A New Generic Representation for Modeling Privacy

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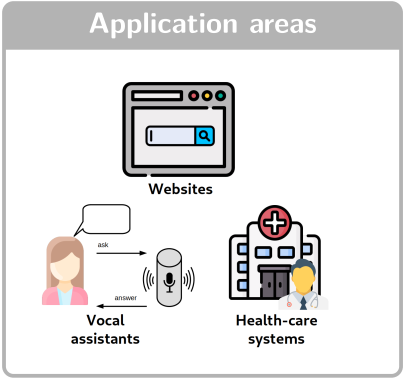
Context

Privacy in information systems



Application areas

Websites

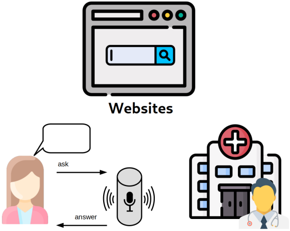
Vocal assistants

Health-care systems

⚠ **Personal data** processing

Privacy in information systems

Application areas



Websites

Vocal assistants

Health-care systems

Laws & Regulations

- GDPR
- Australian Privacy Act
- Japanese Privacy Act
- ...

⚠ **Personal data** processing

⚠ **Mandatory!**

Judgments for non-compliance with the GDPR

Google

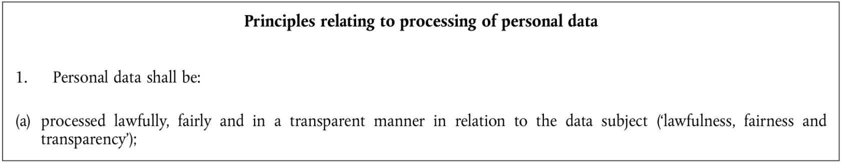
💵 **50 million €** (2019) [15]

WhatsApp

💵 **225 million €** (2021) [14]

Fines for **invalid consent** (lack of transparency)

GDPR



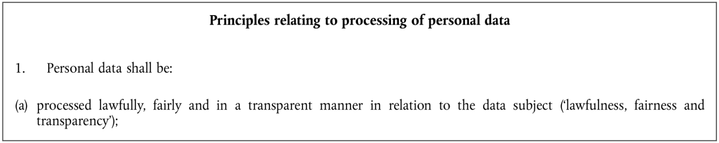
Principles relating to processing of personal data

1. Personal data shall be:

(a) processed lawfully, fairly and in a transparent manner in relation to the data subject ('lawfulness, fairness and transparency');

Privacy verification - Complex

Document



Principles relating to processing of personal data

1. Personal data shall be:

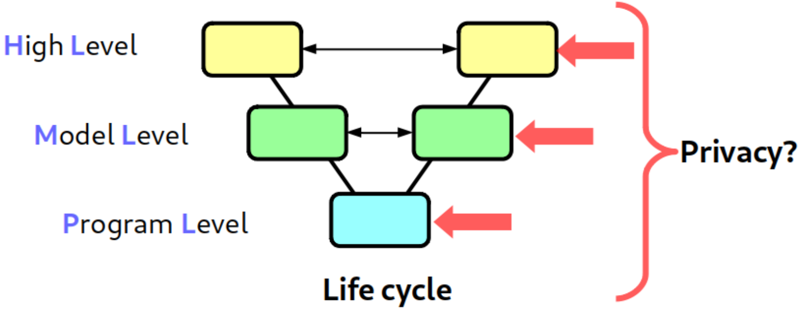
(a) processed lawfully, fairly and in a transparent manner in relation to the data subject ('lawfulness, fairness and transparency');

Gap

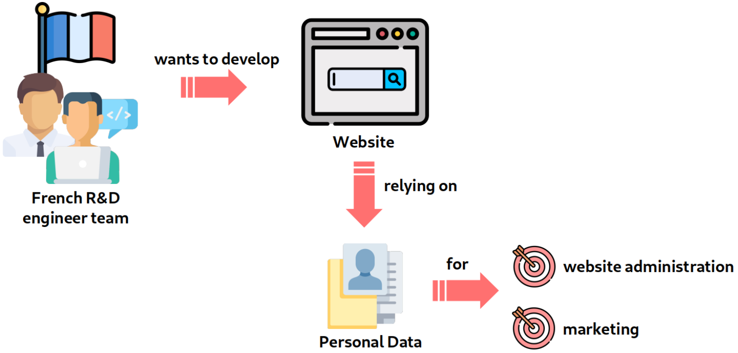
Code

```
public Combined[] join(Payroll[] Ps, Employee[] Es) {
   Combined tab[] = new Combined[Ps.length];
   for (int i=0; i < Ps.length; i++)
      if (Ps[i] != null) tab[i] = checkJoinIndAndfindEmployee(Ps[i], Es);
      else tab[i] = null;
   return tab;}
```

