



Horizon 2020
European Union Funding
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smashHit

Smart Dispatcher for Secure and Controlled sharing of
Distributed Personal and Industrial Data





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Smart Dispatcher for Secure and Controlled sharing of
Distributed Personal and Industrial Data

Data sharing in smashHit: Making consent and contracts interpretable with knowledge graphs

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Leibniz
Universität
Hannover



1. smashHit – Project Summary
2. Automated Contracting Tool
 - Consent management
 - Contract management
3. Future Work and Conclusion

smashHit - project summary



Web: <https://www.smashhit.eu>

Twitter: @smashHitP

- “**smashHit**: Smart Dispatcher for Secure and Controlled Sharing of Distributed Personal and Industrial Data”,
- Funding: EU Horizon 2020, IA,
- Duration: January 2020 - December 2022,
- Budget: approx. 7 million Euro, 720 K Euro (UIBK),
- Leading: automated contracting for data, transparent consent management, proof of innovation concept, dissemination and communication lead,
- Main partners: ATB, Volkswagen, LexisNexis, Uni Hanover, Atos, companies working for city of Helsinki.

- The objective of smashHit is to assure **trusted and secure sharing of data streams from both personal and industrial platforms**, needed to build sectorial and cross-sectorial services, by establishing a Framework for processing of data owner consent and legal rules and effective contracting, as well as joint security and privacy preserving mechanisms.
- SmashHit aims to **overcome obstacles in the rapidly growing Data Economy** which is characterised by heterogeneous technical designs and proprietary implementations, locking business opportunities due to the **inconsistent consent and legal rules** among different data-sharing platforms actors and operators.

- **Objectives**

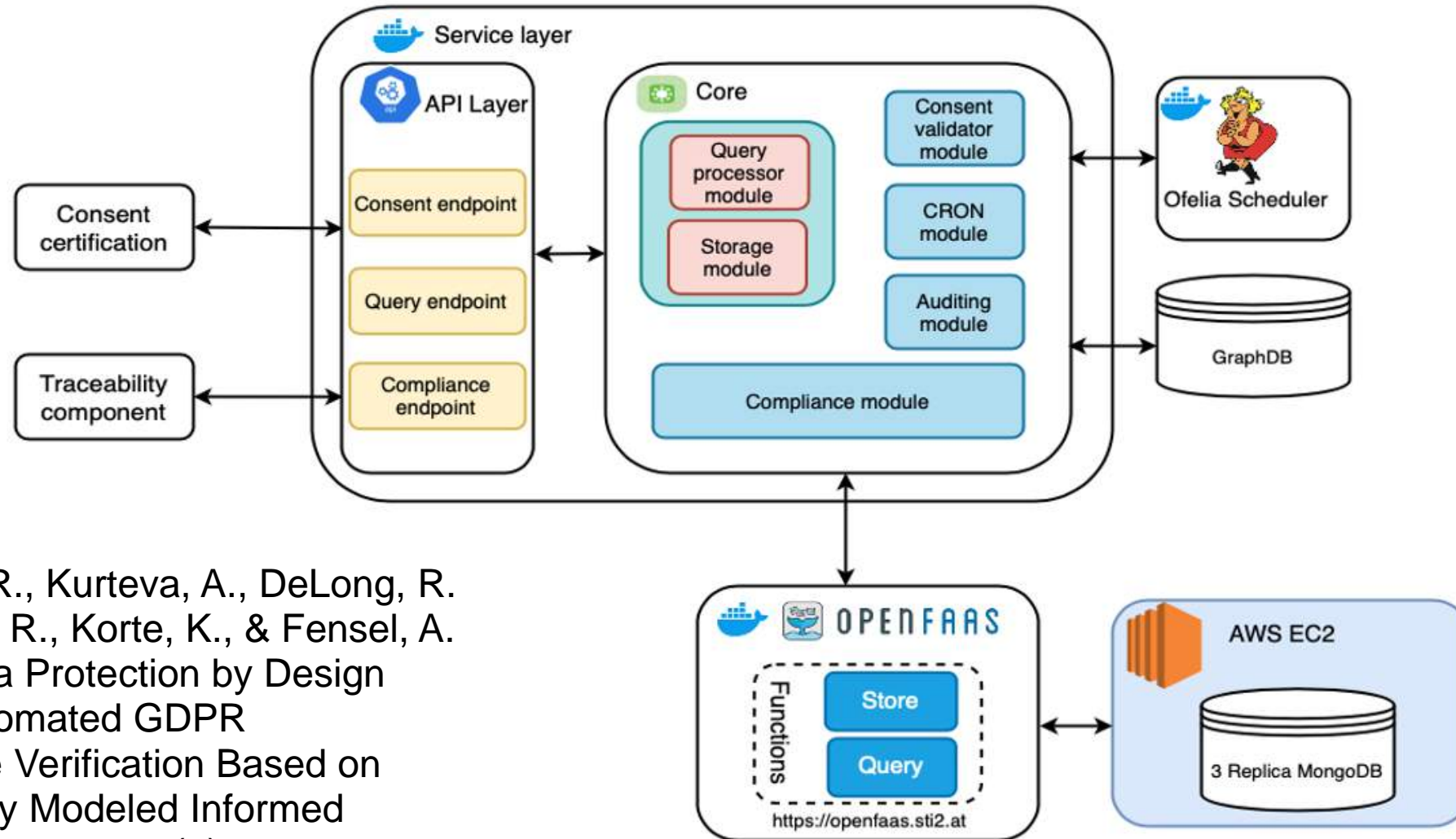
- ACT supports the **automatic generation of consent documents and execution of contracts** based on specific terms and conditions **in compliance with GDPR with the help of semantic technology**, namely ontologies and knowledge graphs.
- ACT is a stand-alone module, which could be reused by any of the smashHit components or by external service providers via an endpoint (e.g. REST API).

- **Work Done**

- **Implementation of:**

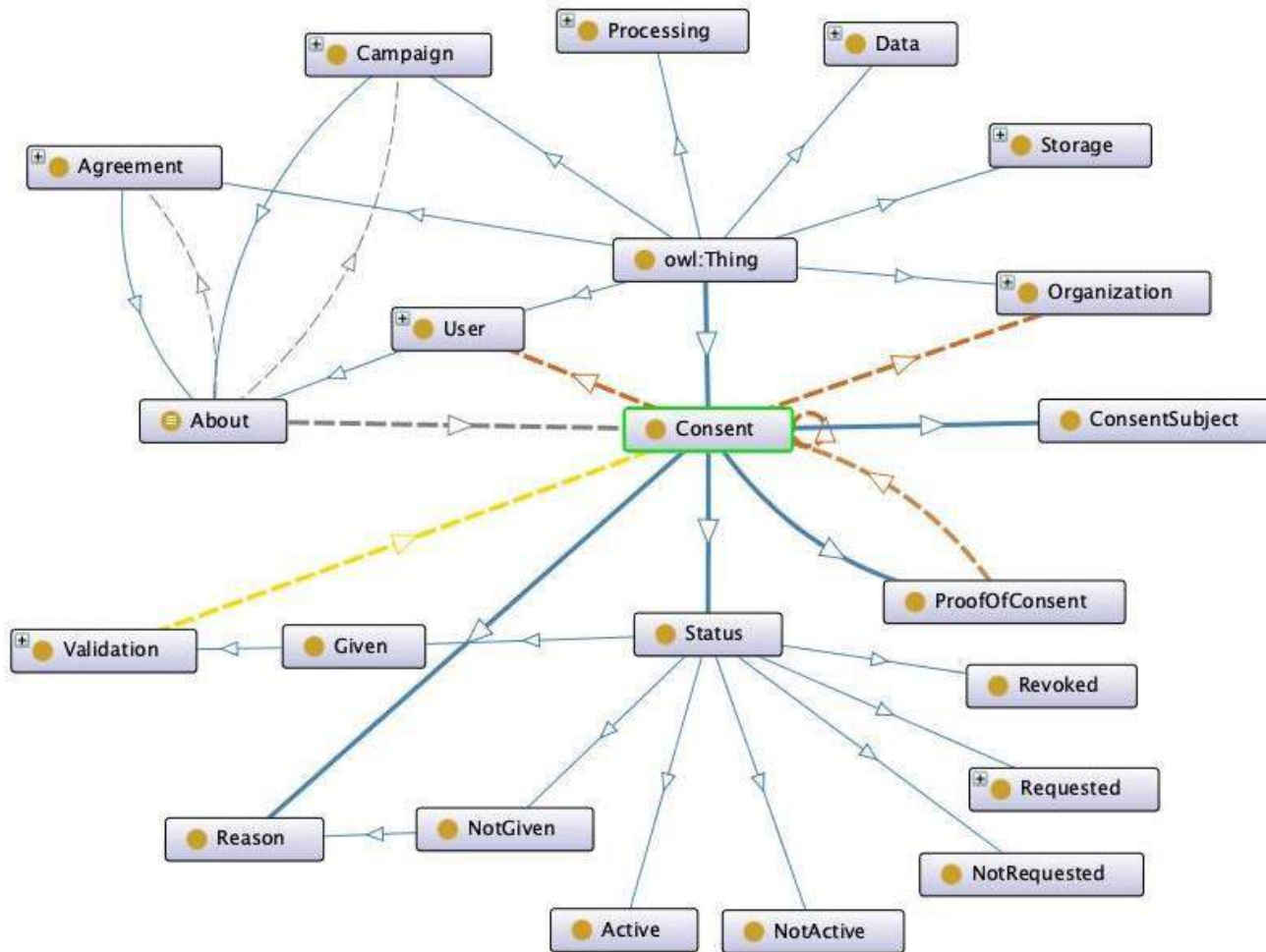
- Semi-automatic consent annotation in the legal knowledge graph based on 2 business cases (BC1 and BC2)
- Consent status update (revocation)
- Semi-automatic contract annotation in the legal knowledge graph based on BC1 and BC2
- Compliance (broken consent chain)
- Integration of the ACT with the Consent Certification and Data Traceability components via APIs

