

# COST EU Workshop on Privacy Issues in Distributed Social Knowledge Graphs



Sabrina Kirrane, 15.06.2022  
Privacy & Semantic Technologies

# Semantic Technologies

**SCIENTIFIC AMERICAN.COM**

May 17, 2001

### The Semantic Web

A new form of Web content that is meaningful to computers will unleash a revolution of new possibilities

By Tim Berners-Lee, James Hendler and Ora Lassila

**SCIENTIFIC AMERICAN**

Features - January 19, 2009

### The Semantic Web in Action

Corporate applications are well under way, and consumer uses are emerging

By Lee Feigenbaum, Ivan Herman, Tonya Hongsemeier, Eric Neumann and Susie Stephens

viewpoints

001:10.1145/2890489 Abraham Bernstein, James Hendler, and Natalya Noy

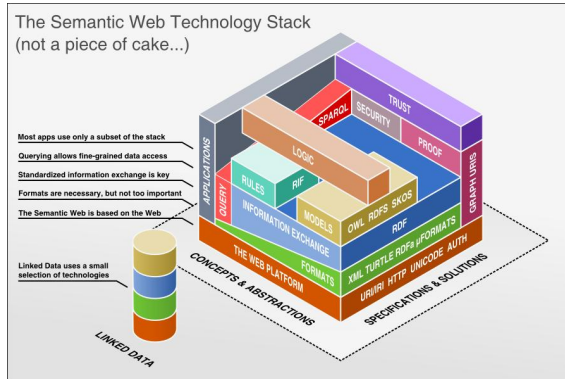
### Viewpoint

## A New Look at the Semantic Web

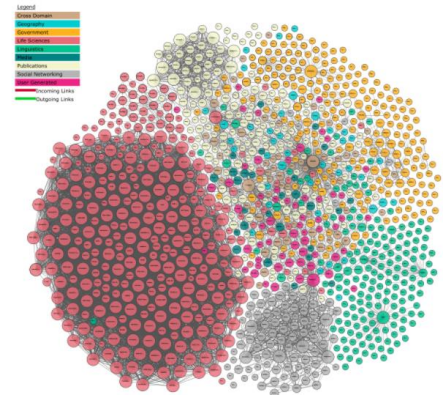
Seeking to make Web data "smarter" by utilizing a new kind of semantics.



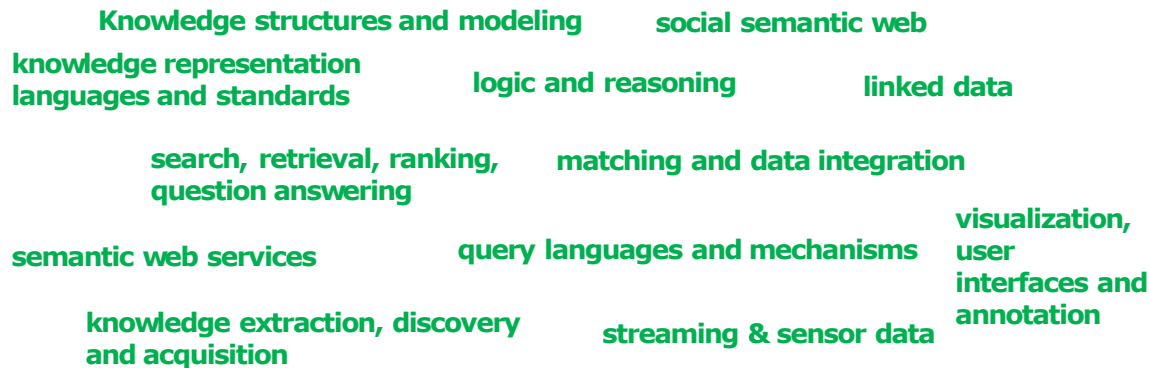
"Now! ... That should clear up a few things around here!"