Privacy verification - Complex



Running example



Example: users's e-mail addresses

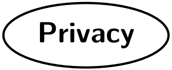
- inform subscription expiration
- send targeted advertising

Contributions

Contributions

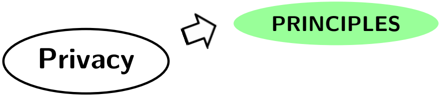
New Generic Privacy Representation

Existing representations



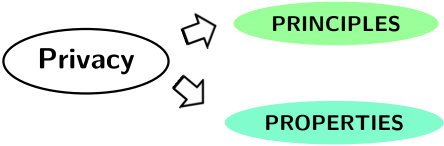
Privacy

Existing representations



🟩 Principles [6, 26, 13]

Existing representations



🟢 Principles [6, 26, 13]
🟢 Properties [18]

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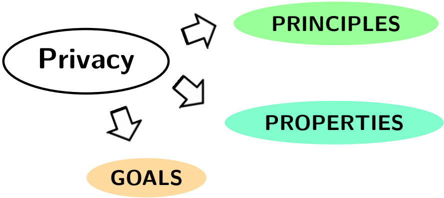
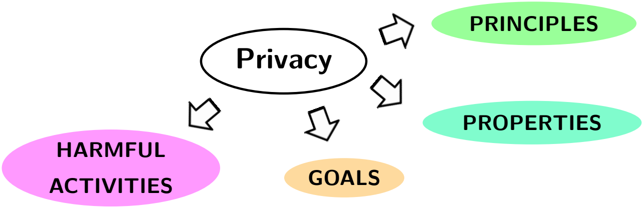


● Principles [6, 26, 13]

● Properties [18]

● Goals [1]

Existing representations


Privacy

PRINCIPLES

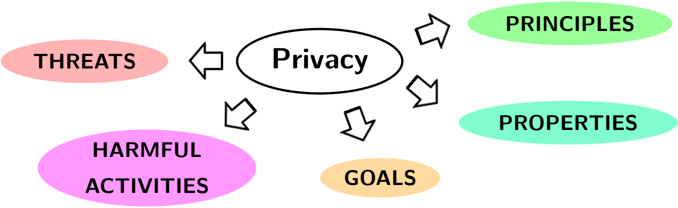
PROPERTIES

GOALS

HARMFUL ACTIVITIES

🟩	Principles [6, 26, 13]	🟪	Harmful Activities [21]
🟦	Properties [18]		
🟧	Goals [1]		

Existing representations



Privacy

THREATS

PRINCIPLES

PROPERTIES

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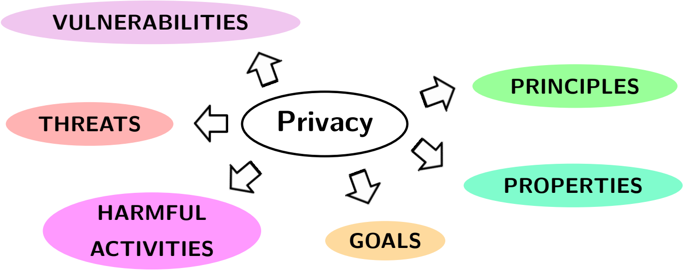
🟦 Properties [18]

🟧 Goals [1]

🟪 Harmful Activities [21]

🟥 Threats [8]

Existing representations



● Principles [6, 26, 13]
● Properties [18]
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● Vulnerabilities [1]

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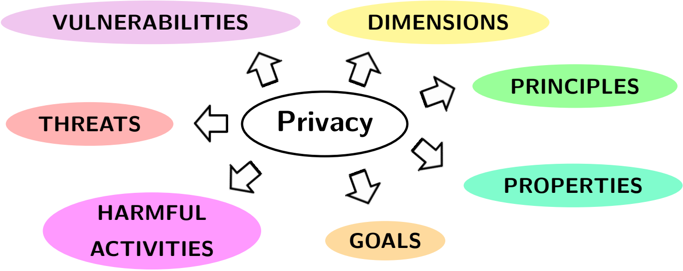