Automatic Contracting Tool (ACT): Architecture

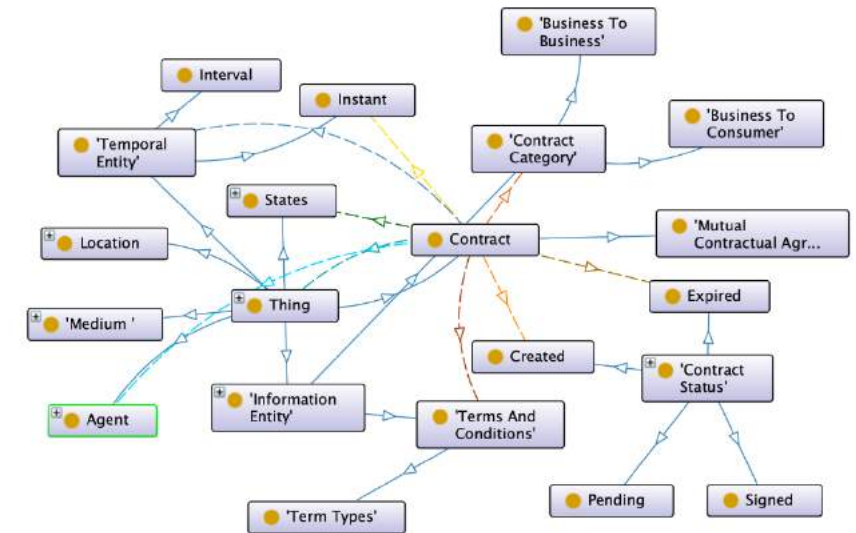


Chhetri, T. R., Kurteva, A., DeLong, R. J., Hilscher, R., Korte, K., & Fensel, A. (2022). Data Protection by Design Tool for Automated GDPR Compliance Verification Based on Semantically Modeled Informed Consent. *Sensors*, 22(7), 2763.


Consent and contract management

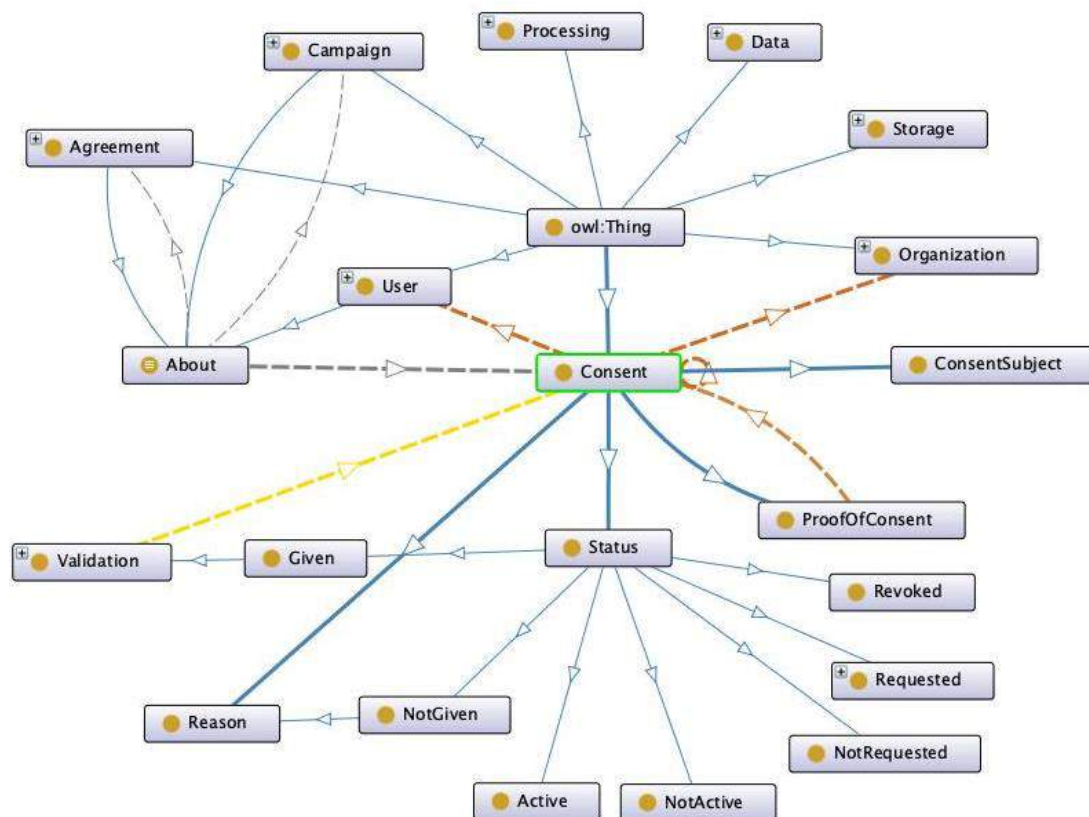


From smashHit Core Ontology



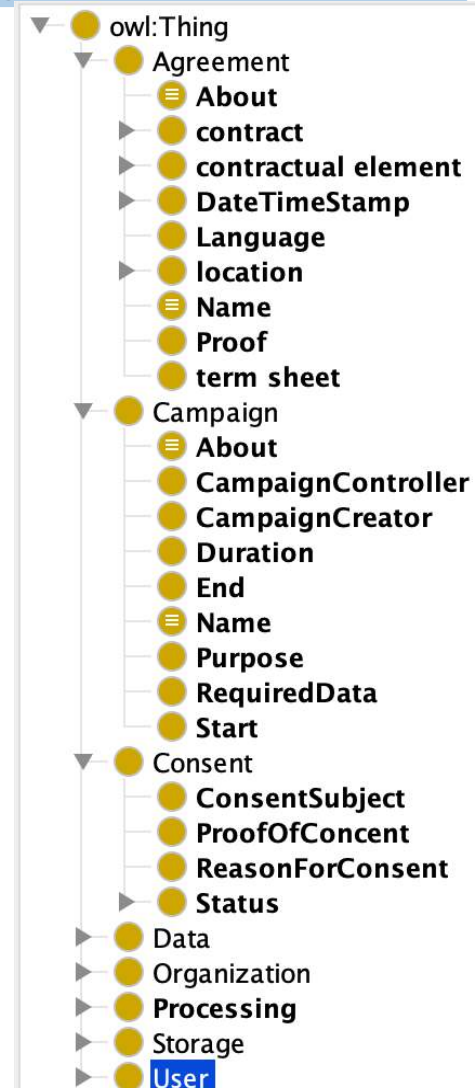
Consent - CampaNeo Knowledge Graph

- Based on the CampaNeo project ontology, which models **consent, campaigns, contracts, data, data processing**
 - Reuses the GConsent¹, FIBO² and DPV³ ontologies
 - Provides common understanding between all entities in the CampaNeo project
 - Supports the interoperability, traceability and transparency of data processing
- 



