Advancing legal compliance in the Solid ecosystem with DPV

Beatriz Esteves, UGent – imec, BE

beatriz.esteves@ugent.be

MOTIVATION

No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence

Universal Declaration of Human Rights

1948

1950

European Convention on Human Rights

Everyone has the right to respect for his private and family life, his home and his correspondence

Se garantiza el derecho al honor, a la intimidad personal y familiar y a la propia imagen

Spanish Constitution

1978

1981

Convention 108 of the Council of Europe

Convention for the protection of individuals with regard to the processing of personal data

protection of individuals with regard to the processing of personal data and on the free movement of such data

Data Protection Directive

1995

2000

Charter of Fundamental Rights of the EU

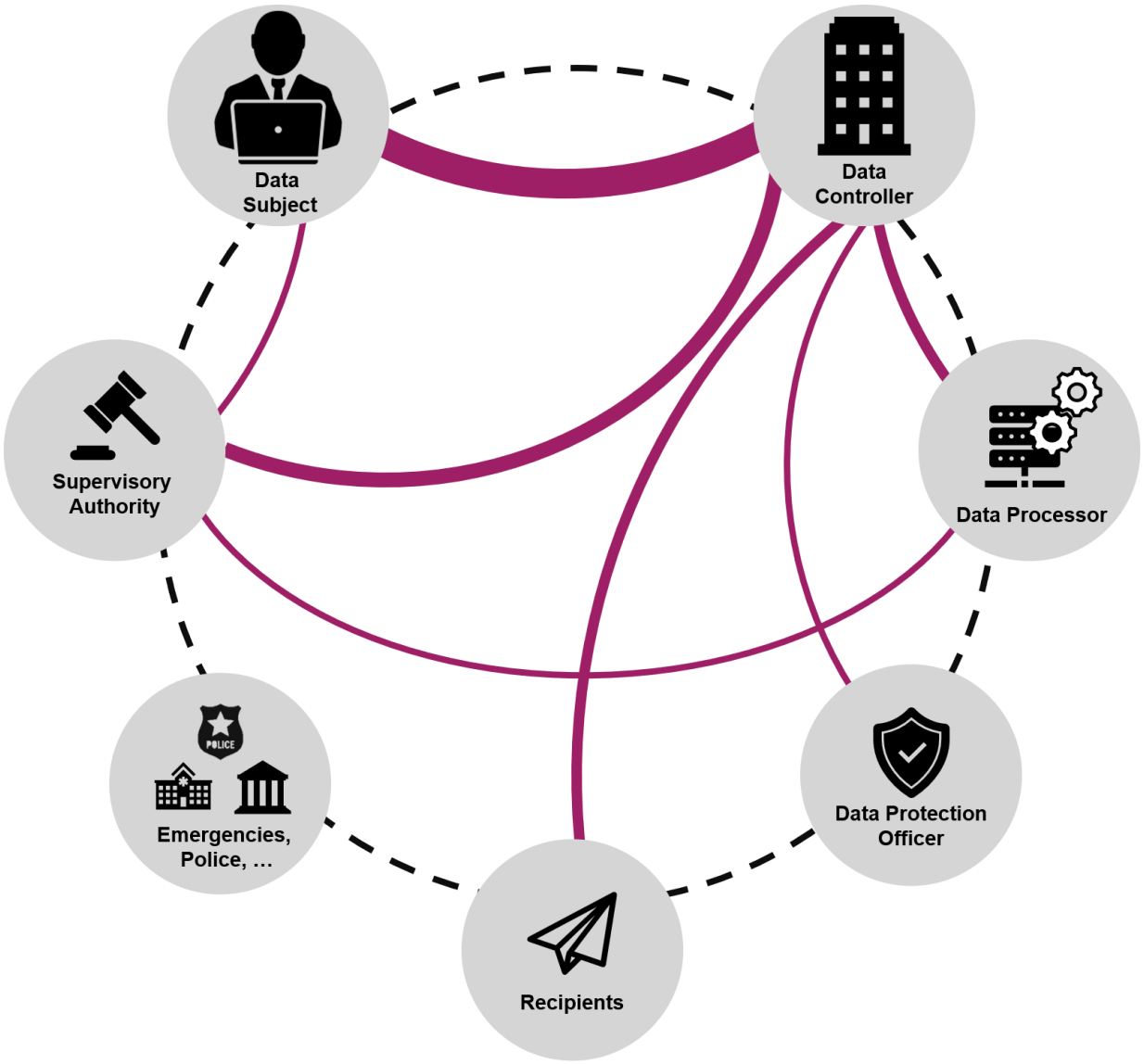
Everyone has the right to the protection of personal data concerning him or her

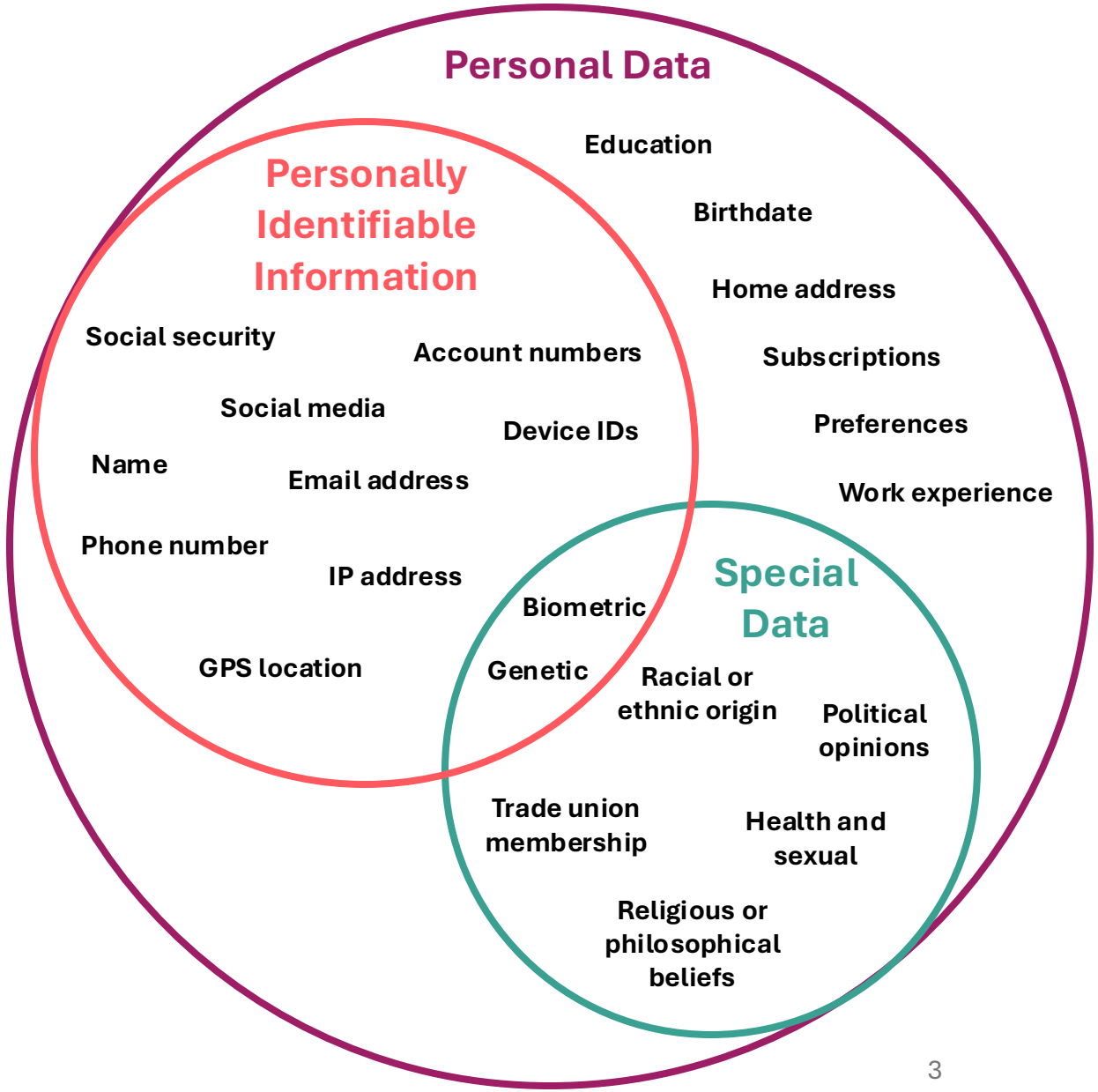
protection of natural persons with regard to the processing of personal data and on the free movement of such data