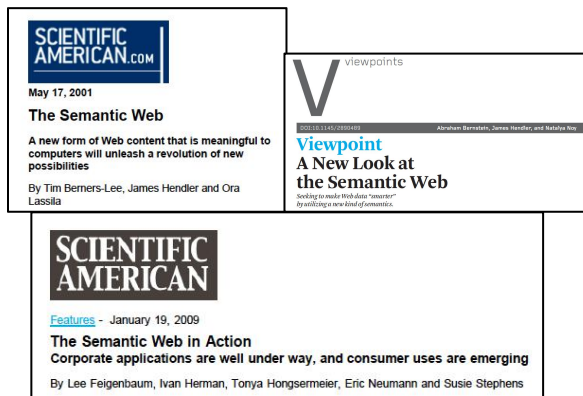
Last updated: 2017-08-22



# Semantic Technologies



# Semantic Technologies



# Privacy Online



<https://sites.google.com/site/privonworkshop>



# Privacy Online: Timeliness

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## the NSA files

NSA files decoded / Edward Snowden's surveillance revelations explained



## Schneier on Security

Blog Newsletter Books Essays News Talks Academic About Me

NEW YORK TIMES BESTSELLER  
**DATA AND GOLIATH**  
The Hidden Battles to Collect Your Data and Control Your World  
BRUCE SCHNEIER

March 2015  
W. W. Norton & Company  
320 Pages  
Hardcover:  
ISBN 978-0393244816

Books >

### Data and Goliath

The Hidden Battles to Collect Your Data and Control Your World

A Book by Bruce Schneier

A *New York Times* Best Seller

You are under surveillance right now.

Your cell phone provider tracks your location and knows who's with you. Your online and in-store purchasing patterns are recorded, and reveal if you're unemployed, sick, or pregnant. Your e-mails and texts expose your intimate and casual friends. Google knows what you're thinking because it saves your private searches. Facebook can determine your sexual orientation without you ever mentioning it.

The power that surveillance does more than simply

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### About Bruce Schneier



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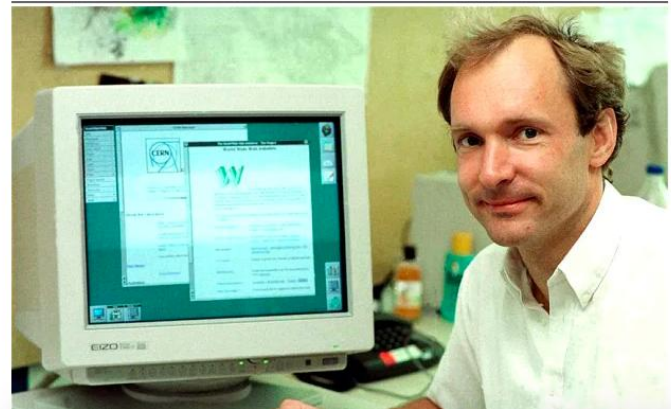
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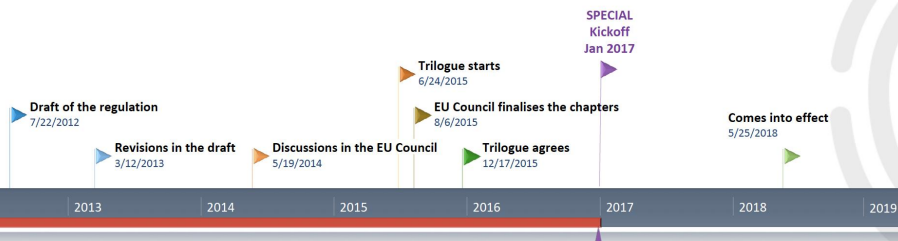
HOME » TECHNOLOGY » TECHNOLOGY NEWS

## Sir Tim Berners-Lee: world needs an 'internet Magna Carta'

The world needs a bill of rights for the internet to stop governments and big businesses from abusing their power, censoring certain information and controlling the web, warns the inventor of the World Wide Web



# Privacy Online: Timeliness



EUGDPR.org   The Regulation   The Process   More Resources   Our Partners

The EU General Data Protection Regulation (GDPR) is the most important change in data privacy regulation in 20 years - we're here to make sure you're prepared.

**TIME UNTIL GDPR ENFORCEMENT UTC**  
**217:03:35:00**  
Days Hrs Mins Secs

GDPR Portal: Site Overview

Quick Links

## Data regulators reject EU-US Privacy Shield safe harbour deal

Pan-European working party questions protection of EU citizens' data from 'massive and indiscriminate' surveillance by US government

Samuel Gibbs and agencies

Thursday 14 April 2016 10.19 BST



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## Trans-Atlantic Framework Would Ease EU-to-US Data Flows

By Dinah Wisenberg Brin  
May 24, 2022



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REUSE PERMISSIONS ?