Metrics	
Axiom	696
Logical axiom count	290
Declaration axioms count	224
Class count	166
Object property count	42
Data property count	8
Individual count	0
Annotation Property count	12
Class axioms	
SubClassOf	171
EquivalentClasses	1
DisjointClasses	3
GCI count	0
Hidden GCI Count	2
Object property axioms	
SubObjectPropertyOf	24
EquivalentObjectProperties	0
InverseObjectProperties	0
DisjointObjectProperties	0
FunctionalObjectProperty	0
InverseFunctionalObjectProperty	0

The CampaNeo Ontology and Metrics

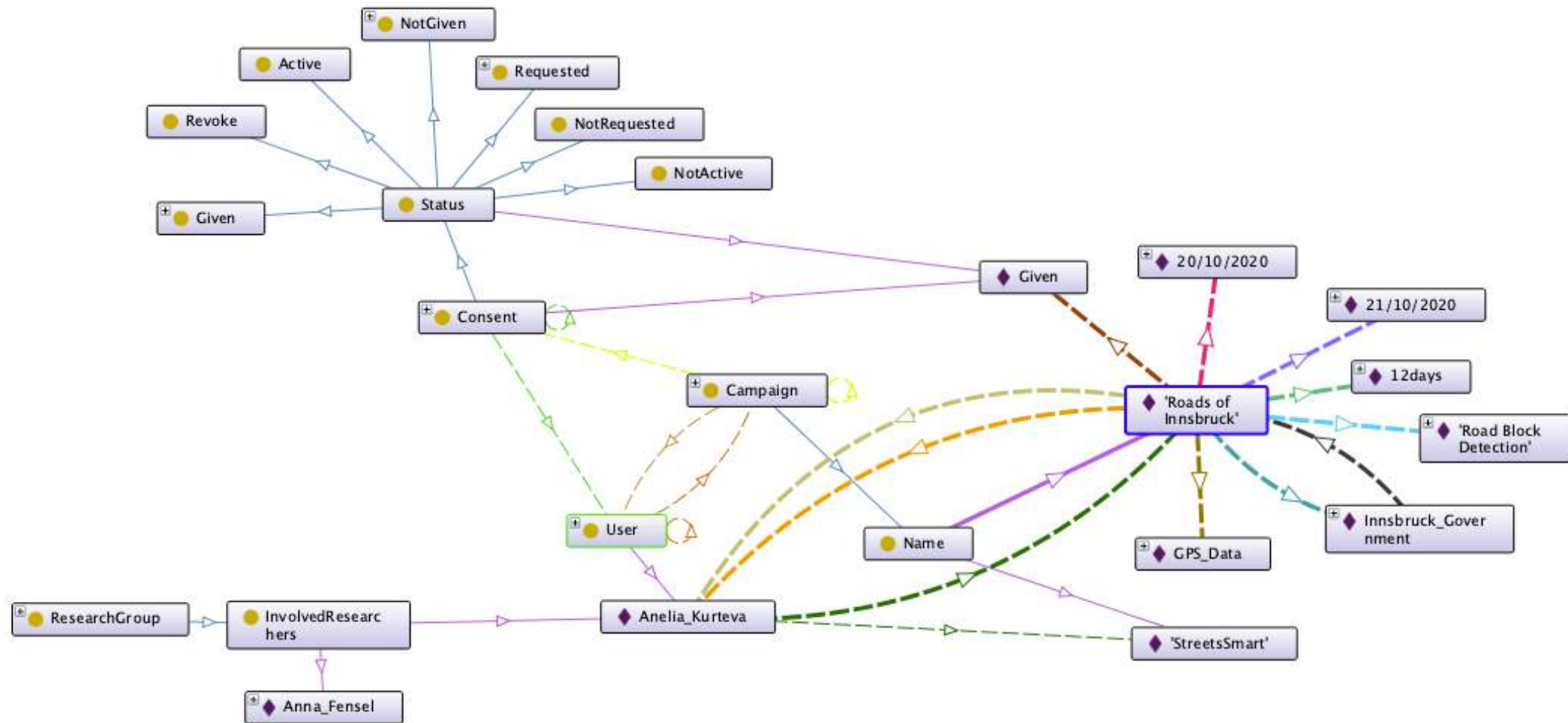


1 <http://openscience.adaptcentre.ie/ontologies/GConsent/docs/ontology>

2 <https://spec.edmcouncil.org/fibo/ontology>

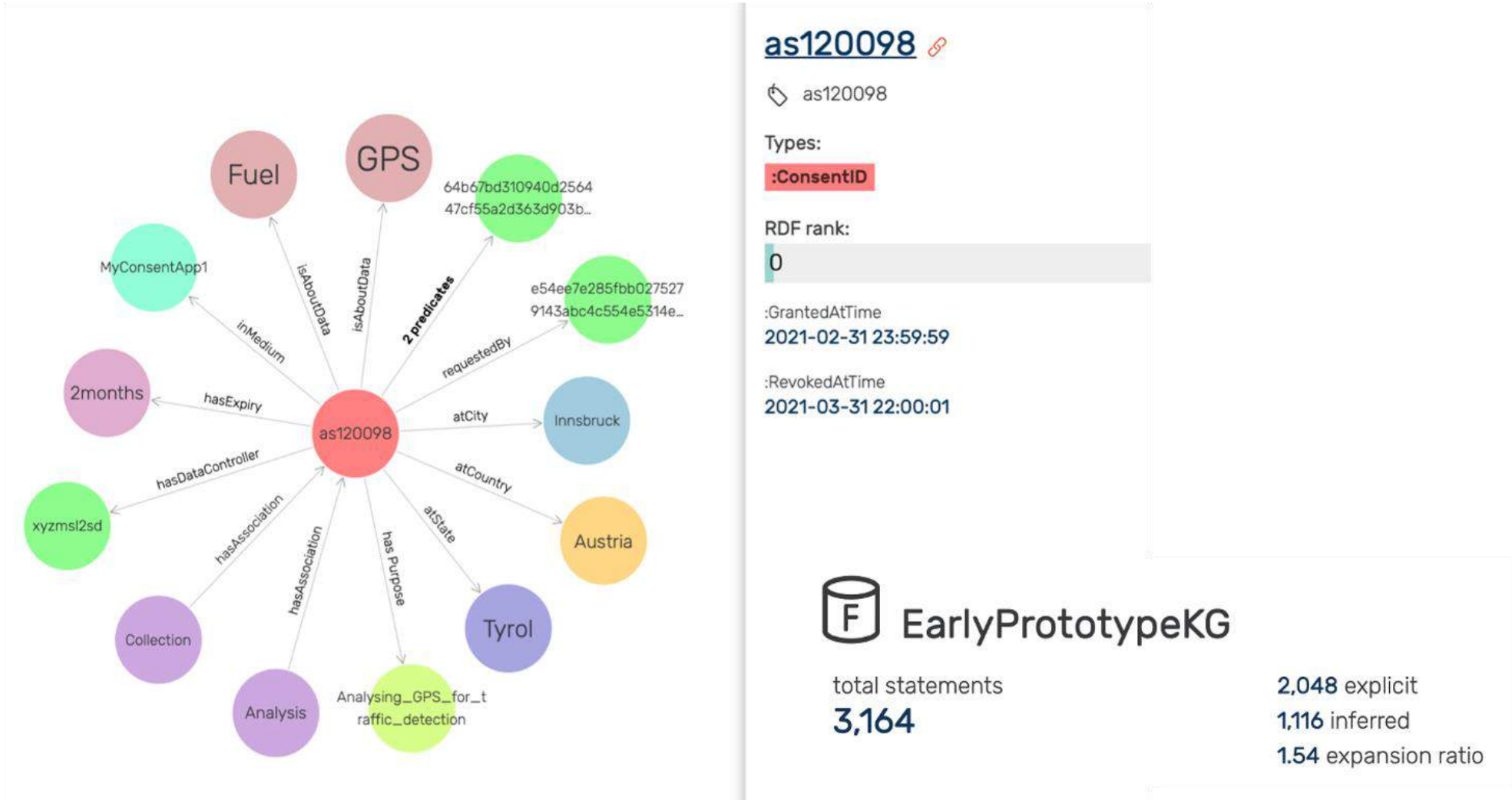
3 <https://w3c.github.io/dpv/>