- ● Principles [6, 26, 13]
- ● Properties [18]
- ● Goals [1]
- ● Harmful Activities [21]
- ● Threats [8]
- ● Vulnerabilities [1]
- ● Dimensions [4]

Existing representations observations

- Many **specific** representations

- Many rely on **similar notions**
  example:
  - Principle: *Purpose limitation* [6]
  - Property: *Purpose binding* [10]
  - Goal: *Choice/Consent* [1]
  - Harmful Activity: *Secondary Use* [21]

Positioning

	Existing representations
Adapted to specific situations	✓
Genericity	✗
Comparing papers	✗
Identifying key elements	?

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💡 **Solution:** A new **generic** representation

GePyR -
A Generic Privacy Representation

Group via generic **categories**

GePyR - A Generic Privacy Representation

Group via generic **categories**

- **Confidentiality category**

the visibility of the e-mail addresses

GePyR -
A Generic Privacy Representation

Group via generic **categories**

- Confidentiality category
- Consent category

  agreement between the website owner and its users

GePyR - A Generic Privacy Representation

Group via generic **categories**

- **Confidentiality category**
- **Consent category**
- **Transparency category**

  awareness of the users

GePyR - A Generic Privacy Representation

Group via generic **categories**

- **Confidentiality category**
- **Consent category**
- **Transparency category**
- **Accountability category**

  ability for the website owner to demonstrate data processing rule respect

Specialisations - Consent

Principles	Properties	Goals	Harmful Activities	Threats	Vulnerabilities	Dimensions
Purpose Limitation [6, 26, 13]	Purpose Binding [10]	Choice/Consent [1]	Interrogation [21]	Policy and Consent Non-Compliance [8]	Information Collection [1]	Purpose [4]
Storage Limitation [6]	Necessity of Data Collection and Processing [10]		Secondary Use [21]		Solicitation [1]	Retention [4]
Data Minimization [6, 13]					Information Monitoring [1]	
Accuracy [6]					Information Storage [1]	

Specialisations - Consent

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Classification example - Consent

LVL	TARGET	REPRESENTATION		REF
HL	Mobile App	Goals	Choice/Consent	[19]
	Home automation	Principles	Purpose limitation	[7]
	Web sites	Principles	Lawfulness, fairness and transparency	[15]
ML	Hospital Information System	Harmful Activities	Secondary use	[17]
	Diagnostic process	Threats	Policy and consent non-compliance	[25]
	Smart device (IOT)	Principles	Lawfulness, fairness and transparency	[3]
PL	Hospital Information System	Threats	Policy and consent non-compliance	[24]
	Web sites	Principles	Purpose limitation	[11]
	Database	Harmful Activities	Secondary use	[9]

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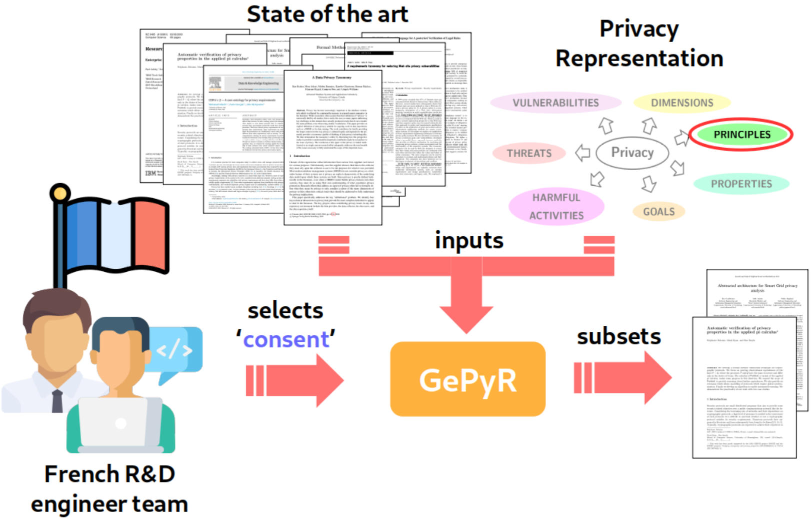
[3] blockchain smart contracts

[11] **J**ava **I**nformation **F**low (JIF)

...