# Beyond Privacy Online....

2015 - 2017

Call for papers: Special Issue on

## The Semantic Web and Linked Data: Security, Privacy and Policy

Although the technology underpinning the Semantic Web and Linked Data has been in existence for a number of years, initially data publishers focused on exposing and linking static, public and open data. Indeed, much like e-Business on the Web was only made possible once security and privacy issues were adequately addressed, linked data and the semantic web might only evolve to a dynamic read/write distributed data source supporting the full spectrum of data and knowledge - from open to private and confidential - if we first provide solutions for challenges with respect to data security, privacy, policies, rights and licensing.

<http://www.semantic-web-journal.net/blog/call-papers-special-issue-semantic-web-and-linked-data-security-privacy-and-policy>

2019 - 2022 ....

Call for Special Sub-Topic  
LegalTech

SEMANTiCS 2019 - The Power of Artificial Intelligence and Knowledge Graphs

<https://2019.semantics.cc/calls>

2020 - 2023

Call for papers: Special Issue on

## Semantic Technologies for Data and Algorithmic Governance

Technology is playing a progressively important key role in enabling effective governance structures, processes, and frameworks. As society becomes increasingly dependent on complex systems ranging from simple 'decision support systems' to 'systems of systems' and 'semi autonomous systems', data and algorithmic governance are of utmost importance.

<http://www.semantic-web-journal.net/blog/call-papers-special-issue-semantic-technologies-data-and-algorithmic-governance>

2020 & 2022

ISWC 2020 Workshop: International Workshop on Artificial Intelligence for Legal Documents (AI4LEGAL).

**COLLOCATED WITH THE 19TH INTERNATIONAL  
CONFERENCE ON THE SEMANTIC WEB, ATHENS, GREECE**

<http://ai.di.uoa.gr/#iswc20-workshop>





A birds eye view of work at the intersection of the

Semantic Web  
&  
Privacy, Security, and Trust!



Disclaimer (1) :  
This is not a  
complete list of  
works

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Disclaimer (1) :  
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complete list of  
works

Disclaimer (2) :  
Several authors  
are participating  
in this workshop

A birds eye view of work at the intersection of the  
  
Semantic Web  
&  
Privacy, Security, and Trust!

- A European Framework for Regulating Data and Metadata Markets (PrivOn 2016) - *Pompeu Casanovas, Víctor Rodríguez-Doncel, Cristiana Santos, Asunción Gómez-Pérez*
- Compliance through Informed Consent: Semantic Based Consent Permission and Data Management Model (PrivOn 2017) - *Kaniz Fatema, Ensar Hadziselimovic, Harshvardhan Pandit, Christophe Debruyne, Dave Lewis, Declan O'Sullivan*
- Modelling Provenance for GDPR Compliance using Linked Open Data Vocabularies (PrivOn 2017) - *Harshvardhan J. Pandit and Dave Lewis*
- GConsent - A Consent Ontology Based on the GDPR (ESWC 2019) - *Harshvardhan J. Pandit, Christophe Debruyne, Declan O'Sullivan, Dave Lewis.*
- GDPRtEXT - GDPR as a Linked Data Resource (ESWC 2018) - *Harshvardhan J. Pandit, Kaniz Fatema, Declan O'Sullivan, Dave Lewis*
- Analysis of Ontologies and Policy Languages to Represent Information Flows in GDPR (SWJ 2022) - *Beatriz Esteves Víctor Rodríguez-Doncel*

- *Energy efficient sensing for managing privacy on smartphones (PrivOn 2013) - Prajit Kumar Das, Anupam Joshi, Tim Finin*
- *Semantic Knowledge and Privacy in the Physical Web (PrivOn 2016) - Prajit Kumar Das, Abhay Kashyap, Gurpreet Singh, Cynthia Matuszek, Tim Finin, Anupam Joshi*
- *Semantic and Sensitivity Aware Location-Privacy Protection for the Internet of Things (PrivOn 2014) - Berker Agir, Jean-Paul Calbimonte and Karl Aberer*
- *A Semantic Context-aware Privacy Model for FaceBlock (PrivOn 2014) - Primal Pappachan , Roberto Yus , Prajit Kumar Das , Tim Finin , Eduardo Mena , and Anupam Joshi*