Consent - CampaNeo Knowledge Graph



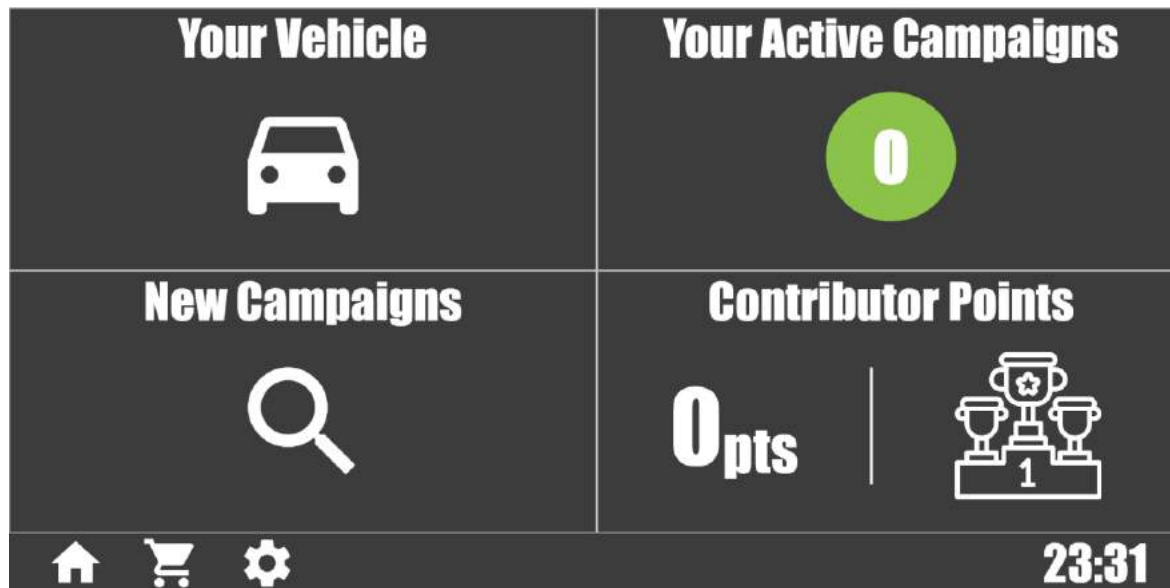
CampaNeo Knowledge Graph Overview

Consent Management in a System

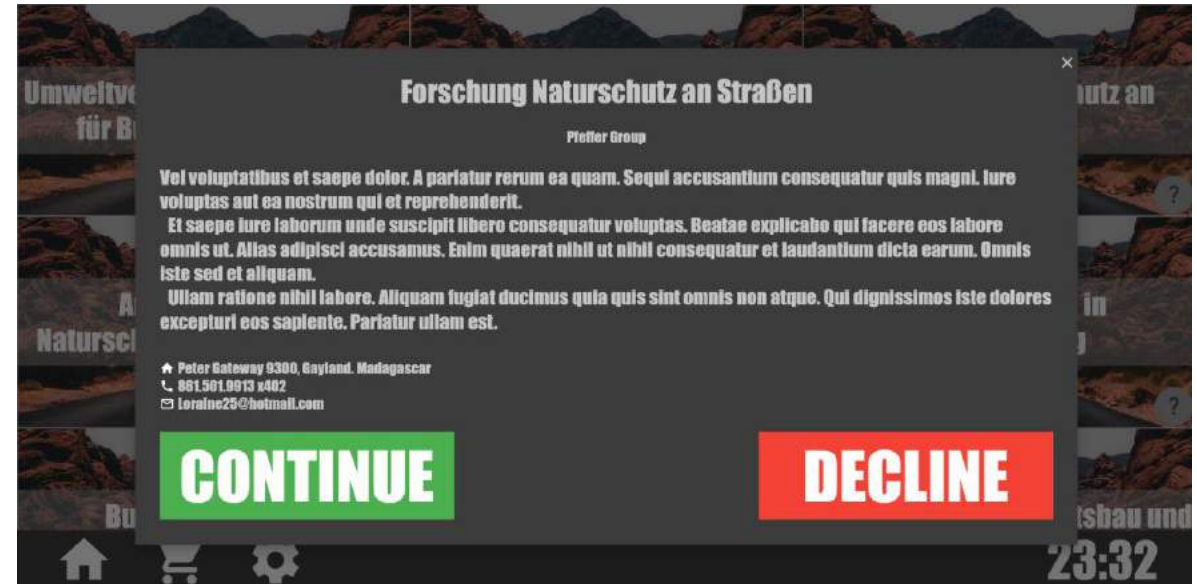


CampaNeo User Interface (UI): Consent Request

- A cross-platform tool/web application for informed consent management (e.g. allows requesting, giving and revoking consent)
- Improves user experience (ease the comprehension of consent)
- Breaks down formalities (e.g. complex privacy policies written in legalese)
- Increases transparency regarding data processing
- Uses gamification to raise awareness about data sharing



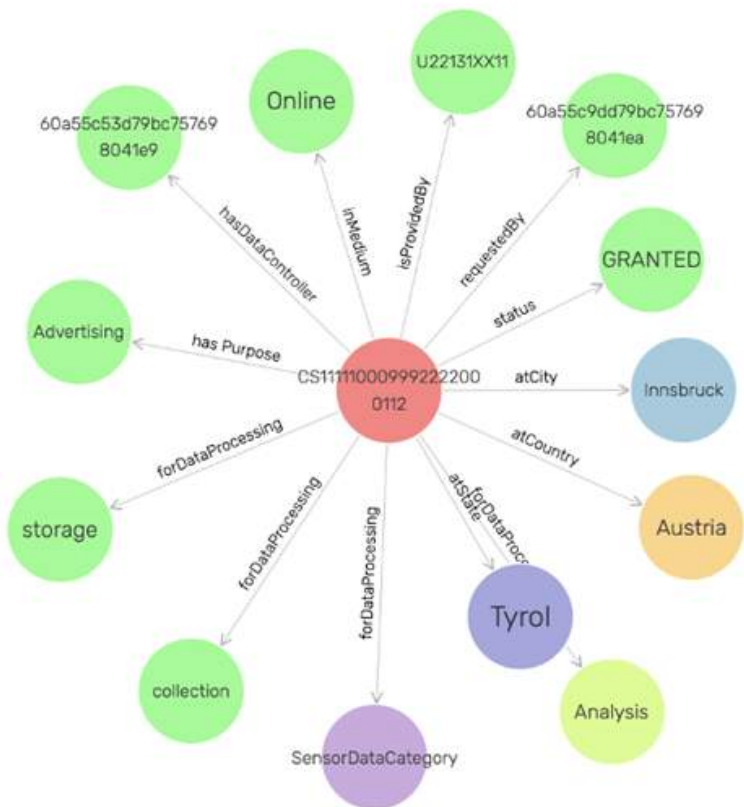
CampaNeo UI's Main Screen



Campaign Description Dialog

[Live Demo](#)