General Data Protection Regulation / Police Directive

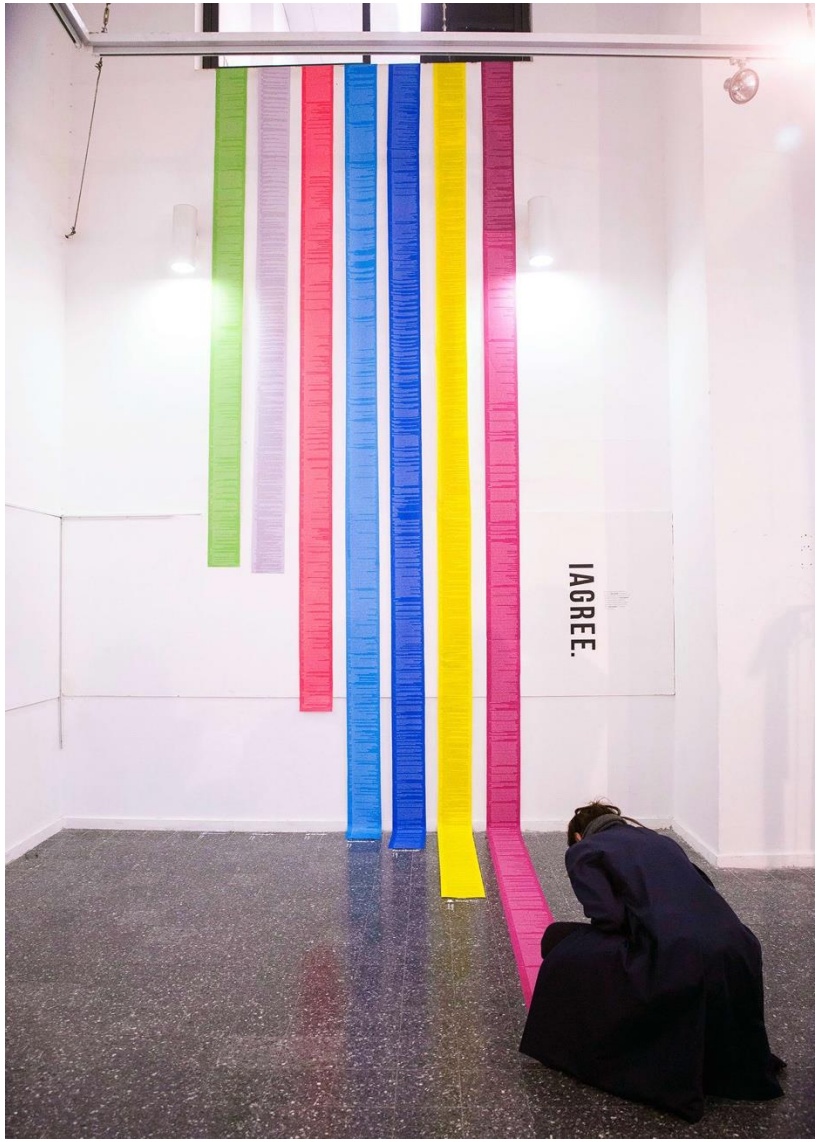
2018

DEFINITIONS – GDPR

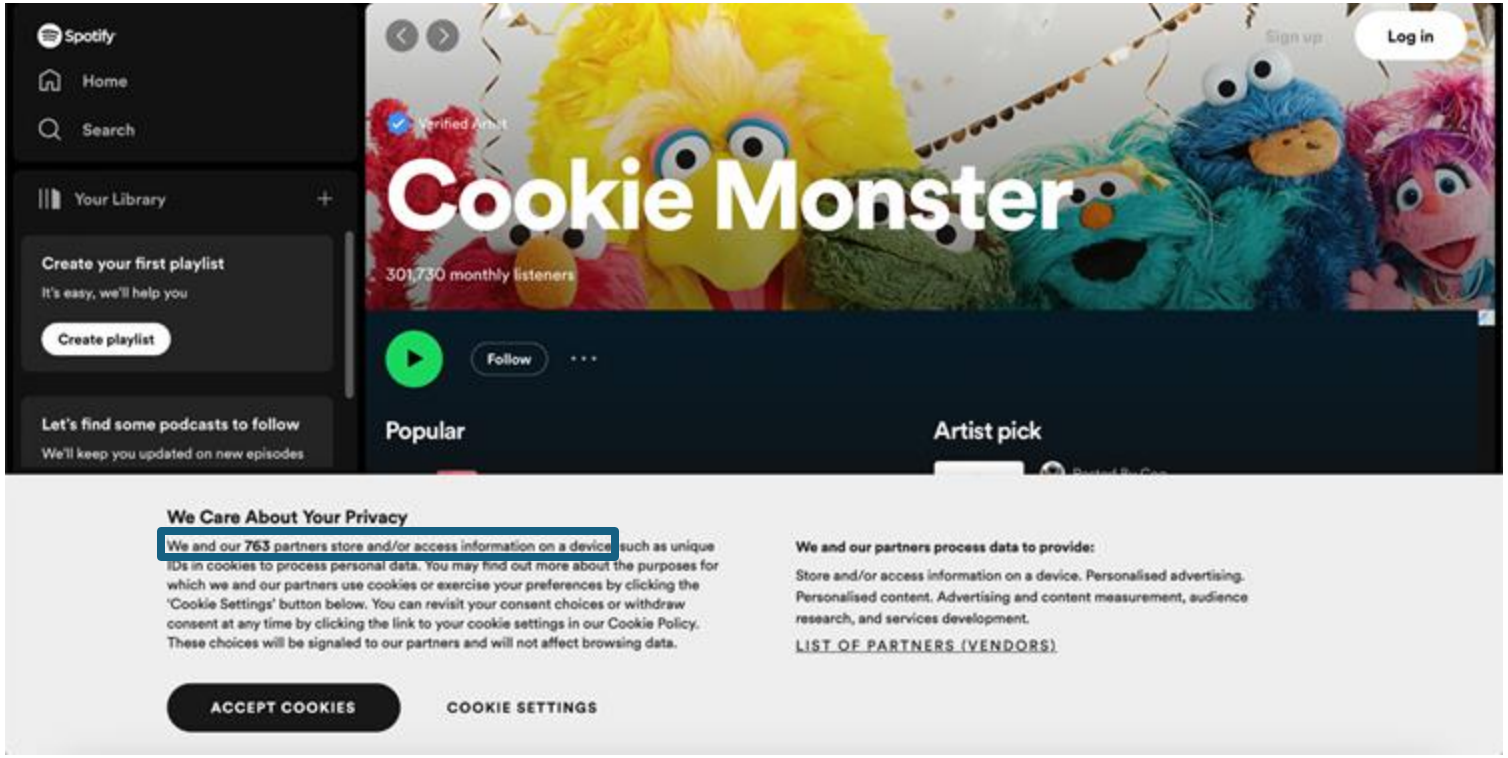




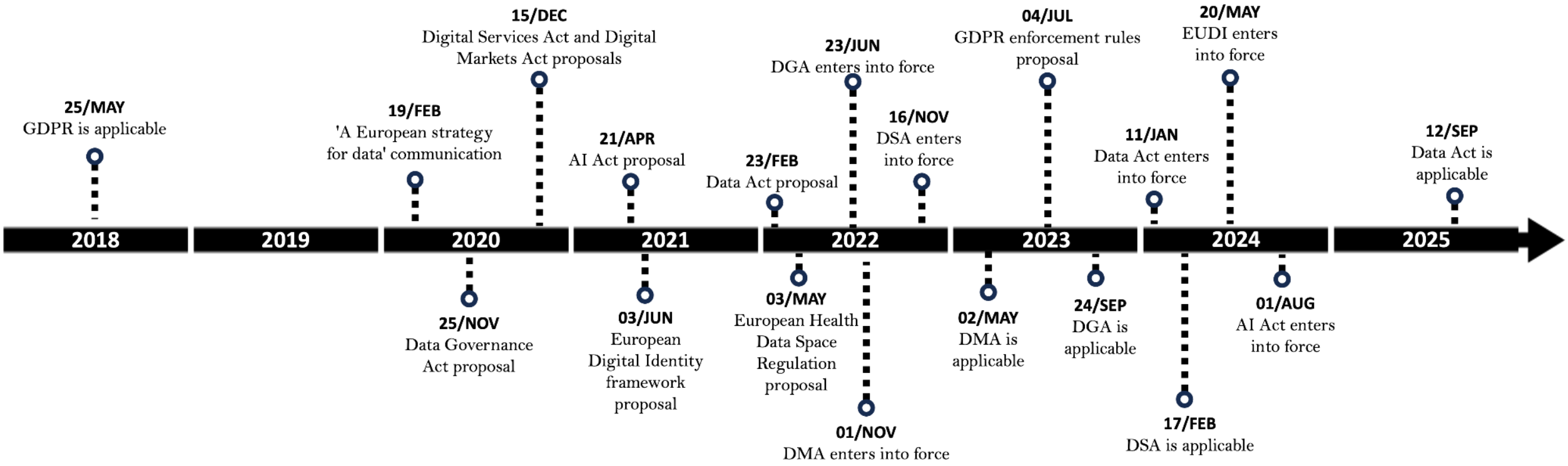
MOTIVATION



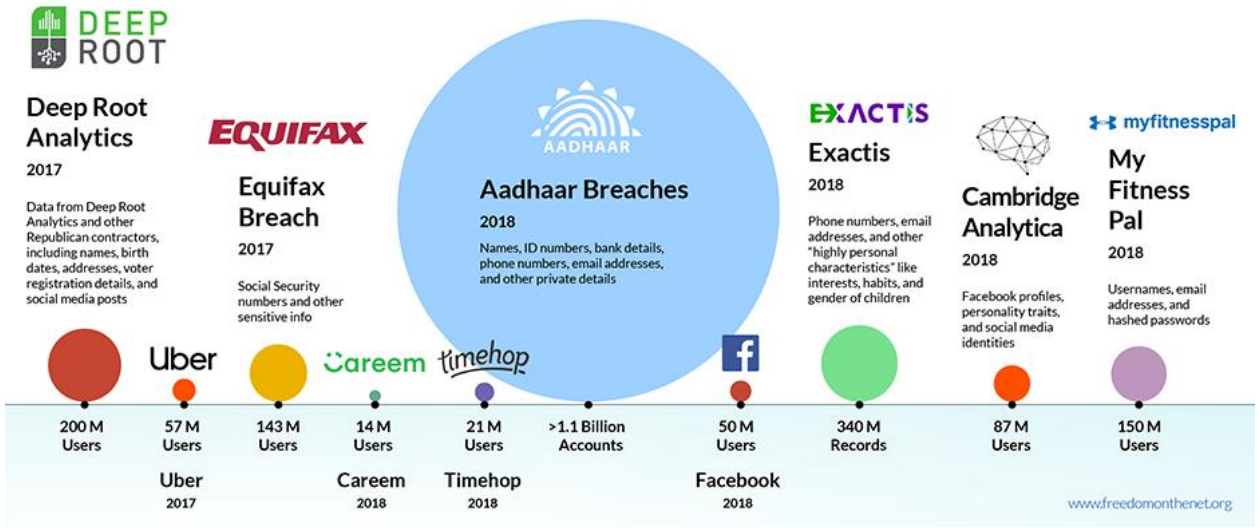
[Photo : Dima Yarovinsky]
https://www.fastcompany.com/90171107/printing-out-the-privacy-policies-of-facebook-snap-and-others



MOTIVATION

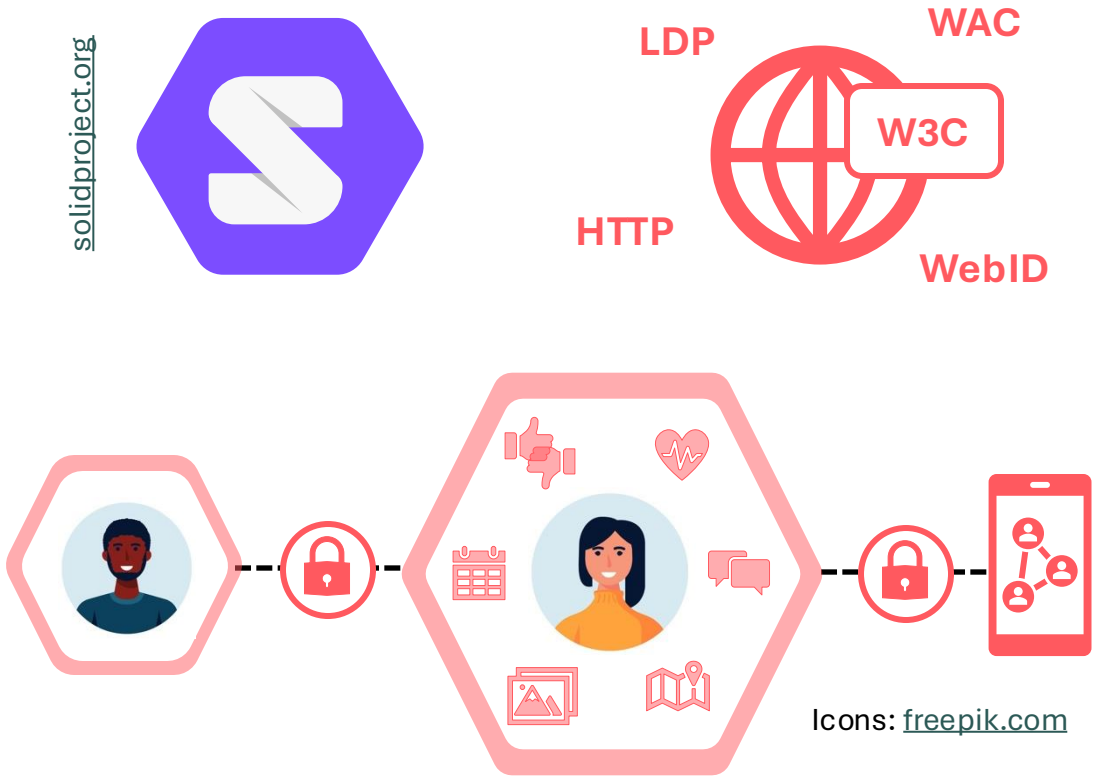

25/MAY
GDPR is applicable
19/FEB
'A European strategy for data' communication
15/DEC
Digital Services Act and Digital Markets Act proposals
21/APR
AI Act proposal
23/FEB
Data Act proposal
23/JUN
DGA enters into force
16/NOV
DSA enters into force
04/JUL
GDPR enforcement rules proposal
11/JAN
Data Act enters into force
20/MAY
EUDI enters into force
12/SEP
Data Act is applicable
2018
2019
2020
2021
2022
2023
2024
2025
25/NOV
Data Governance Act proposal
03/JUN
European Digital Identity framework proposal
03/MAY
European Health Data Space Regulation proposal
01/NOV
DMA enters into force
02/MAY
DMA is applicable
24/SEP
DGA is applicable
17/FEB
DSA is applicable
01/AUG
AI Act enters into force