- Towards the use of graph summaries for privacy enhancing release and querying of Linked Data (PrivOn 2016) - *Benjamin Heitmann, Felix Hermsen, Stefan Decker*
- k-RDF-Neighbourhood Anonymity: Combining Structural and Attribute-based Anonymisation for Linked Data (PrivOn 2017) - *Benjamin Heitmann, Felix Hermsen, and Stefan Decker*
- Semantic Web Enabled Record Linkage Attacks on Anonymized Data (PrivOn 2016) - *Jacob Miracle and Michelle Cheatham*
- Private Record Linkage: Comparison of Selected Techniques for Name Matching (*ESWC 2016*) - *Pawel Grzebala, Michelle Cheatham*

- Towards a Configurable Framework for Iterative Signing of Distributed Graph Data (PrivOn 2013) - *Andreas Kasten and Ansgar Scherp*
- A Framework for Iterative Signing of Graph Data on the Web (ESWC 2014) - *Andreas Kasten, Ansgar Scherp, Peter Schaub*
- Graße—Towards Flexible Search on Encrypted Graph Data (PrivOn 2013) - *Andreas Kasten, Ansgar Scherp, Frederik Armknecht, Matthias Krause*
- Self-Enforcing Access Control for Encrypted RDF (ESWC 2017) - *Javier D. Fernandez, Sabrina Kirrane, Axel Polleres, and Simon Steyskal*
- HDT crypt : Efficient Compression and Encryption of RDF Datasets (SWJ 2020) - *Javier D. Fernandez, Sabrina Kirrane, Axel Polleres, and Simon Steyskal*

- *Spy Watch: A Tool for Transparency in Web Tracking (PrivOn 2013) - Neel Guha*
- *Behavioral Tracing of Twitter Accounts (PrivOn 2017) - Neel Guha*
- *Semantic Web Technologies for Social Translucence and Privacy Mirrors on the Web (PrivOn 2013) - Mathieu d'Aquin and Keerthi Thomas*
- *On Modeling Political Systems to Support the Trust Process (PrivOn 2017) - Carlos Laufer and Daniel Schwab*

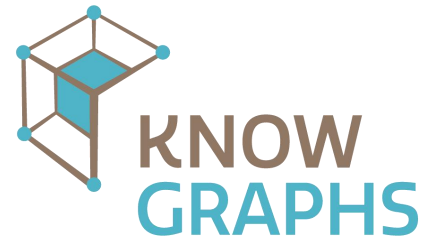
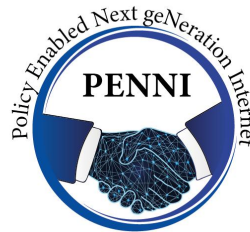


- [Spy Watch: A Tool for Transparency in Web Tracking \(PrivOn 2013\)](#) - *Neel Guha*
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- [On Modeling Political Systems to Support the Trust Process \(PrivOn 2017\)](#) - *Carlos Laufer and Daniel Schwabe*
- [A survey of trust in computer science and the Semantic Web \(JWS 2007\)](#) - *Donovan Artz, Yolanda Gil*

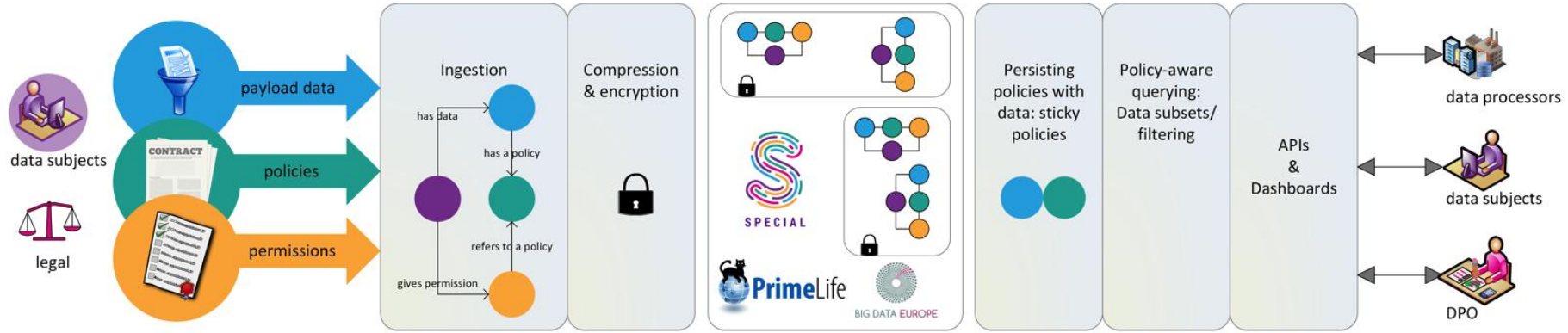
- *Modeling Social Web Privacy to Detect Perception Gaps (PrivOn 2015) - Davide Ceolin, Lora Aroyo, and Jesper Duinker*
- *Evaluation of Semantic Web Ontologies for Privacy Modelling in Smart Home Environments (PrivOn 2016) - Suzana Iacob, Antonis Bikaki*
- *PrivOnto: A Semantic Framework for the Analysis of Privacy Policies (SWJ 2018) - Alessandro Oltramari, Dhivya Piraviperumal, Florian Schaub, Shomir Wilson, Sushain Cherivirala, Thomas B. Norton, N. Cameron Russell, Peter Story, Joel Reidenberg, Norman Sadeh*
- *Semantic-enabled Architecture for Auditable Privacy-Preserving Data Analysis (SWJ 2022) - Fajar J. Ekaputra, Andreas Ekelhart, Rudolf Mayer, Tomasz Miksa, Tanja Šarcevi, Sotirios Tsepelakis, Laura Waltersdorfer*

