on-chain.



Tested Smart Policies



Set Example:

- Verifies if a user is part of a predefined role set (e.g., "Project Manager").



Listing 1 Example:

- Requires meeting two constraints (time-based access control).



zkABAC Example:

- Defines multiple conditions for students to access a scholarship prize (five constraints):
 - Must be a bachelor student.
 - Must have an average grade > 27.
 - Must be enrolled for less than 3 years.
- For the zkABAC, the deployment costs with 10 and 20 constraints increased by 41% and 130%.



Listing 2 Example:

- Example of the previous slide.

<i>Example</i>	<i>Deployment</i>	<i>Satisfied</i>	<i>Not Satisfied</i>
Set	1769328	5012	5012
Listing 1	537876	3335	2990
zkABAC	1136850	6237	6215
Listing 2	1287194	8471	8449

Gas cost of Smart Policies.

Benefits and challenges



Benefits

- ✓ **Transparent & Immutable** Access Control (via blockchain).
- ✓ **Machine-readable and Enforceable Policies** (ODRL + Smart Contracts).
- ✓ **Flexible ABAC Approach.**



Challenges



Gas Costs: Complex policies are expensive to execute.



Conflicting Policies: Need a mechanism to resolve contradictions.



Scalability: Handling multiple constraints efficiently in smart contracts.

Conclusion and Future Works



Combining ODRL, ABAC, and Smart Policies offers a robust solution for managing access control in SSI systems.



Natural Language Translation: Automating ODRL policy creation from human-readable descriptions.



Improved Policy Conflict Resolution: Developing a method for resolving contradictions in overlapping policies.

Current Research

How is written a claim?

```
... "credentialSubject": {  
  "id":  
  "did:jwk:eyJrdHkiOi...m9aTkFP0EVncmsifQ",  
  "given_name": "John",  
  "family_name": "Doe",  
  "email": "johndoe@example.com",  
  "phone_number": "+1-202-555-0101",  
  "address": {  
    "street_address": "123 Main St",  
    "locality": "Anytown",  
    "region": "Anystate",  
    "country": "US"  
  },  
  "birthdate": "1940-01-01",  
  "is_over_18": true,  
  "is_over_21": true,  
  "is_over_65": true  
},  
...
```

Claims can be of various **types** depending on the type of Credentials.

For instance an **Identity Credential** containing:

- given_name;
- family_name;
- email;
- phone_number;
- birthdate;
- address...

Minimizing information disclosure



"Are you over 18?"



```
"birthdate": "1940-01-01",  
"is_over_18": true,  
"is_over_21": true,  
"is_over_65": true
```

Also with **non-numerical**
values

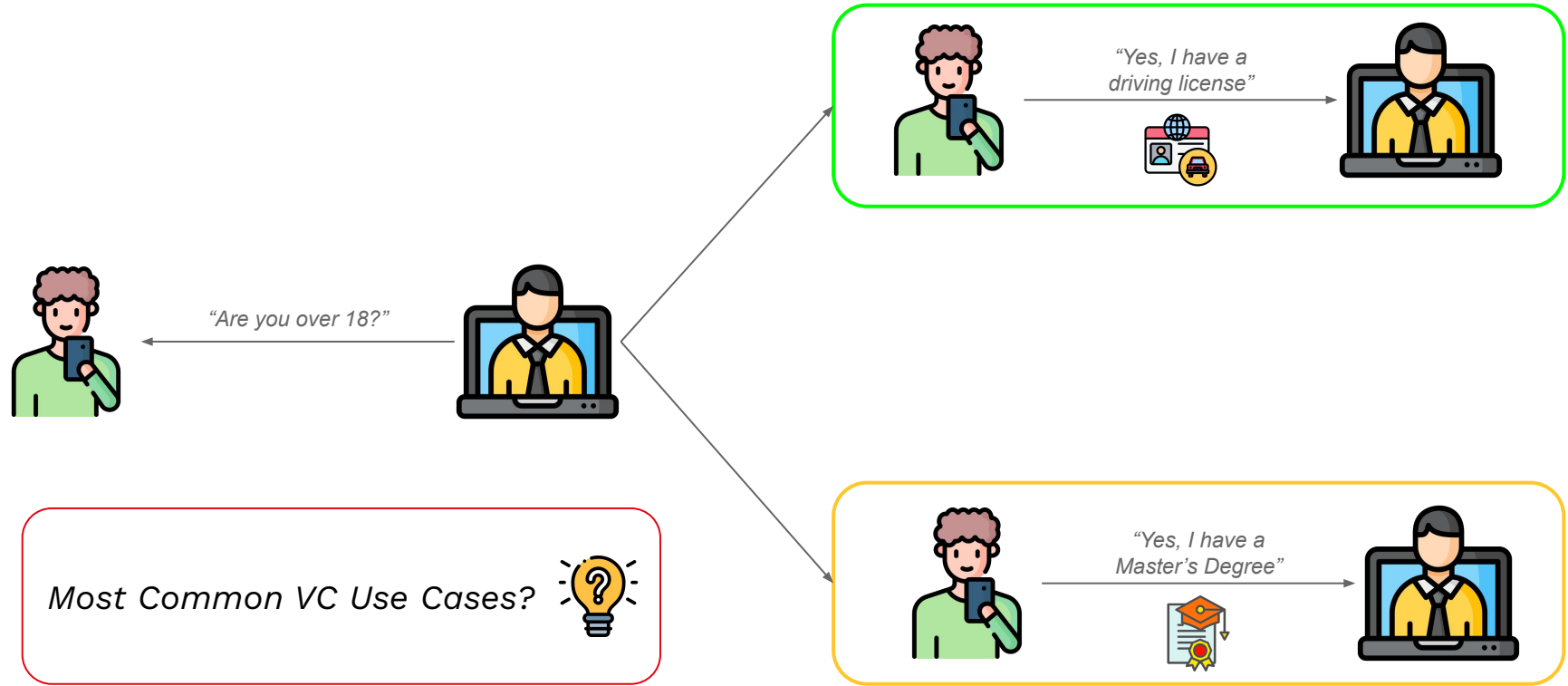
Real Age: exact match calculated as
 $\text{current_year} - \text{birth_year} = \text{age}$ (e.g 86)

Loose Bind Strategy: **less tight bound** about the actual value of the attributes and thus provides a **higher uncertainty** about the actual values.

Tight Bind Strategy: the claim that **logically implies** the term in the disclosure policy and that is **closer** to the actual value assumed by the birth date.

F. Paci, D. Bauer, E. Bertino, D. M. Blough, and A. Squicciarini. 2008. "Minimal credential disclosure in trust negotiations." In Proceedings of the 4th ACM workshop on Digital identity management (DIM '08). Association for Computing Machinery, New York, NY, USA, 89–96.

Other strategies?



Thank you for your attention!



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