Running example



State of the art

Privacy Representation

VULNERABILITIES

DIMENSIONS

THREATS

Privacy

PRINCIPLES

PROPERTIES

HARMFUL ACTIVITIES

GOALS

inputs

selects 'consent'

GePyR

subsets

Abstracted architecture for Smart Grid privacy analysis

Automatic verification of privacy properties in the applied pi calculus'

French R&D engineer team

Positioning

	Existing representations	GePyR
Adapted to specific situations	✓	✓
Genericity	✗	✓
Comparing papers	✗	✓
Identifying key elements	?	?

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	Existing representations	GePyR
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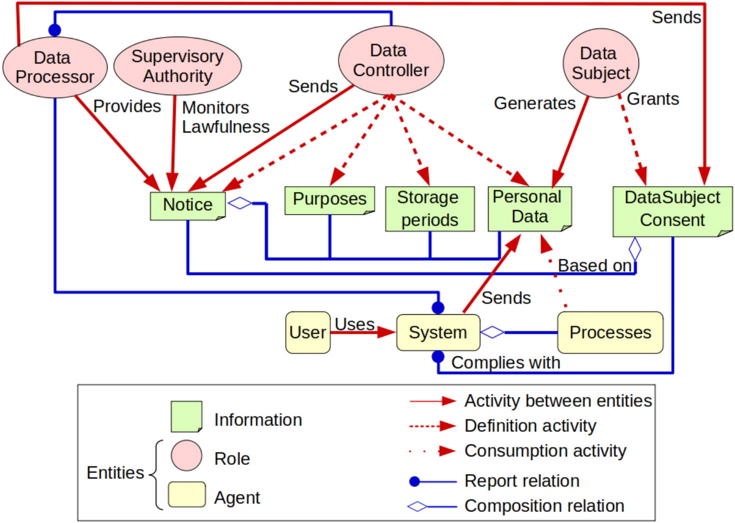
Identifying key elements	?	?

complete with an **ontology**

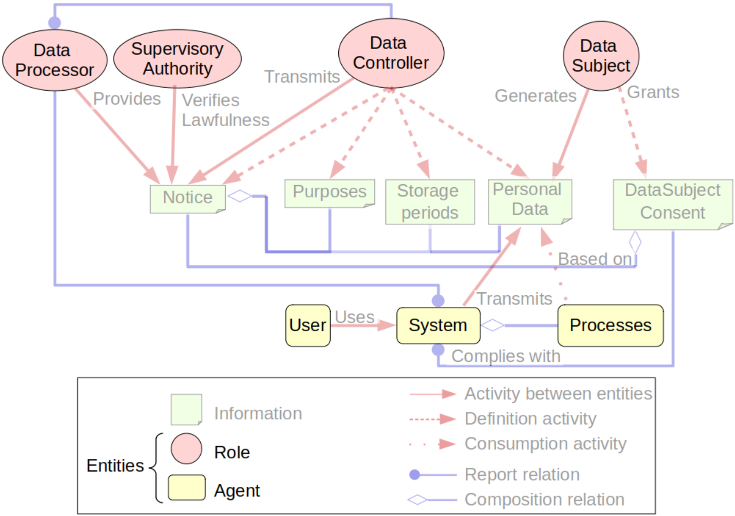
Contributions

New Privacy Context Ontology

PyCO - Privacy Context Ontology



PyCO - Privacy Context Ontology



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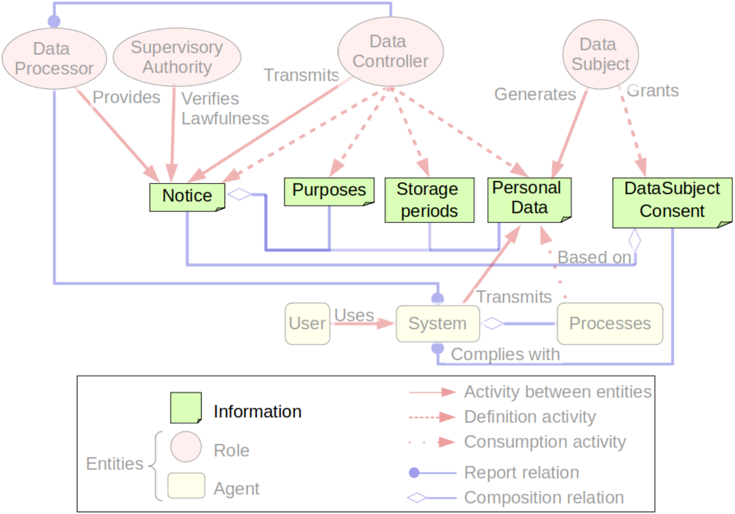