Automatic Contracting Tool (ACT): Consent Logs

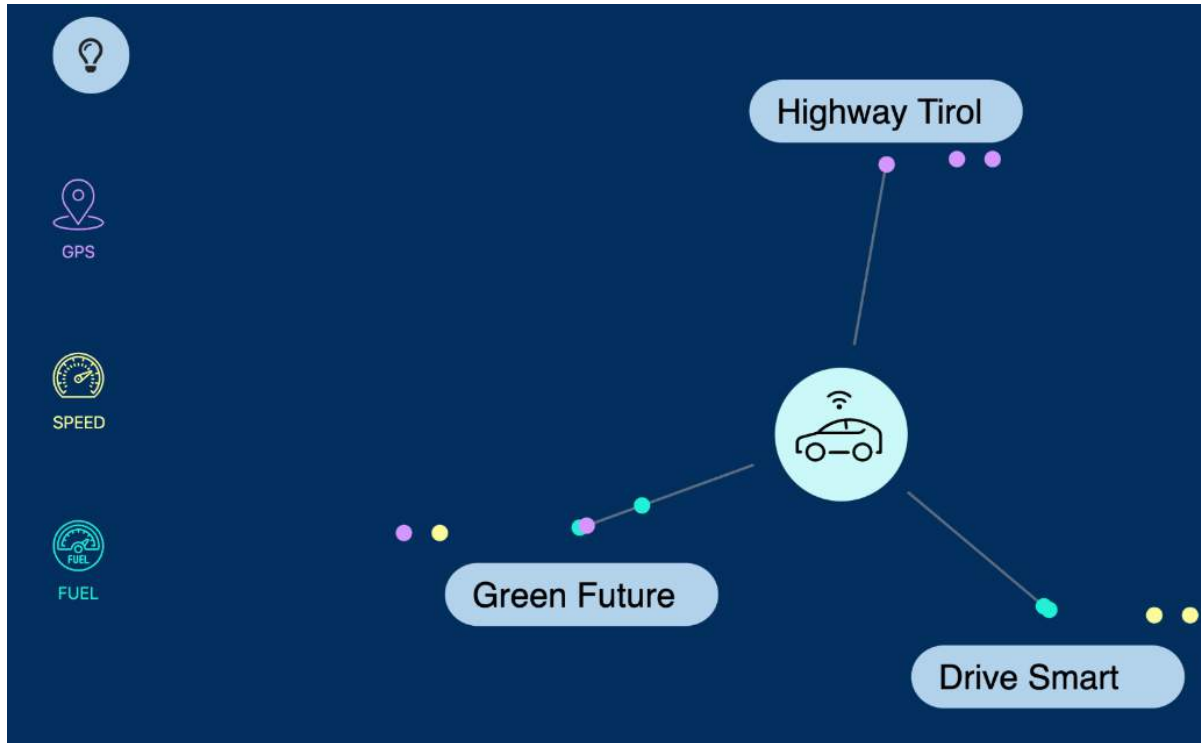


<pre>_id: ObjectId("60ba53d64efd8a05ac001199") act_status_code: 7100 decision: "CONSENT_CREATION_SUCCESS" decision_token: "3d9c1e2c3544c01a54cfa42b936a68b8aead39024b2d59281e28be1e908b14cc48edd5..." timestamp: 1622816693.63209</pre>
<pre>_id: ObjectId("60ba54146e6224454283946b") act_status_code: 7100 decision: "CONSENT_CREATION_SUCCESS" decision_token: "92bbcf2091fc26247886ce7476d31608b8be7d783a7d0f2984117af90b5206ed6fee06..." timestamp: 1622816756.318912</pre>
<pre>> _id: ObjectId("60ba542c91672ce3197cd3cf") act_status_code: 7100 decision: "CONSENT_CREATION_SUCCESS" decision_token: "46a868ae7b598abe0cab0c1af27cf525538c0e5d82902f7099a465b06ea6ca4419ff77..." timestamp: 1622816780.583193</pre>
<pre>_id: ObjectId("60ba545b5865ece578cf51bf") act_status_code: 7100 decision: "CONSENT_CREATION_SUCCESS" decision_token: "24ffd6079a7c6a06cf9c5510f83690755cc041875bb6d9a6895c7532f072ea84cdf031..."</pre>

CampaNeo User Interface (UI): Post-Consent Visualisation of Data Flows

- Visualisation of what happens after consent is given
- Provides transparency of data sharing
- Raises user's awareness of consent and the implications that follow

[Live Demo](#)



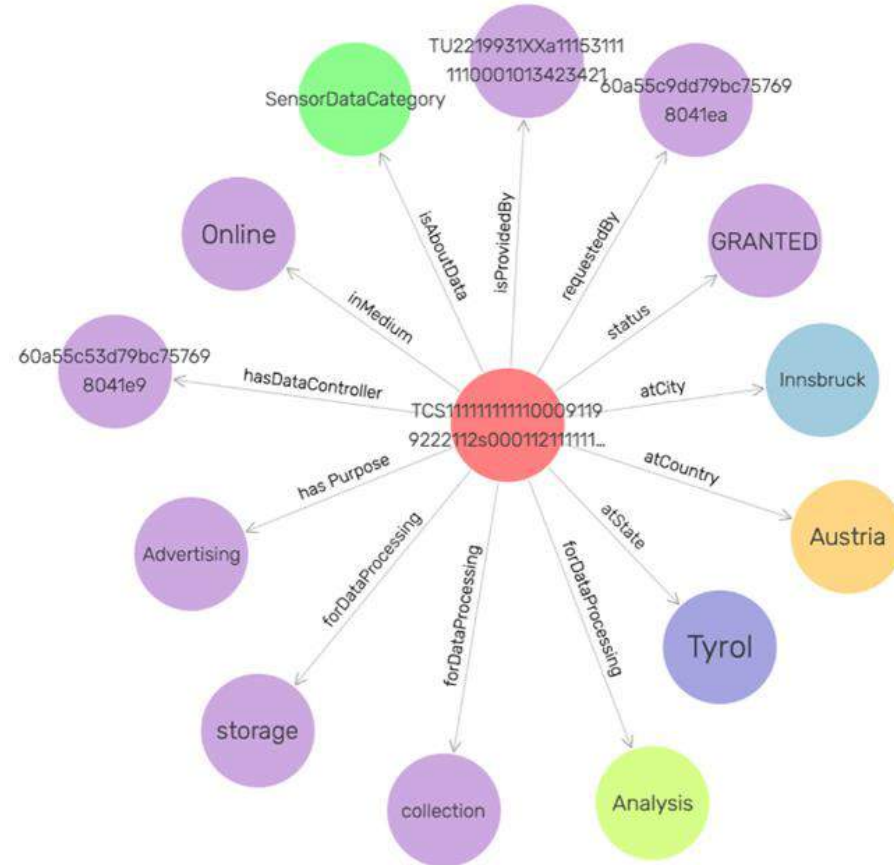
The screenshot shows the 'Green Future' app interface. At the top, there is a header with a light blue icon, a back arrow, and the text 'Green Future'. Below the header is a list of data retrieval events, each with a location icon, a timestamp, and a source name.

Location	Timestamp	Source
University of Innsbruck	GPS (retrieved on 2021-01-11T08:48:00)	University of Innsbruck
Volkswagen	Speed (retrieved on 2021-01-11T09:01:00)	Volkswagen
Volkswagen	Fuel (retrieved on 2021-01-12T09:02:00)	Volkswagen
University of Innsbruck	GPS (retrieved on 2021-01-12T08:35:00)	University of Innsbruck
Volkswagen	Fuel (retrieved on 2021-01-12T09:05:00)	Volkswagen

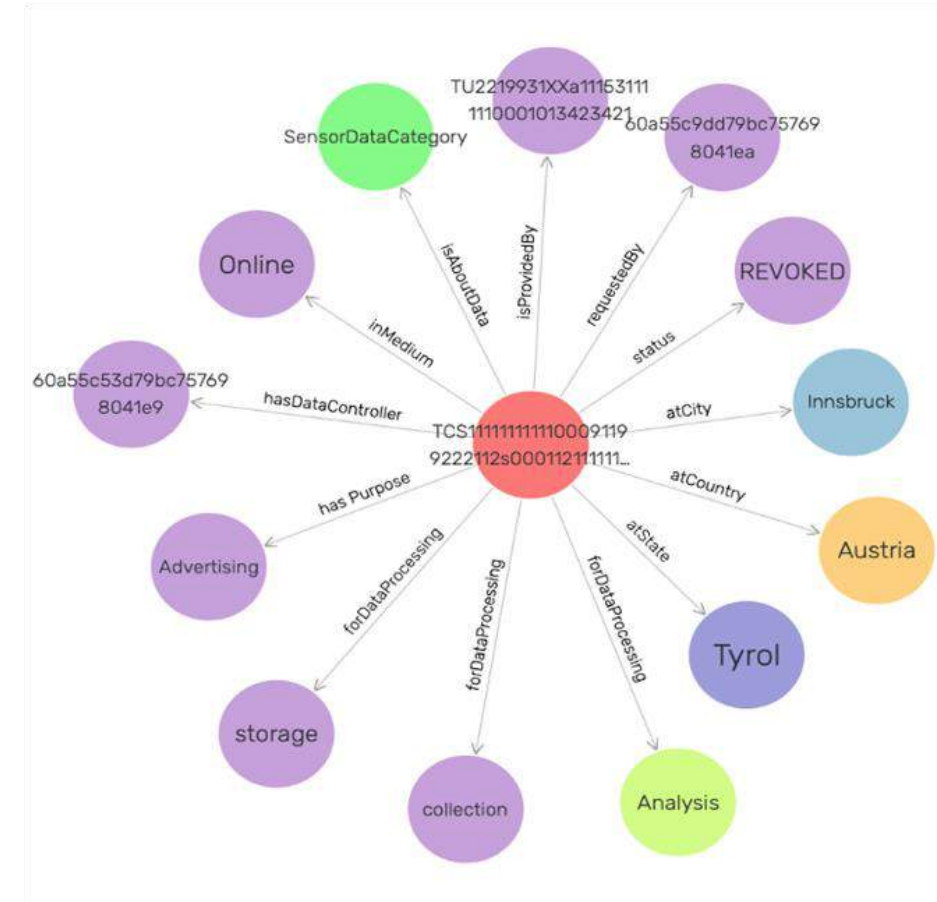
For more details:

Bless, C., et al. "Raising Awareness of Data Sharing Consent Through Knowledge Graph Visualisation", Studies on the Semantic Web, Volume 53: Further with Knowledge Graphs. IOS Press, 2021. 44-57.