Work that I've personally been involved in at the intersection of

Solid  
&  
Privacy, Security, and Trust!






# Scalable Policy-aware Linked Data Architecture For Privacy, Transparency and Compliance



SPECIAL leverages past infrastructure and lessons learned

- ❖ **Big Data Europe** scalability and elasticity
- ❖ **PrimeLife** policy languages, access control policies, release policies and data handling policies
- ❖ The **Platform for Privacy Preferences Project (P3P)** and the **Open Digital Rights Language (ODRL)** vocabularies

## Greater Control and Transparency in Personal Data Processing

Giray Havur<sup>1,3</sup><sup>a</sup>, Miel Vander Sande<sup>2</sup><sup>b</sup> and Sabrina Kirrane<sup>1</sup><sup>c</sup>

<sup>1</sup>*Institute for Information Business, Vienna University of Economics and Business, Austria*

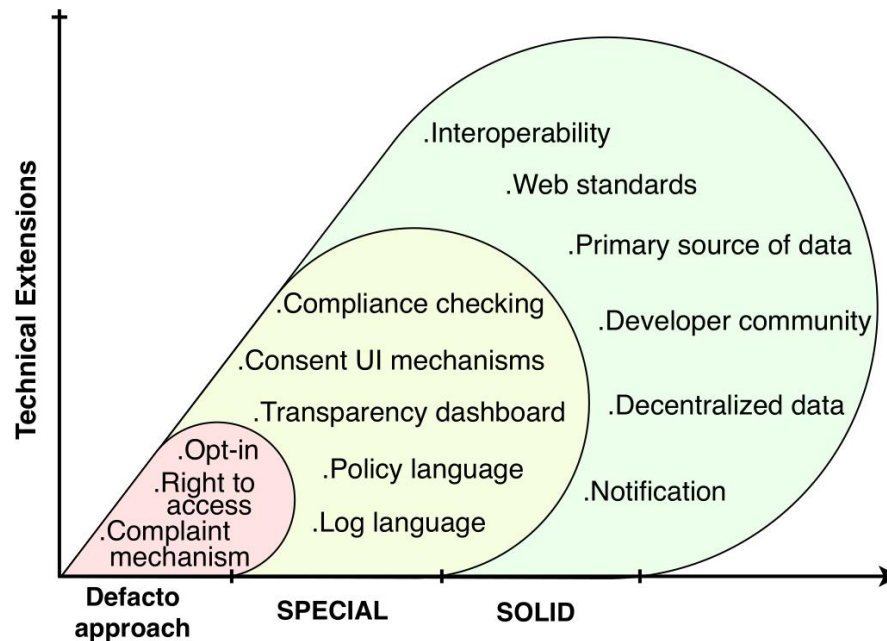
<sup>2</sup>*IDLab, Ghent University – imec, Belgium*

<sup>3</sup>*Corporate Technology, Siemens AG Austria, Austria*




*giray.havur, sabrina.kirrane@wu.ac.at, miel.vanderSande@ugent.be*

Keywords: Usage Control, Consent, Transparency, Compliance, Trust, Decentralisation.