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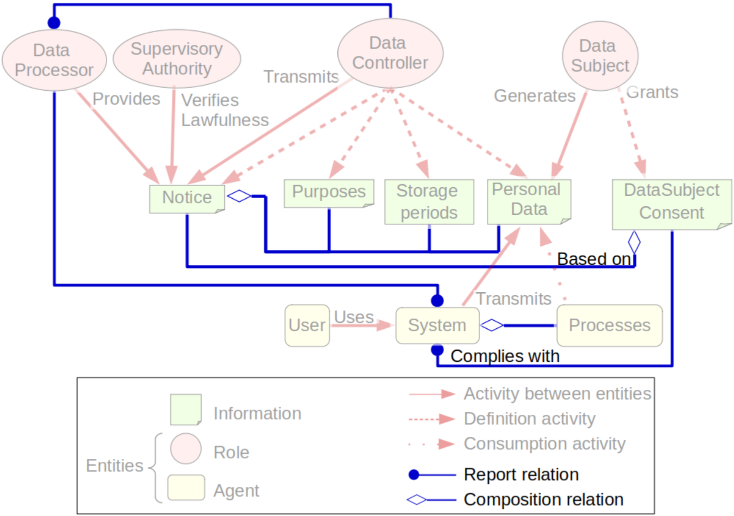

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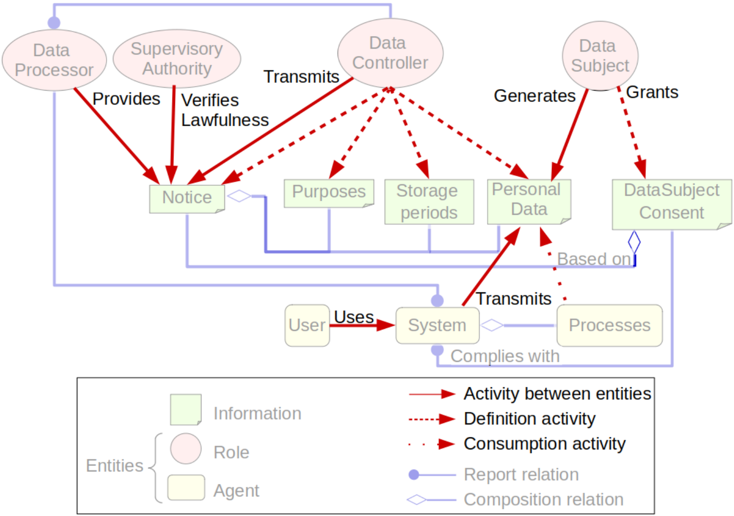
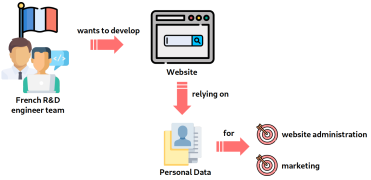


PyCO - Running Example



Data Subject User	website's user
Data Controller Data Processor	website's owner
Personal Data	email address
Purposes	administration & marketing
System	website
Processes	functions (website's code)
Supervisory Authority	CNIL

PyCO - Example of use

LVL	DOMAIN	SYSTEM	PRO-CESSES	PUR-POSES	PRIVATE DATA	STORAGE PERIODS	REF
HL	Public Transport	Mobile App	DNL*	Keywords	DNL*	∅	[19]
	Home Automation	Vocal Assistants	DNL*	DNL*	DNL*	∅	[7]
	Web Services	Web Sites	DNL*	DNL*	DNL*	∅	[15]
ML	Medical	IT	BPM**	Keywords	Keywords	∅	[17]
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	Web services	Web sites	Functions	DNL* or Keywords	"Object"	Keywords	[11]
	Human resources	Database	Functions	Keywords	"Objects"	∅	[9]

* Descriptions in Natural Language

** Business Process Models

PyCO - Running Example

LVL	DOMAIN	SYSTEM	PRO-CESSES	PUR-POSES	PRIVATE DATA	STORAGE PERIODS	REF
HL	Public Transport	Mobile App	DNL*	Keywords	DNL*	∅	[19]
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* Descriptions in Natural Language