Automatic Contracting Tool (ACT): Consent Revocation



Existing granted consent



Consent after revocation

Automatic Contracting Tool (ACT): Consent APIs

Automatic Contracting API Specification ^{v01}

/swagger/

Create Consent

POST /consent/create/

Revoke consent

PUT /consent/revoke/{consent_id}

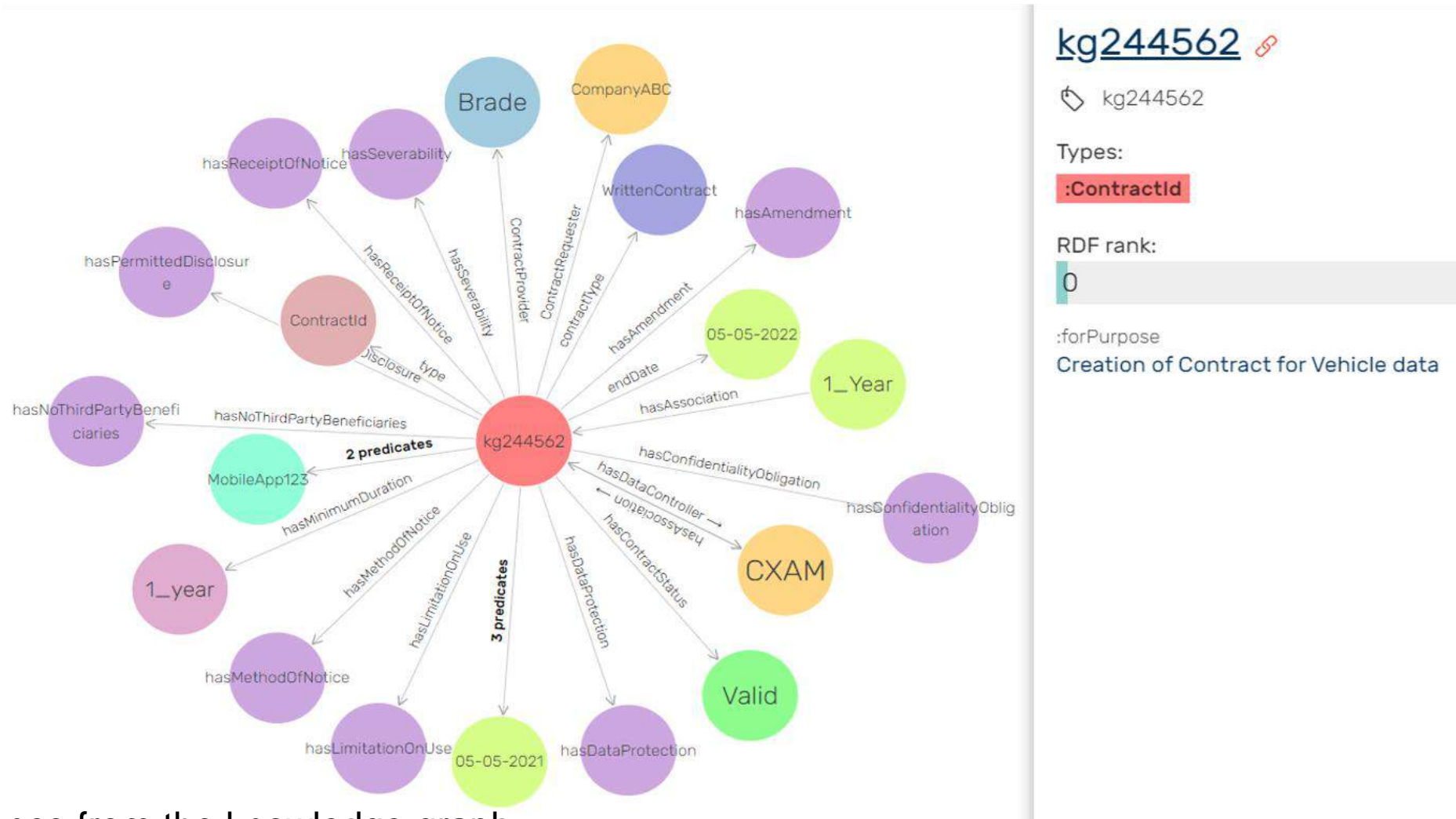
All ConsentID

GET /query/bconsentid/

ConsentID by consentprovider ID

GET /query/consentid/{consentprovider_id}/

Automatic Contracting Tool (ACT): Contracts



Contract instance from the knowledge graph

ACT Early Prototype Functionalities

Table 5: Key functionalities of the ACT components

Component	Key functionalities
Legal Knowledge Graph	A semantic model for consent, which further models legal obligation based on the given consent, GDPR requirements and contracts.
	The KG shall provide (at minimum) a GDPR compliant and transparent data model for informed consent. By using it one shall be able to answer the following questions: <ul style="list-style-type: none">• What data is requested?• Who requests the data?• What is the purpose of the request?• With whom will data be shared?• How long will data be shared?• Who has given consent?• Who has withdrawn consent?
	Further, it will model terms and conditions from contracts.
Graph Database	A main data store for the smashHit legal knowledge graph. Allows data storage, modification and retrieval.
Consent Request API Endpoint	API endpoints through which, consent will be received and distributed to other smashHit components by the ACT. <ul style="list-style-type: none">• Supports the consent document annotation and generation from data owner/data subject input.
Contract Engine	The contract engine (CE) consists of a contract generator, contract publisher endpoint and a graph database is responsible for consent document creation (generation) and publishing.

- ACT's early prototype focuses on:
- consent creation
- semantic consent representation with a knowledge graph
- consent revocation
- GDPR compliance based on consent

- Table 5: Key functionalities of the ACT components (continuing)

Component	Key functionalities
	<p>The CE provides the following features.</p> <ul style="list-style-type: none">• Consent document generation.• Consent document publishing.• Consent modification.• Storing consent in graph database for future reference.• Contract generation (optional feature).• Contract publishing (optional feature).
Compliance Engine	<p>The compliance engine verifies the compliance of data access in accordance with, but not only the consent. Contracts, mainly their terms and conditions, might be considered as well.</p> <ul style="list-style-type: none">• Compliance verification:• Checks if the data controller is accessing data from the data owner/ data subject as per the consent.• Alert:• Notification of breach of consent? if any to the data owner/ data subject as well as data controller.

ACT Early Prototype Interfaces

Swagger documentation of the following APIs:

Table 6: Interfaces used

Interface	Offered by	Used by	Sequence Diagram
Consent Request API	Automatic Contracting Tool	Automatic Contracting Tool	Informed Consent Decision Record Creation and Storage
Get Consent ID API	Automatic Contracting Tool (key Consent Certificate)	Traceability Component, Security and Privacy component	Data use traceability interaction sequence diagram
Notification Receiving API	Consent Certification Component	Automatic Contracting Tool	Sequence diagram for broken consent chain compliance scenario
Notification Sending API	Automatic Contracting Tool	Data owner, Data Processor	Sequence diagram for broken consent chain compliance scenario and Sequence diagram compliance engine
Context Sensitivity API	Context Sensitivity Tool	Automatic Contracting Tool	Deliverable 2.3: Context Configuration Sequence Diagram, Context Monitoring Sequence Diagram
Write Trace Information to the Legal Knowledge Graph (API)	Automatic Contracting Tool	Traceability Component (Traceability Manager)	Consent/Contract Information Annotation and Storage

Table 7: Consent Request API Endpoints offered by the Automatic Contracting

Endpoint Name	CRUD Functionality
User ID/Username	Create, Read, Delete
Consent Request	Create, Read, Update, Delete
Consent Decision	Create, Read, Update, Delete
Consent Decision Time	Create, Read, Update, Delete
Consent Decision Date	Create, Read, Update, Delete
Consent Purpose	Read, Update, Delete
Consent Data Type	Read, Update, Delete
Consent Data Processing	Read, Update, Delete
Data Controller Identity	Read, Update, Delete
Consent Requester	Read, Update, Delete