Abstract: Although the European General Data Protection Regulation affords data subjects more control over how their personal data is stored and processed, there is a need for technical solutions to support these legal rights. In this position paper we assess the level of control, transparency and compliance offered by three different approaches (i.e., defacto standard, SPECIAL, Solid). We propose a layered decentralised architecture based on combining SPECIAL and Solid. Finally, we introduce our usage control framework, which we use to compare and contrast the level of control and compliance offered by the four different approaches.



## Greater Control and Transparency in Personal Data Processing

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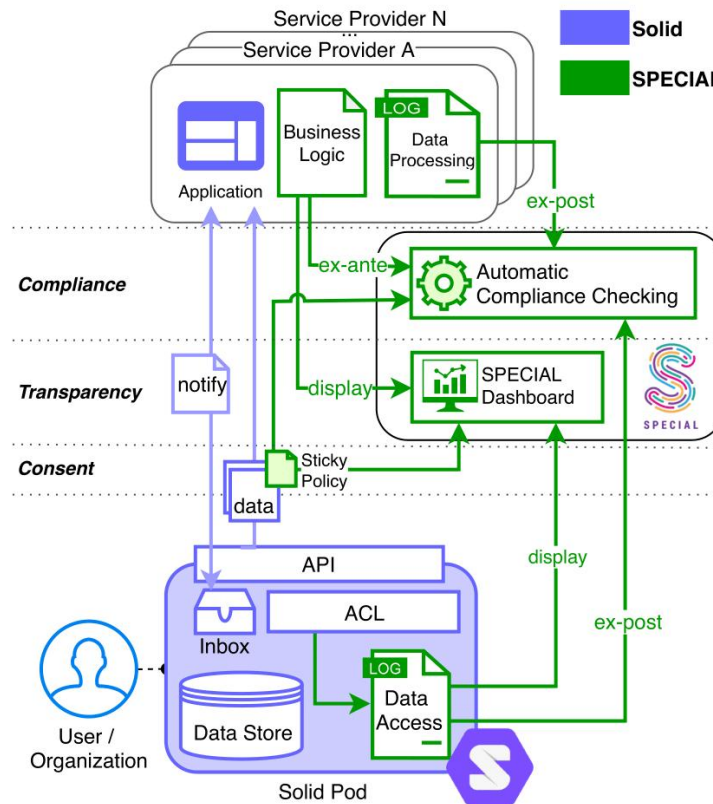
<sup>2</sup>IDLab, Ghent University – imec, Belgium

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# Privacy Preserving Aggregation

## Towards Querying in Decentralized Environments with Privacy-Preserving Aggregation

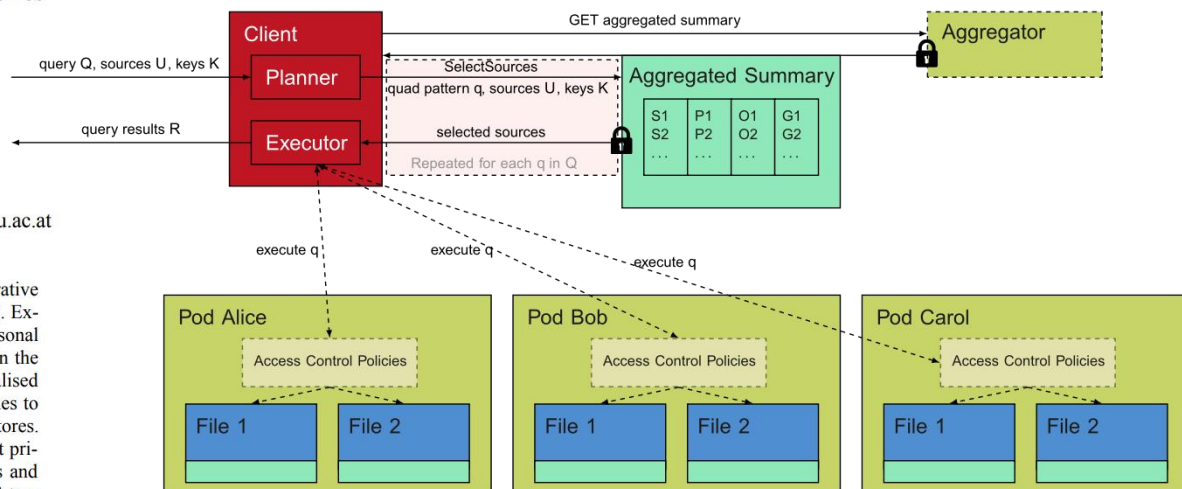
Ruben Taelman<sup>1</sup>, Simon Steyskal<sup>2</sup>, Sabrina Kirrane<sup>3</sup>