MOTIVATION



THE BATTLE OF THE INTERNET: OPEN VS CLOSED – FURTHER EXPLORATION, Christopher Langley

DECENTRALISED WEB



Solid is a specification for decentralised data stores based on interoperable data formats and protocols

Solid's authorisation mechanism currently relies on two access control languages – WAC and ACP

WAC – Web Access Control

```
<#authorization1> a acl:Authorization ;
    acl:agent <https://beatriz.providerZ.com/profile/card#me> ;
    acl:accessTo <https://victor.providerY.com/docs/file1.ttl> ;
    acl:mode acl:Read, acl:Write .
```

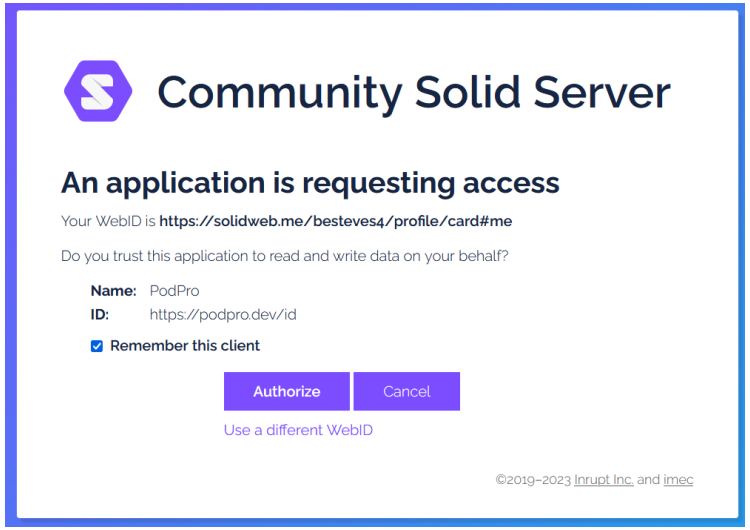
ACP – Access Control Policy

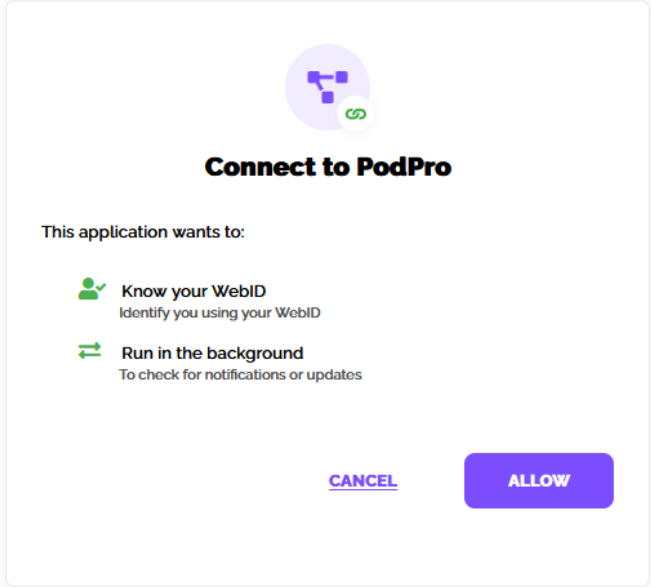
```
<#grant1> a acp:AccessGrant ;
    acp:grant acl:Read, acl:Write ;
    acp:context [
        acp:agent <https://beatriz.providerZ.com/profile/card#me> ;
        acp:issuer <https://identityProviderZ.com> ;
        acp:target <https://victor.providerY.com/docs/file1.ttl> ;
        acp:client <https://clientApplicationA.com> ] .
```

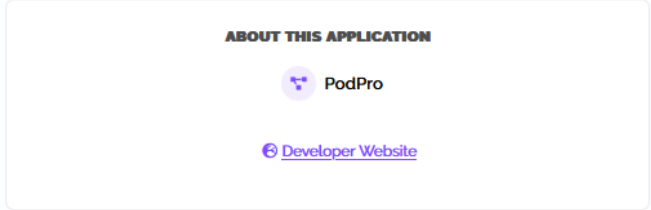
PIMS AS A LEGAL-TECH TOOL

"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 [Source]