** Business Process Models

Positioning

	Existing representations	GePyR	PyCO
Adapted to specific situations	✓	✓	✓
Genericity	✗	✓	≈
Comparing papers	✗	✓	✓
Identifying key elements	?	?	✓

Conclusion and Future Work

Conclusion and future work

Contributions *Paper classification*

- **GePyR**: **Ge**neric **P**rivac**y** **R**epresentation
  → *Genericity*
- **PyCO**: **P**rivac**y** **C**ontext **O**ntology
  → *Key element identification*

Future Work

- **Extending** our state of the art
- **Identifying** properties related to our category of consent
- **Defining** a language to verify consent properties

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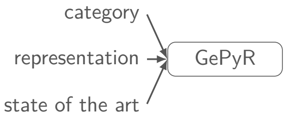
Appendix

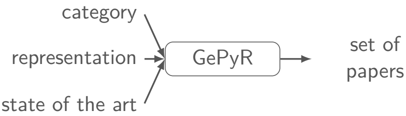
Appendix

GePyR with PyCO

Methodology example - GePyR & PyCO



Methodology example - GePyR & PyCO



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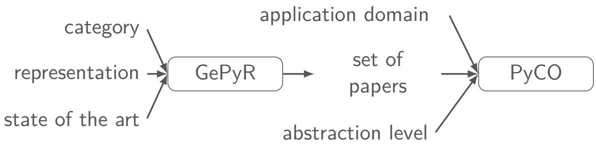

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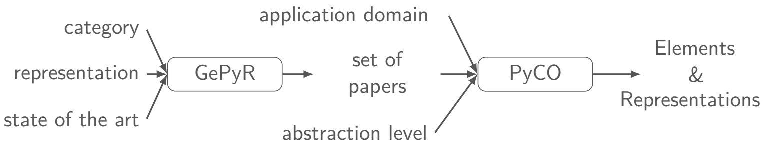

Appendix

Confidentiality category

Specialisations - Confidentiality

Principles	Properties	Goals	Harmful Activities	Threats	Vulnerabilities	Dimensions
Integrity and Confidentiality [6]	Anonymity [18]	Integrity/Security [1]	Identification [21]	Linkability [8]	Information Aggregation [1]	Visibility [4]
	Unlinkability [18]		Breach of Confidentiality [21]	Identifiability [8]		Granularité [4]
Data Breach Notification [13]	Undetectability [18]			Compliance [8]	Information Transfer [1]	
	Unobservability [18]		Disclosure [21]	Detectability [8]		
			Increased Accessibility [21]	Disclosure of Information [8]		

Classification example - Confidentiality

LVL	TARGET	REPRESENTATION		REF
HL	Location-based services	Threats	Linkability	[2]
	Communication protocols	Threats	Disclosure of information	[23]
	Trace sets	Properties	Non-interference	[5]
ML	Communication protocols	Properties	Unlinkability	[12]
	Data-flow diagram	Vulnerabilities	Information Storage	[16]
	Cyber Physical Systems	Threats	Disclosure of information	[20]
PL	Internet of Things	Principles	Data minimization	[3]
	Web privacy policies	Properties	Non-Disclosure	[11]
	Mobile applications	Principles	Data breach notification	[22]

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[23] role-based language to specify communication protocols (with tool)

[20] anonymity technique & purpose-based access control algorithms

Appendix

PyCO

PyCO - Example of use

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	Smart Building	Smart device (IOT)	BPM**	Keywords	Keywords	∅	[3]
PL	Medical	IT	Functions	Keywords	Keywords	∅	[24]
	Web services	Web sites	Functions	DNL* or Keywords	"Object"	Keywords	[11]
	Human resources	Database	Functions	Keywords	"Objects"	∅	[9]

* Descriptions in Natural Language

** Business Process Models

PyCO - Example of use

LVL	DOMAIN	SYSTEM	PRO-CESSES	PUR-POSES	PRIVATE DATA	STORAGE PERIODS	REF
HL	Public Transport	Mobile App	DNL*	Keywords	DNL*	∅	[19]
	Home Automation	Vocal Assistants	DNL*	DNL*	DNL*	∅	[7]
	Web Services	Web Sites	DNL*	DNL*	DNL*	∅	[15]
ML	Medical	IT	BPM**	Keywords	Keywords	∅	[17]
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** Business Process Models

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