<sup>1</sup>IDLab, Ghent University – imec, Belgium, ruben.taelman@ugent.be

<sup>2</sup>Siemens AG Austria, Austria, simon.steyskal@siemens.com

<sup>3</sup>Vienna University of Economics and Business, Austria, sabrina.kirrane@wu.ac.at

**Abstract.** The Web is a ubiquitous economic, educational, and collaborative space, however, it also serves as a haven for personal information harvesting. Existing decentralised Web-based ecosystems, such as Solid, aim to combat personal data exploitation on the Web by enabling individuals to manage their data in the personal data store of their choice. Since personal data in these decentralised ecosystems are distributed across many sources, there is a need for techniques to support efficient privacy-preserving query execution over personal data stores. Towards this end, in this position paper we present a framework for efficient privacy preserving federated querying, and highlight open research challenges and opportunities. The overarching goal being to provide a means to position future research into privacy-preserving querying within decentralised environments.



# Blockchain Oracles, Truted Execution Environments & Solid



## A Usage Control Architecture for Solid Data Stores

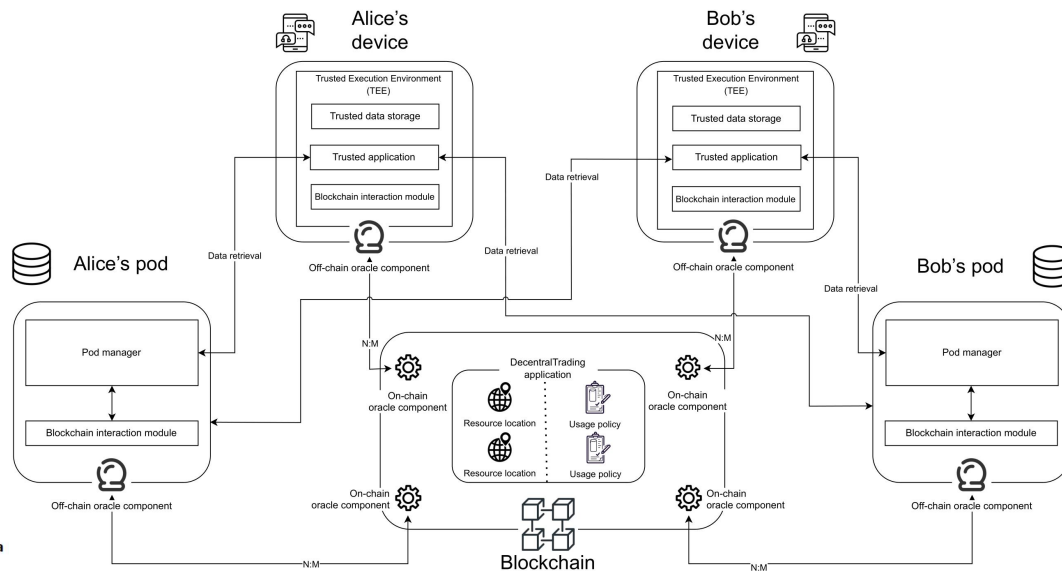
Davide Basile  
Sapienza University of Rome, Italy

Claudio Di Ciccio  
Sapienza University of Rome, Italy

Valerio Goretta  
Sapienza University of Rome, Italy

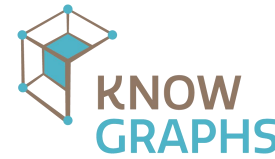
Sabrina Kirrane  
Vienna University of Economics and Business, Austria

**Abstract**—Decentralization initiatives, such as Solid and Digi.me, enable data owners to control who has access to their data and to stimulate innovation by creating both application and data markets, thus enabling small players to compete with large organizations that are currently dominant in the tech industry market. Despite these efforts, once Solid data owners share their data with others it is no longer possible for them to control how their data are used. In order to address this issue we propose a usage control architecture, that relies on a blockchain application and a trusted execution environment in order to monitor compliance with usage control policies. We demonstrate the potential of the architecture by describing the various workflows needed to realize a data market motivating use case scenario. Additionally, we discuss the merits of the architecture from privacy, security, integrateability, and affordability perspectives.