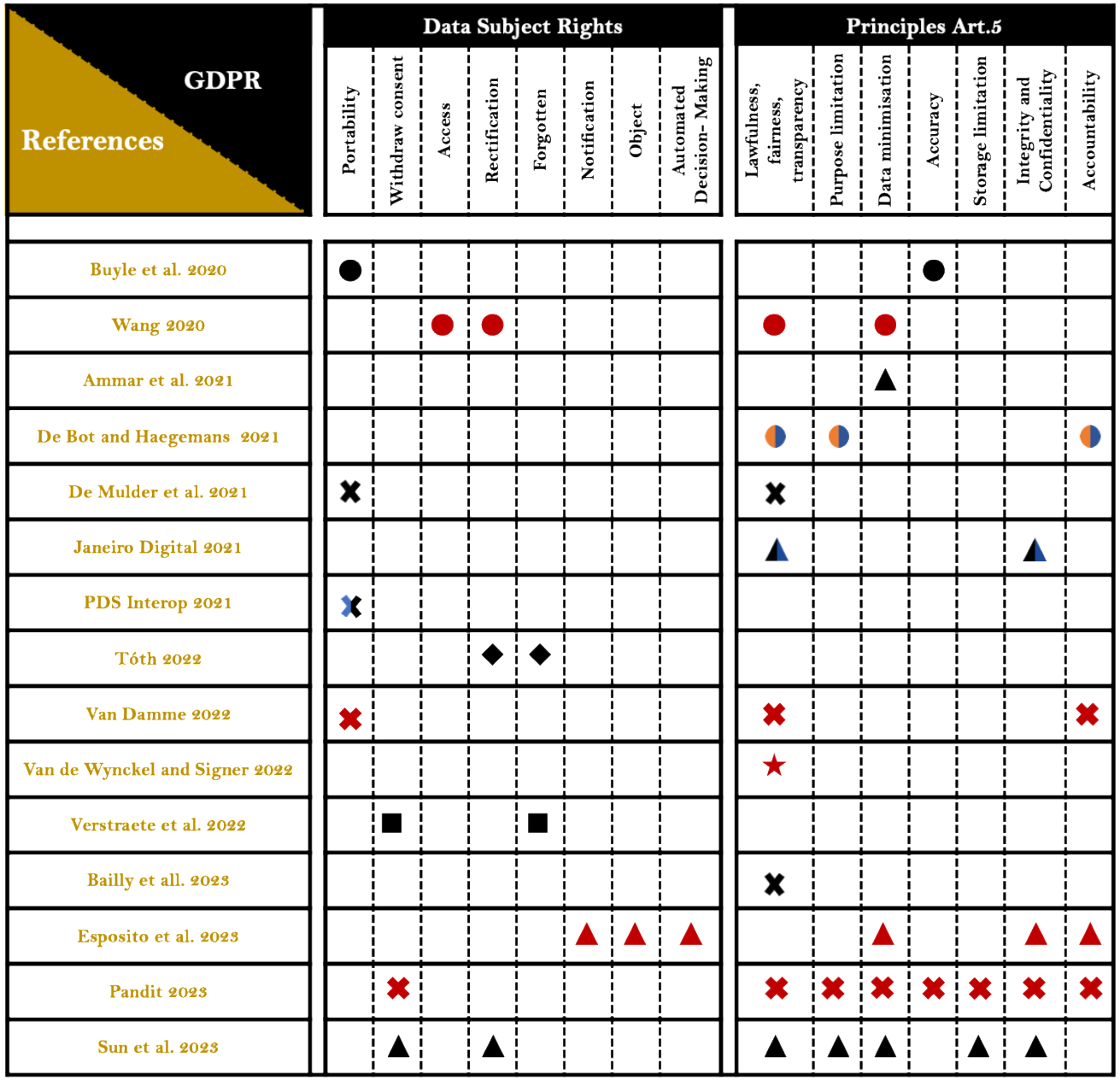
Beatriz Esteves, Haleh Asgarinia, Andres Chomczyk Penedo, Blessing Mutiro, and Dave Lewis. **Fostering trust with transparency in the data economy era: an integrated ethical, legal, and knowledge engineering approach**. In *1st International Workshop on Data Economy*, pages 57–63. ACM, 2022. doi: 10.1145/3565011.3569061.

Haleh Asgarinia, Andres Chomczyk Penedo, Beatriz Esteves, and Dave Lewis. **"Who Should I Trust with My Data?" Ethical and Legal Challenges for Innovation in New Decentralized Data Management Technologies**. *Information 14(7)*, 2023. doi: 10.3390/info14070351.

Marcu Florea and Beatriz Esteves. **Is Automated Consent in Solid GDPR-Compliant? An Approach for Obtaining Valid Consent with the Solid Protocol**. *Information 14(12)*, 2023. doi: 10.3390/info14120631.

Is this enough for Solid users to know what is happening to their data? Is it enough to comply with GDPR's requirements?

DECENTRALISED WEB



Red – theory
Black – apps
Orange – identity provider
Blue – Pod provider

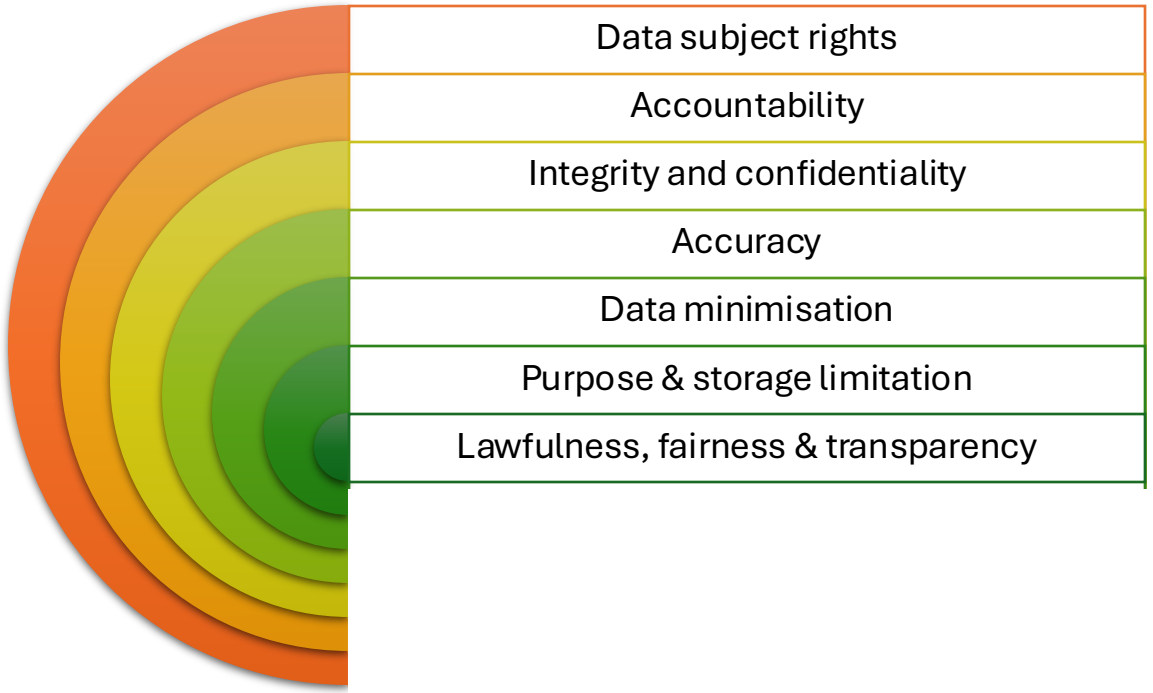
○ – Government
△ – Health
☆ – Location
☐ – Human resources
◇ – Hospitality
✕ – No domain

- Strong focus on the **'lawfulness, fairness and transparency'** principle
- Distinct works were also found to tackle the right to **data portability**, **withdrawal of consent**, and **rectification**
- No work was found on the right to **restrict the processing** of personal data

LEGAL CHALLENGES TO THE SOLID VISION

"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 [Source]



What is missing from Solid?