Automatic Contracting Tool (ACT): Contract APIs

All ContractId

GET /contract/

Create Contract

POST /contract/create/

Contract By Contract Id

GET /contract/query/contractbyid/{id}/

Contract By Contract Provider

GET /contract/query/contractbyprovider/{provider}/

Contract By Contract Requester

GET /contract/query/contractbyrequester/{requester}/

Contract revoke By Contract Id

PUT /contract/query/contractrevokebyid/{id}/

Models

ContractRequest >

```
ContractRequest {  
  Amendment string  
  ConfidentialityObligation string  
  Confidentiality Obligation string  
  ContractId* string  
  Contract ID string  
  ContractProvider* string  
  Contract Provider string  
  ContractRequester* string  
  Contract Requester string  
  ContractStatus string  
  Contract Status string  
  ContractType* string  
  Contract Type string  
  DataController* string  
  Data Controller string  
  DataProtection string  
  Data Protection string($date)  
  EffectiveDate string($date)  
  Effective Date string($date)  
  ExecutionDate string($date)  
  Execution Date string($date)  
  ExpireDate string($date)  
  Expire Date string  
  LimitationOnUse string  
  Limitation On Use string  
  Medium string  
  Medium string  
  MethodOfNotice string  
  Method Of Notice string  
  NoThirdPartyBeneficiaries string  
  No Third Party Beneficiaries string  
  PermittedDisclosure string  
  Permitted Disclosure string  
  Purpose* string  
  For What Purpose string  
  ReceiptOfNotice string  
  Receipt Of Notice string  
  Severability string  
  Severability string($date)  
  StartDate string  
  Start Date string  
  TerminationForInsolvency string  
  Termination For Insolvency string  
  TerminationForMaterialBreach string  
  Termination For Material Breach string  
  TerminationOnNotice string  
  Termination On Notice string  
  Waiver string  
  Waiver string  
}
```


- Consent Certification Component

Endpoints:

Create Consent

POST

/consent/create/

Revoke consent

PUT

/consent/revoke/{consent_id}

- Data Use Traceability Component

Endpoints:

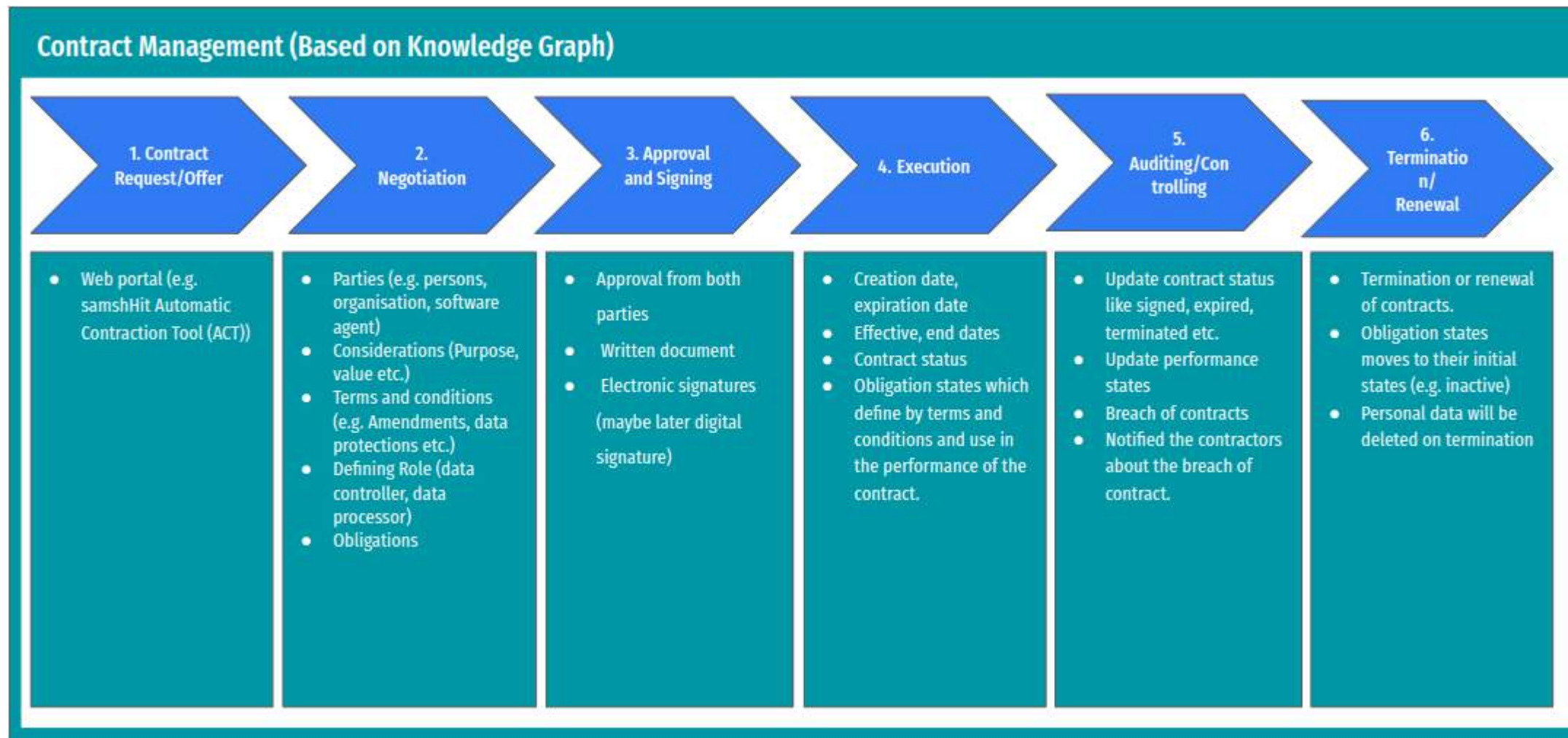
All ConsentID

GET /query/bconsentid/

ConsentID by consentprovider ID

GET /query/consentid/{consentprovider_id}/

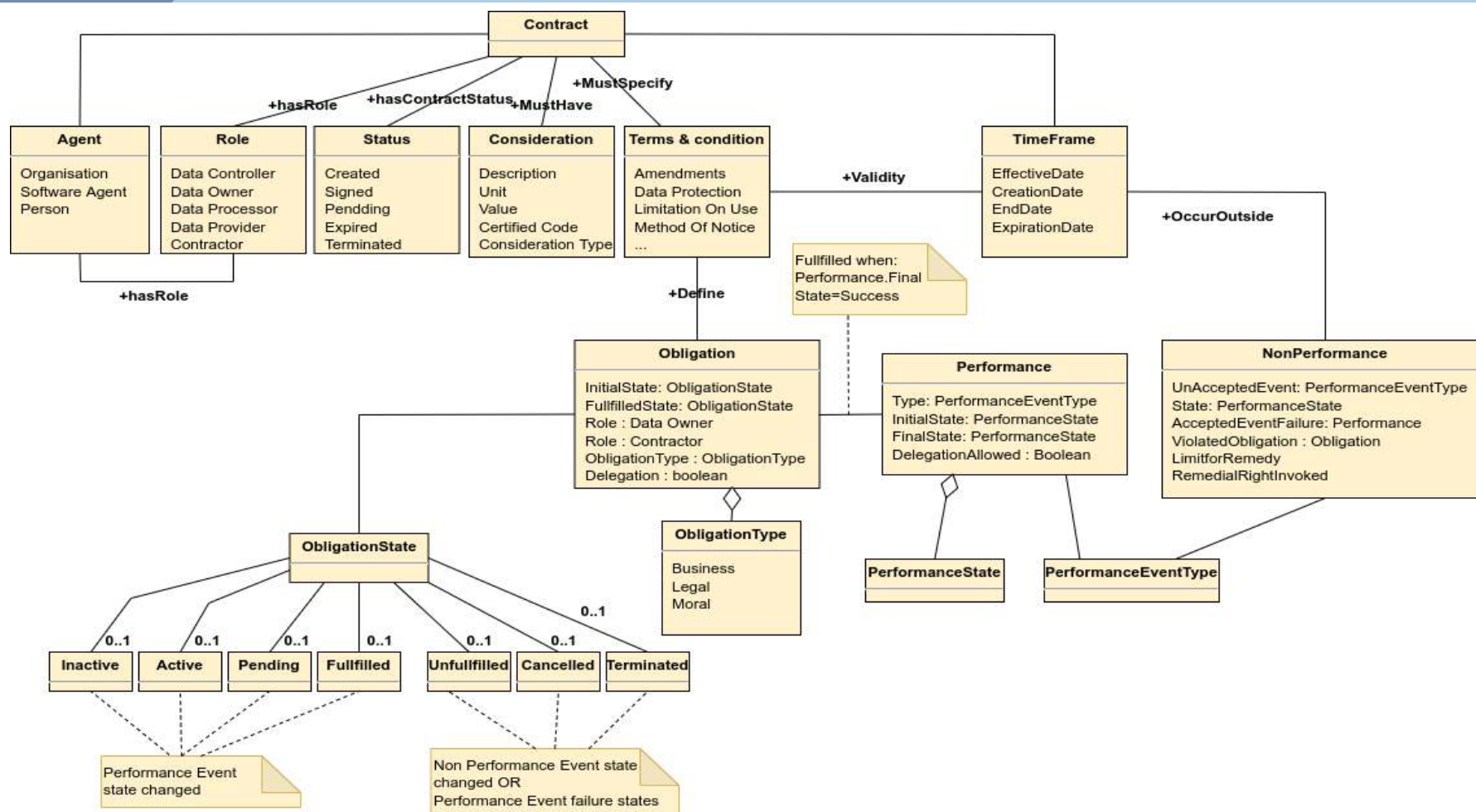
- Agreements between two or more parties
- Enforceable or recognised by law
- Key Elements
 - Contractors (e.g. software agents, applications)
 - Considerations
 - Terms and conditions
 - Obligations defined by terms and conditions (e.g. obligation to pay)