# Usage Control Specification, Enforcement & Usability



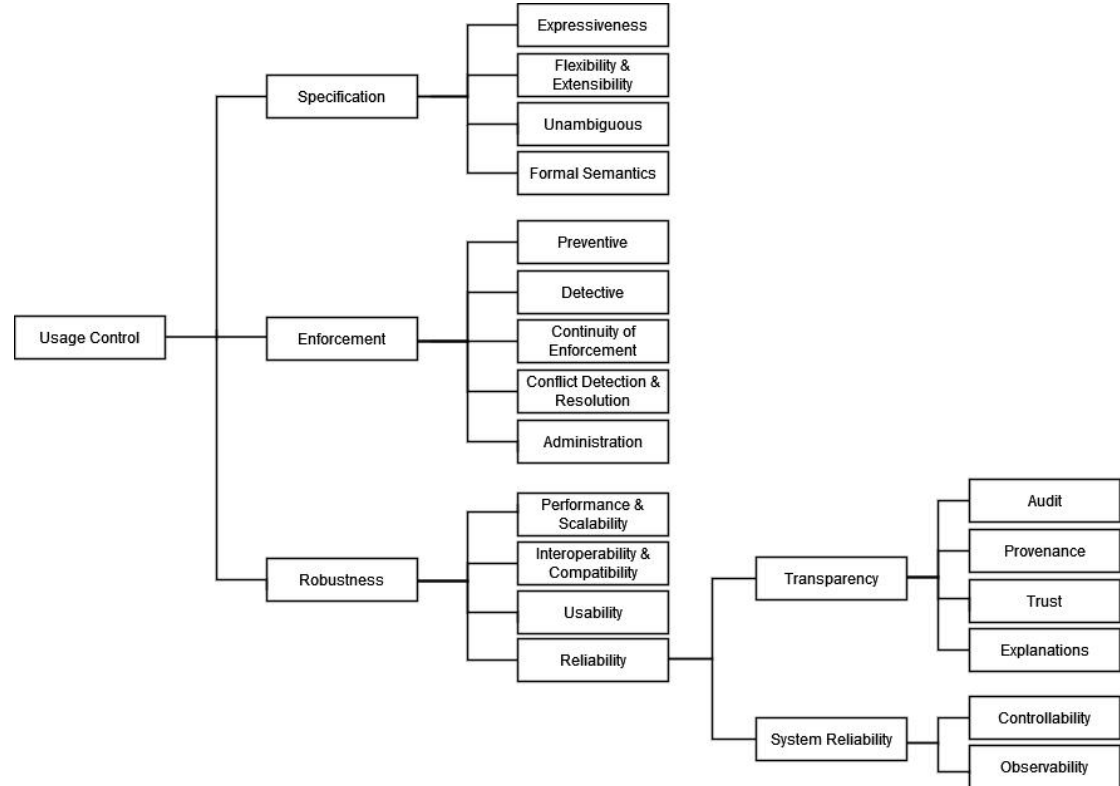
## Semantic Technology based Usage Control for Decentralized Systems

Ines Akaichi<sup>[0000-0002-6020-5572]</sup>

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Vienna University of Economics and Business  
[ines.akaichi@wu.ac.at](mailto:ines.akaichi@wu.ac.at)

**Abstract.** The sharing of data and digital assets in a decentralized setting is associated with various legislative challenges, including, but not limited to, the need to adhere to legal requirements with respect to privacy (e.g. *data protection legislation*) and copyright (e.g. *copyright legislation*). In order to enable software platform providers to manage data and digital assets appropriately and to provide more control to data and digital asset owners, usage control technologies could be used to make sure that consumers handle data according to privacy preferences, licenses, regulatory requirements, among others. In this research proposal, we explore the application of usage control in decentralized environments. In particular, we address the challenges related to the specification of usage control policies, the enforcement of the respective policies, and the usability of the tools that are used to administer them.

**Keywords:** Policy · Usage Control · Reasoning · Semantic Web · Administration · Decentralized Systems.



# In Conclusion

- There are some excellent starting points, however there is still a lot of work to be done
- Multidisciplinary work can sometimes be hard to get published
- Workshops and community initiatives are necessary in order to push the research agenda forward
- We need to move beyond privacy, regulatory requirements and licensing silo's towards usage control in the general sense

Regulatory Compliance

Policies & Vocabularies

Encryption

Digital Signatures

Anonymisation

Transparency

Trust

Privacy Enhancing Technologies

.....

# Thank you / contact details



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