No records of agreements for the provision of services

Lack of tools to give / withdraw consent

No metadata about Solid infrastructure

No information on the identity and contacts of Solid providers

Lack of tools to get available categories of data

Record keeping and log maintenance are nonexistent

Lack of tools to rectify data inaccuracies

Difficulty for users to set (granular) access to resources

Access grants valid in perpetuity

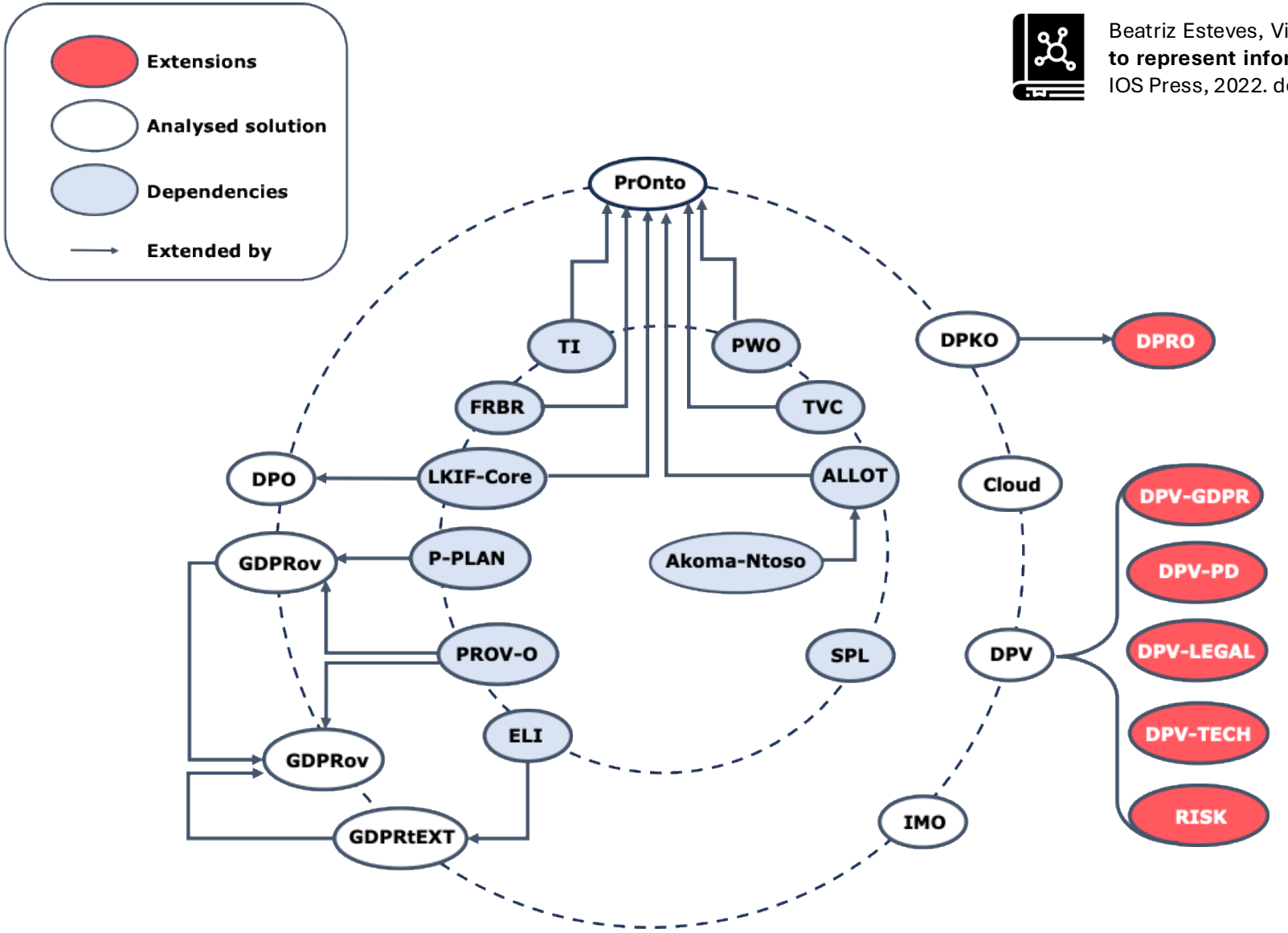
Data requests miss a purpose

Compatibility of purposes cannot be checked

Consent dialogue not enough for informed decision

Access grants not sufficient to be a valid record of consent

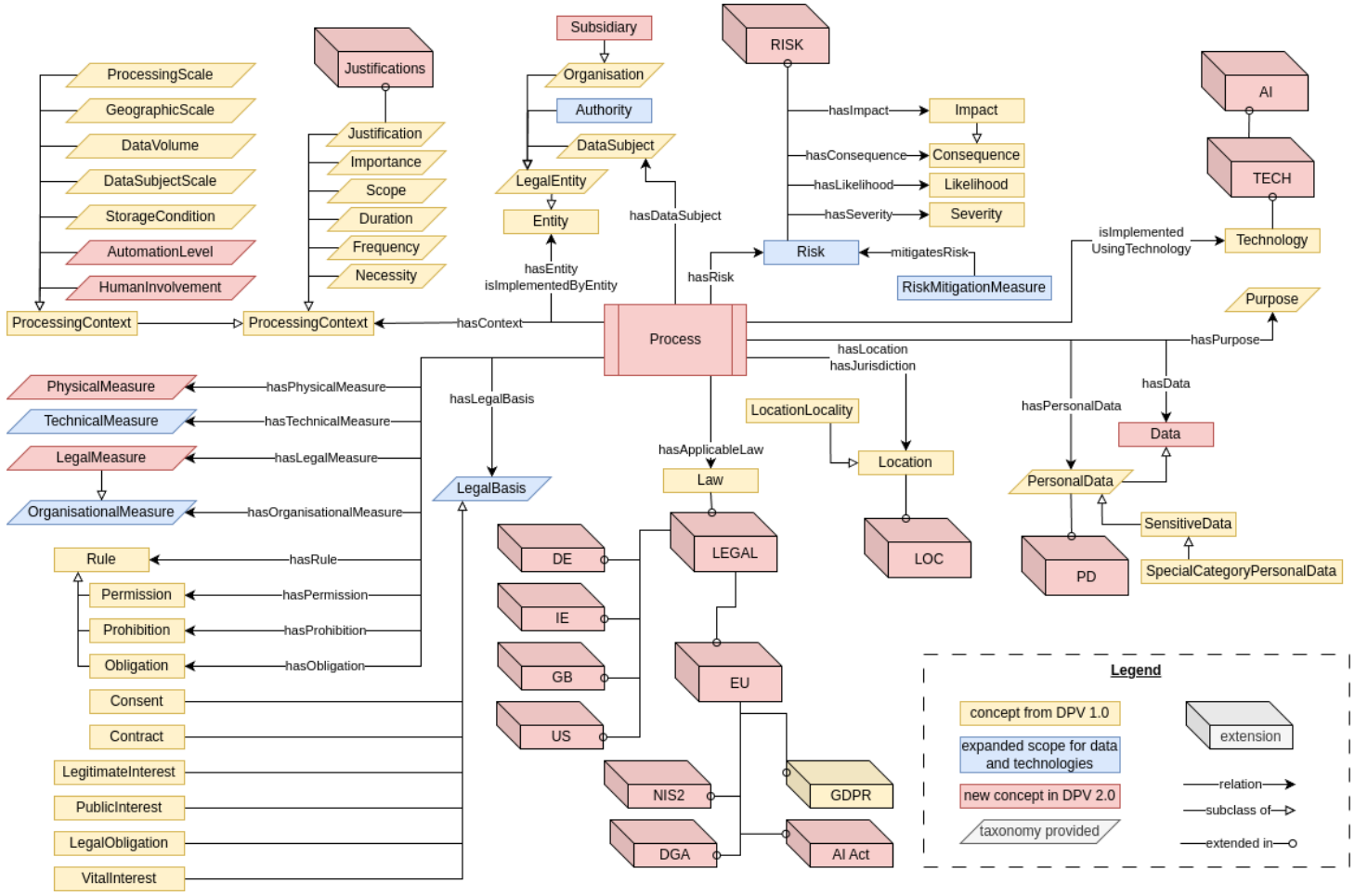
DATA PROTECTION VOCABULARIES



Beatriz Esteves, Victor Rodriguez-Doncel, **Analysis of ontologies and policy languages to represent information flows in GDPR.** *Semantic Web Journal 15(3)*, pages 709-743. IOS Press, 2022. doi: 10.3233/SW-223009.

- **DPV** and **GDPRtEXT** include the most concepts to represent, at least partially, privacy terms from the 'right to be informed' (Arts. 13 and 14) and other data subject rights (Arts. 15 to 22)
- Only DPV has be updated in the past two years
- DPKO, IMO, and PrOnto lack open and accessible resources

DATA PRIVACY VOCABULARY



Data Privacy Vocabulary (DPV)

https://w3id.org/dpv

- 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

Harshvardhan J. Pandit, Axel Polleres, Bert Bos, Rob Brennan, Bud Bruegger, Fajar J. Ekaputra, Javier D. Fernández, Roghaiyeh Gachpaz Hamed, Elmar Kiesling, Mark Lizar, Eva Schlehahn, Simon Steyskal, and Rigo Wenning. **Creating a Vocabulary for Data Privacy: The First-Year Report of Data Privacy Vocabularies and Controls Community Group (DPVCG)**. *On the Move to Meaningful Internet Systems: OTM 2019 Conferences*, volume 11877 of Lecture Notes in Computer Science, pages 714–730. Springer International Publishing, 2019. doi: 10.1007/978-3-030-33246-4_44.

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.