- Automatic detection of contract conflict/breach (based on obligations):
 - Validity of contracts
 - Fulfilment of obligations
 - Contract expiration, termination and renewal
 - Automated rule-based reasoning
 - (e.g. IF {(contract status="signed")} THEN {(contract cannot be modified)}.)
 - Automatic updates of contractors through notifications
 - Compliant with License
 - Licensing digital assets (e.g. Digital contracts)
 - Support the automated clearance of rights using DALICC¹

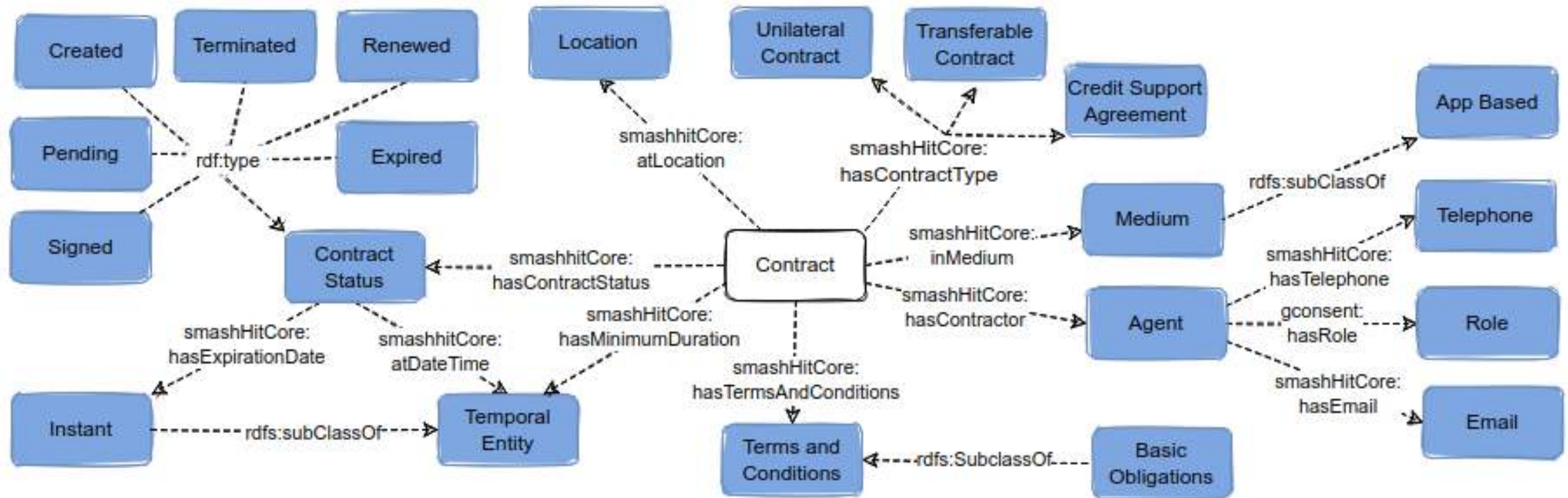
¹ <https://www.dalicc.net/>

Contract Data Model (Ontology)



<http://www.diva-portal.org/smash/get/diva2:7604/FULLTEXT01.pdf>

Current Contract Semantic Model



From our smashHitCore ontology

Breach of Contract (UI)

New Contract Obligation

Contract


Term






Description

Start Date

End Date

Party



Contract ID	Description	Contractor	Term	Status	Action
1	Obligation to pay	Brade	Payment Terms	Pending	
1	Obligation to deliver	Scott	Delivery Terms	Pending	
1	Selling data to third party	Scott	Payment Terms	Pending	
1	Selling data to third party	Brade	Payment Terms	Fulfilled	
2	Obligation to pay	Tim	Payment Terms	Violated	

- **Work In Progress**

- Second iteration of the legal knowledge graph based on the new smashHitCore ontology changes
- Implementing compliance based on the given informed consent
- Further extension of the knowledge graph with specific contracts (e.g. reuse from DALICC)
- Automated Clearance Rights (License) modelling (annotation of sample licenses in the knowledge graph)
- Integration with the license creation and contracts components via APIs

- **Outlook**

- Complete the work that is in progress
- Extend the functionalities of the ACT regarding contracts and licenses:
 - **Annotate** (create instances in the legal knowledge graphs) licenses based on BC1 and BC2
 - **Define/extend** the available API specification for contracts and licenses
- Testing:
 - Implement tests that focus on the interaction between the ACT and the rest of the smashHit system
 - Implement tests that validate the correct execution of the ACT in the context of BC1 and BC2

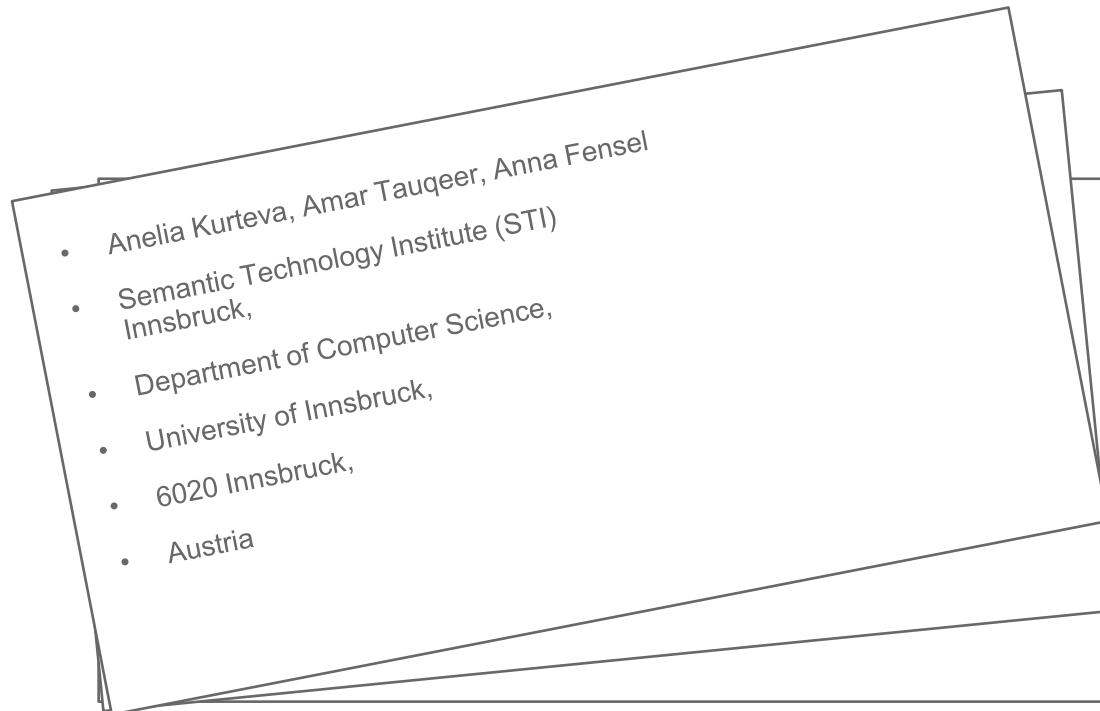
Consent and contract management with Automated Contracting Tool:

- Semantic representation of consent and contracts
- Consent and contract instances in the legal knowledge graph
- Implementation of consent revocation
- Implementation of compliance (broken consent chain)
- Specification of consent and contract APIs
- Implementation and integration of all of the above in the ACT

Final prototype functionalities:

- Automatic detection of contract breach via contract compliance reasoning
- Consent and contract annotation
- Contract APIs swagger specifications

Thank you for your attention !



Web: <https://www.smashhit.eu>

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