DATA PRIVACY VOCABULARY

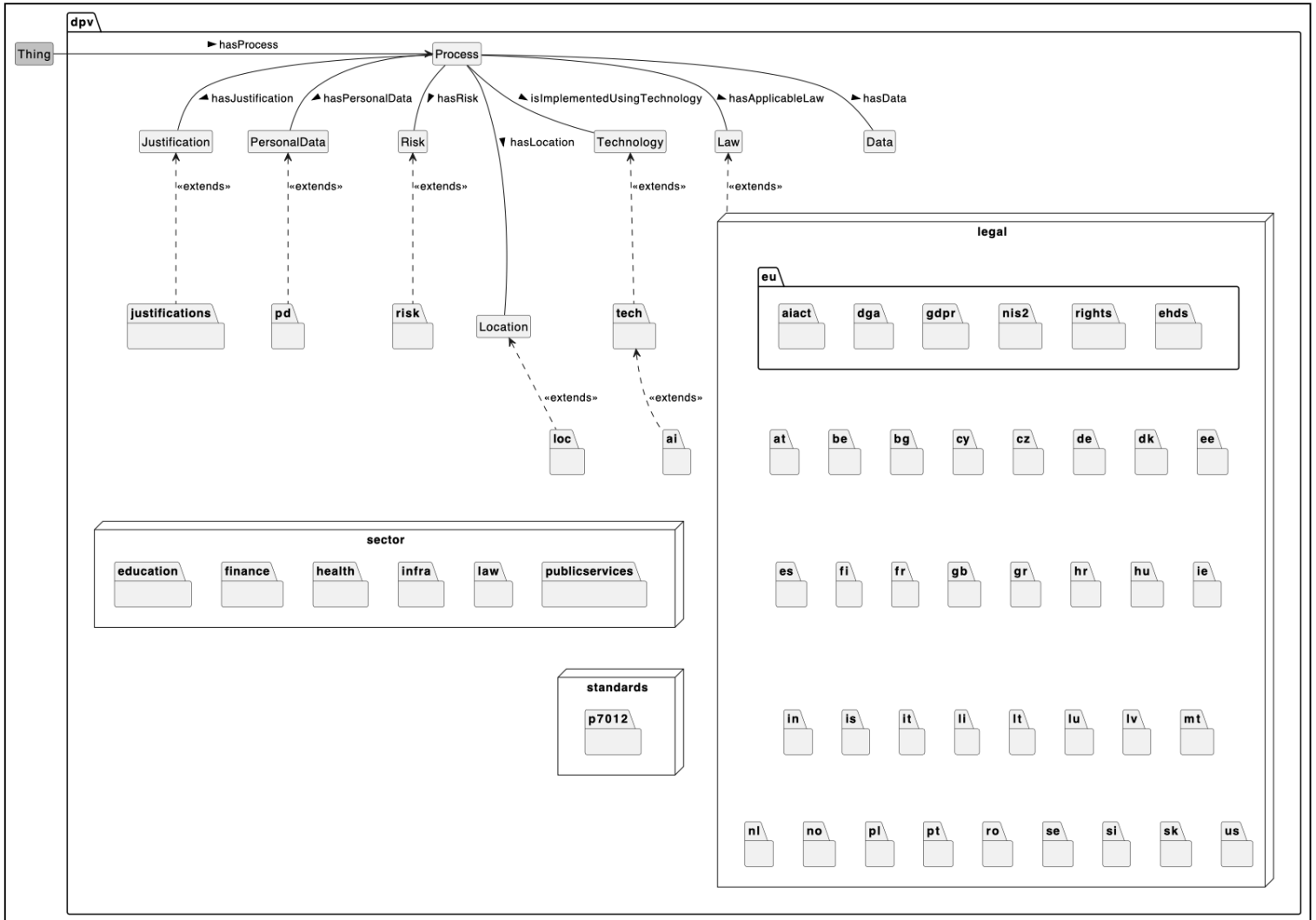


Figure 20 Structure of DPV vocabularies where DPV defines the core concepts which are then extended in specific extensions. The LEGAL extensions are named using ISO 3166-2 country codes, and contain specific extensions modelling laws within that jurisdiction. SECTOR and STANDARDS extensions also contain extensions within them modelling specific sectors and standards respectively.

GENERAL DATA PROTECTION REGULATION

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EU General Data Protection Regulation (GDPR)

version 2.1

Final Community Group Report 16 March 2025

This version:
https://www.w3.org/community/reports/dpvcg/CG-FINAL-eu-gdpr-20250316/

Latest published version:
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https://dev.dpvcg.org/legal/eu/gdpr

Editor:
Harshvardhan J. Pandit (ADAPT Centre, Dublin City University)

Authors:
Beatriz Esteves (IDLab, IMEC, Ghent University)
Georg P. Krog (Signatu AS)
Harshvardhan J. Pandit (ADAPT Centre, Dublin City University)
Paul Ryan (Uniphar PLC)

Feedback:
GitHub w3c/dpv (pull requests, new issue, open issues)

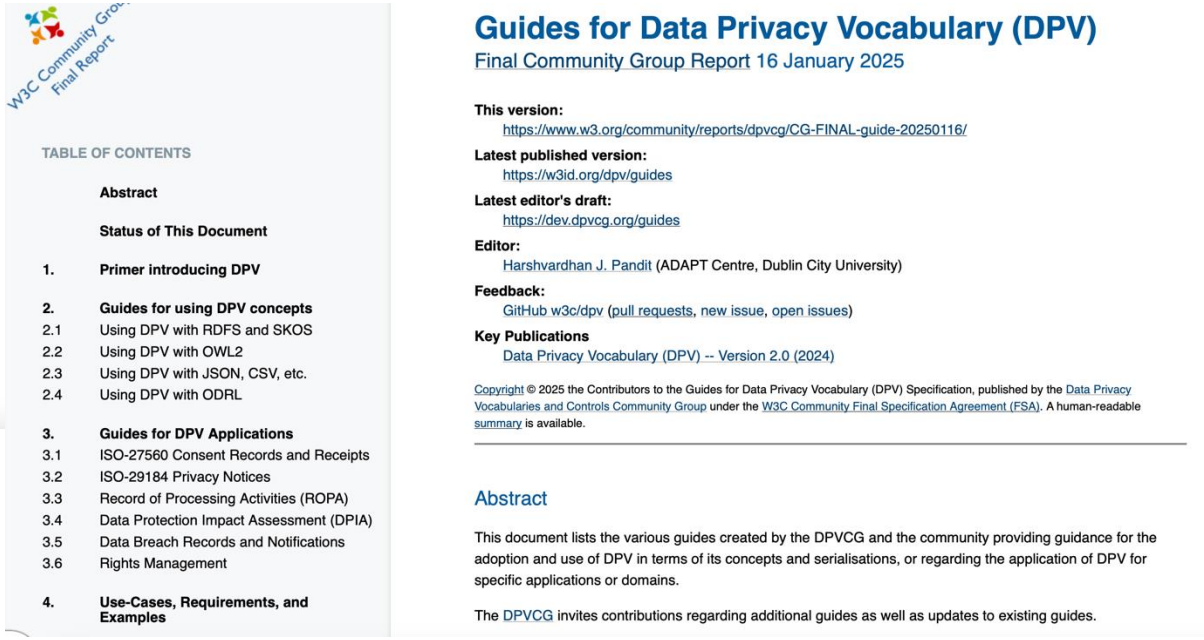
This Release
https://w3id.org/dpv/2.1/legal/eu/gdpr

Previous Release
https://w3id.org/dpv/2.0/legal/eu/gdpr

Changelog
Changelog for v2.1

Key Publications
Data Privacy Vocabulary (DPV) -- Version 2.0 (2024)

https://w3id.org/dpv/legal/eu/gdpr



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Guides for Data Privacy Vocabulary (DPV)

Final Community Group Report 16 January 2025

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https://w3id.org/dpv/guides

Latest editor's draft:
https://dev.dpvcg.org/guides

Editor:
Harshvardhan J. Pandit (ADAPT Centre, Dublin City University)

Feedback:
GitHub w3c/dpv (pull requests, new issue, open issues)

Key Publications
Data Privacy Vocabulary (DPV) -- Version 2.0 (2024)

Abstract

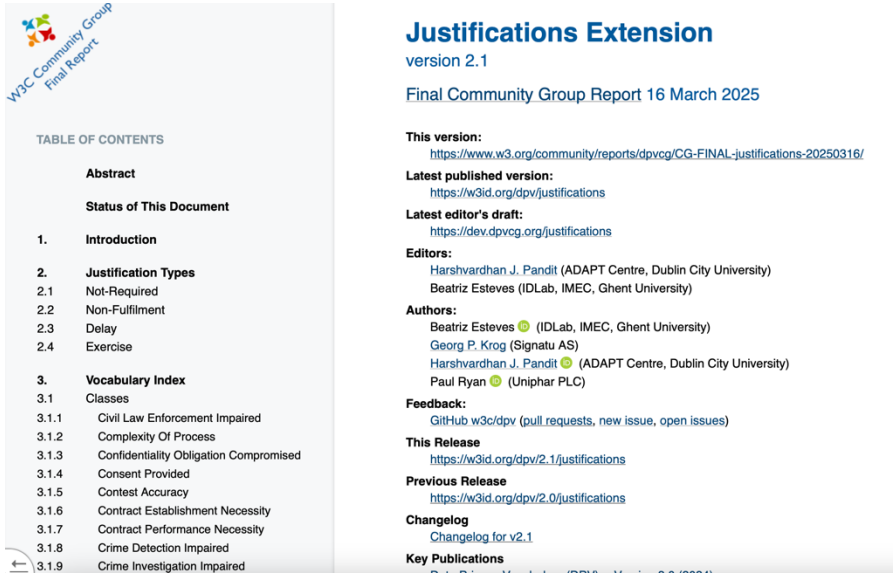
This document lists the various guides created by the DPVCG and the community providing guidance for the adoption and use of DPV in terms of its concepts and serialisations, or regarding the application of DPV for specific applications or domains.

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

https://w3id.org/dpv/guides

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.

RIGHTS MANAGEMENT



W3C Community Group Final Report

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Justifications Extension

version 2.1

Final Community Group Report 16 March 2025

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Editors:
Harshvardhan J. Pandit (ADAPT Centre, Dublin City University)
Beatriz Esteves (IDLab, IMEC, Ghent University)

Authors:
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Georg P. Krog (Signatu AS)
Harshvardhan J. Pandit (ADAPT Centre, Dublin City University)
Paul Ryan (Uniphar PLC)

Feedback:
GitHub w3c/dpv (pull requests, new issue, open issues)

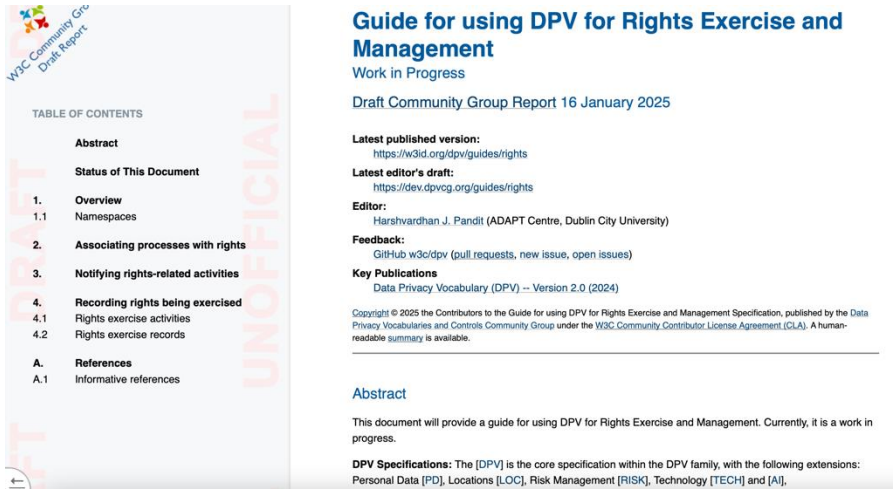
This Release
https://w3id.org/dpv/2.1/justifications

Previous Release
https://w3id.org/dpv/2.0/justifications

Changelog
Changelog for v2.1

Key Publications

https://w3id.org/dpv/justifications



W3C Community Grc Draft Report

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Guide for using DPV for Rights Exercise and Management

Work in Progress

Draft Community Group Report 16 January 2025

Latest published version:
https://w3id.org/dpv/guides/rights

Latest editor's draft:
https://dev.dpvcg.org/guides/rights

Editor:
Harshvardhan J. Pandit (ADAPT Centre, Dublin City University)

Feedback:
GitHub w3c/dpv (pull requests, new issue, open issues)

Key Publications
Data Privacy Vocabulary (DPV) -- Version 2.0 (2024)

Abstract

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

DPV Specifications: The [DPV] is the core specification within the DPV family, with the following extensions: Personal Data [PD], Locations [LOC], Risk Management [RISK], Technology [TECH] and [AI],

https://w3id.org/dpv/guides/rights

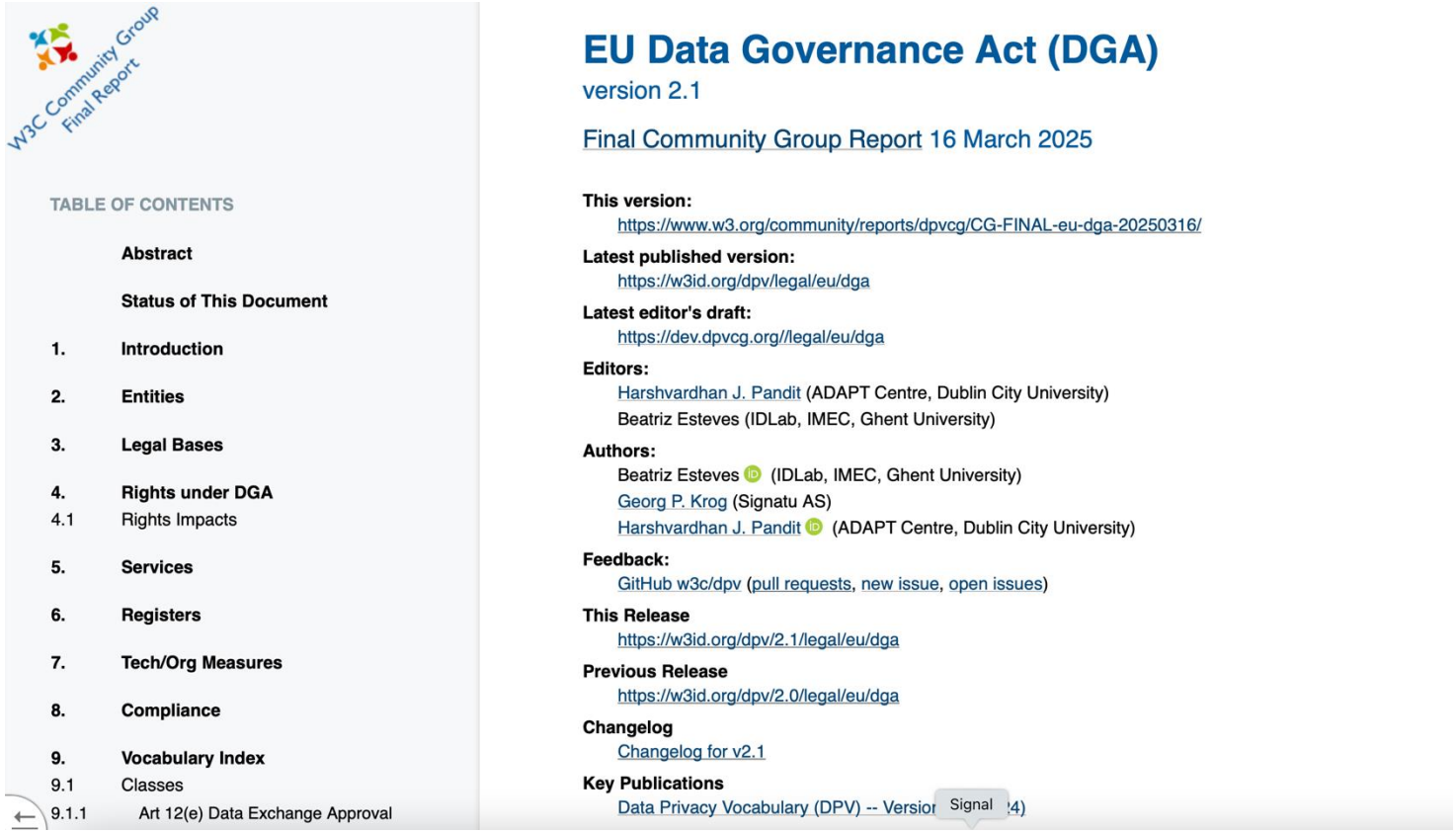
```
ex:RejectRightToErasure a dpv:RightNonFulfilmentNotice ;
    dcterms:issued "2024-09-06"^^xsd:date ;
    dcterms:description "Notice of non-fulfillment related to an exercised right to erasure" ;
    dcterms:identifier "x4ghyun-658393" ;
    dcterms:language "EN" ;
    dcterms:publisher ex:DataController ;
    dpv:hasRight eu-gdpr:A17 ;
    dpv:hasDataController ex:DataController ;
    dpv:isImplementedByEntity ex:DataController ;
    foaf:page <https://example.org/DataController/RejectRightToErasure> ;
    dpv:hasRecipient ex:DataSubject ;
    dpv:hasStatus dpv:RequestUnfulfilled ;
    dpv:hasJustification justifications:FreedomOfExpressionImpaired .

ex:DataSubject a dpv:DataSubject .
```


Beatriz 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.

Beatriz 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.

DATA GOVERNANCE ACT



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EU Data Governance Act (DGA)

version 2.1

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

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Previous Release
https://w3id.org/dpv/2.0/legal/eu/dga

Changelog
Changelog for v2.1

Key Publications
Data Privacy Vocabulary (DPV) -- Versio

Signal

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

Legal terms validated by legal scholars and Data Protection Officers and integrated into the outcomes of the W3C DPVCG

Use Cases

UC1. Conditions for the Reuse of Public Data

UC2. Policies for Data Altruism

UC3. Records of Altruistic and Intermediation Activities

UC4. Registers of Entities

Beatriz Esteves and Víctor Rodríguez-Doncel. **Semantifying the Governance of Data in Europe**. In *18th International Conference on Semantic Systems – CEUR Workshop Proceedings*, volume 3235, 2022. URL: https://ceur-ws.org/Vol-3235/paper17.pdf.

Beatriz 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.

DATA GOVERNANCE ACT

```
ex:SIPPA_assets a :DataAssetList, dcat:Catalog ;
    dct:description "Asset list maintained by SIPPA" ;
    dct:created "2022-12-10"^^xsd:date ;
    dct:publisher ex:SIPPA ; dcat:dataset ex:dataset_001 .
ex:SIPPA a :SingleInformationPointProvider .
ex:dataset_001 a dcat:Dataset ; dct:publisher ex:publicsectorbodyX ;
    dpv:hasData :StatisticallyConfidentialData ;
    dct:description "Dataset with statistically confidential data" ;
    dct:created "2022-12-04"^^xsd:date ;
    odrl:hasPolicy ex:policy_001 ; :hasFee "0€"^^xsd:string ;
    dcat:mediaType <iana.org/assignments/media-types/text/csv> ;
    dct:extent "5.6MB"^^xsd:string .
```

```
ex:policy_001 a odrl:Offer, :DataReusePolicy ;
    odrl:permission [
        odrl:target ex:dataset_001 ; odrl:action :Reuse ;
        odrl:assigner ex:publicsectorbodyX ;
        odrl:constraint [
            odrl:and [
                odrl:leftOperand odrl:dateTime ;
                odrl:operator odrl:lteq ;
                odrl:rightOperand "2023-12-31"^^xsd:date ], [
                odrl:leftOperand odrl:purpose ;
                odrl:operator odrl:isA ;
                odrl:rightOperand :ScientificResearch ] ] ] .
ex:publicsectorbodyX a :PublicSectorBody ;
    dpv:hasName "Public Sector Body X" ;
    dpv:hasContact "mailto:publicsectorbodyX@email.com" ;
    :hasCompetentBody [
        a :DataReuseCompetentBody ; dpv:hasName "Competent Body X" ;
        dpv:hasContact "mailto:competentbodyX@email.com" ] .
```

```
ex:publicregistry_DI_PT a :RegisterOfDataIntermediationServiceProviders ;
    dct:description "Public register of intermediaries working in PT" ;
    dct:created "2023-12-15"^^xsd:date ;
    dct:modified "2023-12-23"^^xsd:date ;
    dct:publisher ex:nationalauthority_PT ;
    :hasDataIntermediationServiceProvider ex:DISP_Y .
ex:nationalauthority_PT a :DataIntermediationAuthority ;
    dpv:hasName "Data Intermediation Authority of Portugal" ;
    dpv:hasContact "mailto:nationalauthority_PT@email.com" ;
    dpv:hasJurisdiction "PT" .
ex:DISP_Y a :DataCooperative ;
    dpv:hasName "Data Cooperative Y" ; dpv:hasAddress "Lisboa, Portugal" ;
    dct:description "Provider of anonymised geolocation data" ;
    dcat:landingPage <http://cooperativeA.com/> ;
    dct:date "2023-12-23"^^xsd:date .
```

```
ex:altruism_logs a :RegisterOfDataIAltruismActivity ;
    dct:description "Activity logs of the Data Altruism Organisation A" ;
    dct:created "2023-11-04"^^xsd:date ;
    dct:modified "2023-11-13"^^xsd:date ;
    dct:publisher ex:altruism_A ; dcat:record ex:log_001 .
ex:altruism_A a :DataAltruismOrganisation ;
    dpv:hasName "Data Altruism Organisation A" ;
    dpv:hasAddress "Lisboa, Portugal" ;
    dcat:landingPage <http://example.com/altruism_A> .
ex:log_001 a dcat:CatalogRecord ;
    dct:created "2023-11-13"^^xsd:date ;
    :hasDataUser ex:userZ ; :hasFee "1000€"^^xsd:string ;
    dpv:hasPersonalDataHandling [
        dct:description "Download and reuse anonymised health records to
        ↪ improve healthcare" ;
        dpv:hasProcessing :Download, :Reuse ; dpv:hasDuration 6226453 ;
        dpv:hasPurpose :DataAltruism, :ImproveHealthcare ;
        dpv:hasPersonalData dpv-pd:HealthRecord ;
        dpv:hasTechnicalMeasure dpv:Anonymisation ] .
ex:userZ a :DataUser ; dpv:hasName "Data User Z" ;
    dpv:hasContact "mailto:user_z@email.com" .
```

WHO IS USING DPV? WHAT ARE THEY DOING?

Year	Mention	Use	Ext.	Contrib.	Domain	Effort
2020	X				Health	N/A
2020	X				Media	N/A
2020	X					N/A
2020		X				++
2020		X			Health	++
2020			X	X		++
2021	X				Health	N/A
2021	X					N/A
2021		X				++
2021		X			Smart products	+
2021			X	X		+
2022	X					N/A
2022	X			X		N/A
2022			X	X		+
2022	X				Health	N/A
2022		X				+
2022		X			IoT	+
2022		X			Health	+
2023		X			Smart cities	+

Creating a **vocabulary** for **data privacy**: The first-year report of **data privacy vocabularies** and controls community group (DPVCG)

HJ Pandit, A Polleres, B Bos, R Brennan… - On the Move to …, 2019 - Springer

…) was set up to jointly develop such **vocabularies** towards interoperability in the context of **data privacy**. This paper presents the resulting **Data Privacy Vocabulary** (DPV), along with a …

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(At the time of writing the paper we had 81 citations)

We looked at how much *Effort* it would take for these works to integrate the changes made in DPV.

Most works only required minor changes in changed concepts (+ *in table)*, other works required changing IRIs to the new formats as they were using an old pre-v1.0 draft version of the DPV.

🏆 Prototyping an End-User User Interface for the Solid Application Interoperability Specification under GDPR by H Bailly, A Papanna, R Brennan wins **Best In-Use Paper award** at ESWC 2023 🏆

🏆 Using Patterns to Manage Governance of Solid Apps by B. Esteves, H. Pandit wins **Best Paper award** at Workshop on Ontology Patterns (WOP), ISWC 2023 🏆

🏆 Implementing ISO/IEC TS 27560: 2023 Consent Records and Receipts for GDPR and DGA by H. Pandit, J. Lindquist, G. P. Krog wins **Best Paper award** at Annual Privacy Forum 2024 organised by European Union Agency for Cybersecurity (ENISA) and EU Commission _🏆

WHAT PROJECTS AND INDUSTRIES ARE USING DPV?

EU Horizon Projects

SPECIAL TRAPEZE

MOSAICrOWN

smashHit FAIRVASC

PROTECT ITN

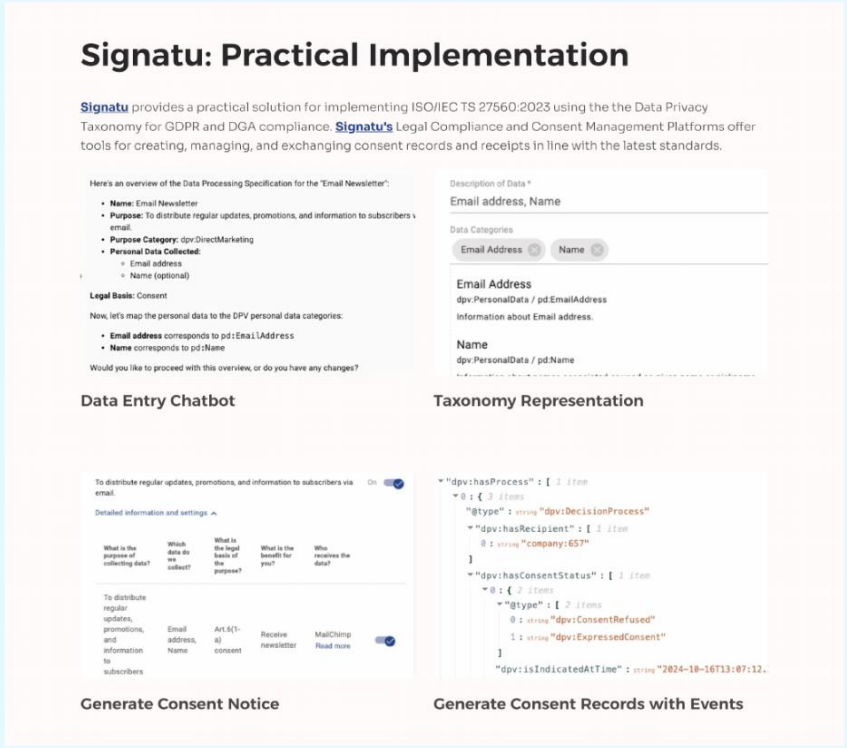
Industry

Signatu Inrupt JLINC

Athumi / Solid Lab

* These are the projects we know about. Most uses of DPV go unreported, and DPV is also commonly referenced in footnotes and inline text which we do not have a way to track. Projects also contained industry partners.

Spotlight: Signatu's use of DPV (Georg P. Krog)



https://www.w3.org/community/dpvcg/wiki/Adoption_of_DPVCG

WHAT'S COMING NEXT?

Come join us in the W3C Data Privacy Vocabularies and Controls Community Group (DPVCG) !!!

Find a short intro at https://www.dpvcg.org/

Primer

Data Privacy Vocabulary (DPV)

Final Community Group Report 01 August 2024

https://w3id.org/dpv/primer

IEEE SA STANDARDS ASSOCIATION IEEE

IEEE P7012

IEEE Draft Standard for Machine Readable Personal Privacy Terms

IEEE P7012 is using DPV to express terms

- More Jurisdictions
- AI taxonomies
- ODRL alignment
- Risks/Impacts
- AI Act compliance
- Guidance for using DCAT and PROV
- New ISO standard proposed based on DPV modelling of Legal Bases
- Machine-Actionable Rights

CALL FOR CONTRIBUTIONS

~ NXDG 2025 ~

NeXt-generation Data Governance workshop 2025

co-located with 21st SEMANTiCS
3-5 September 2025
Vienna, Austria

https://w3id.org/nxdg/2025

Advancing legal compliance in the Solid ecosystem with DPV

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