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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Agenda

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

Web: https://www.smashhit.eu
Twitter: @smashHitP
• 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.
**Automatic Contracting Tool (ACT)**

- **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. an 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

Consent and contract management

From smashHit Core Ontology
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

The CampaNeo Ontology and Metrics

2. https://spec.edmcouncil.org/fibo/ontology
3. https://w3c.github.io/dpv/
Consent - CampaNeo Knowledge Graph

CampaNeo Knowledge Graph Overview
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
Automatic Contracting Tool (ACT): Consent Logs
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

For more details:
Automatic Contracting Tool (ACT): Consent Revocation

Existing granted consent

Consent after revocation
## Automatic Contracting API Specification

### Create Consent

<table>
<thead>
<tr>
<th>Method</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST</td>
<td>/consent/create/</td>
</tr>
</tbody>
</table>

### Revoke consent

<table>
<thead>
<tr>
<th>Method</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUT</td>
<td>/consent/revoke/{consent_id}</td>
</tr>
</tbody>
</table>

### All ConsentID

<table>
<thead>
<tr>
<th>Method</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>/query/bconsentid/</td>
</tr>
</tbody>
</table>

### ConsentID by consentprovider ID

<table>
<thead>
<tr>
<th>Method</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>/query/consentid/{consentprovider_id}/</td>
</tr>
</tbody>
</table>
Automatic Contracting Tool (ACT): Contracts

Contract instance from the knowledge graph
ACT Early Prototype Functionalities

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Key functionalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal Knowledge Graph</td>
<td>A semantic model for consent, which further models legal obligation based on the given consent, GDPR requirements and contracts.</td>
</tr>
<tr>
<td></td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>• What data is requested?</td>
</tr>
<tr>
<td></td>
<td>• Who requests the data?</td>
</tr>
<tr>
<td></td>
<td>• What is the purpose of the request?</td>
</tr>
<tr>
<td></td>
<td>• With whom will data be shared?</td>
</tr>
<tr>
<td></td>
<td>• How long will data be shared?</td>
</tr>
<tr>
<td></td>
<td>• Who has given consent?</td>
</tr>
<tr>
<td></td>
<td>• Who has withdrawn consent?</td>
</tr>
<tr>
<td></td>
<td>Further, it will model terms and conditions from contracts.</td>
</tr>
<tr>
<td>Graph Database</td>
<td>A main data store for the smashHit legal knowledge graph. Allows data storage, modification and retrieval.</td>
</tr>
<tr>
<td>Consent Request API Endpoint</td>
<td>API endpoints through which, consent will be received and distributed to other smashHit components by the ACT.</td>
</tr>
<tr>
<td></td>
<td>• Supports the consent document annotation and generates it from data owner/data subject input.</td>
</tr>
<tr>
<td>Contract Engine</td>
<td>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.</td>
</tr>
</tbody>
</table>
ACT Early Prototype Functionalities

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Key functionalities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The CE provides the following features.</td>
</tr>
<tr>
<td></td>
<td>• Consent document generation.</td>
</tr>
<tr>
<td></td>
<td>• Consent document publishing.</td>
</tr>
<tr>
<td></td>
<td>• Consent modification.</td>
</tr>
<tr>
<td></td>
<td>• Storing consent in graph database for future reference.</td>
</tr>
<tr>
<td></td>
<td>• Contract generation (optional feature).</td>
</tr>
<tr>
<td></td>
<td>• Contract publishing (optional feature).</td>
</tr>
<tr>
<td>Compliance Engine</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>• Compliance verification:</td>
</tr>
<tr>
<td></td>
<td>• Checks if the data controller is accessing data from the data owner/ data subject as per the consent.</td>
</tr>
<tr>
<td></td>
<td>• Alert:</td>
</tr>
<tr>
<td></td>
<td>• Notification of breach of consent? if any to the data owner/ data subject as well as data controller.</td>
</tr>
</tbody>
</table>
ACT Early Prototype Interfaces

Swagger documentation of the following APIs:

Table 6: Interfaces used

<table>
<thead>
<tr>
<th>Interface</th>
<th>Offered by</th>
<th>Used by</th>
<th>Sequence Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consent Request API</td>
<td>Automatic Contracting Tool</td>
<td>Automatic Contracting Tool</td>
<td>Informed Consent Decision Record Creation and Storage</td>
</tr>
<tr>
<td>Get Consent ID API</td>
<td>Automatic Contracting Tool (key Consent Certificate)</td>
<td>Traceability Component, Security and Privacy component</td>
<td>Data use traceability interaction sequence diagram</td>
</tr>
<tr>
<td>Notification Receiving API</td>
<td>Consent Certification Component</td>
<td>Automatic Contracting Tool</td>
<td>Sequence diagram for broken consent chain compliance scenario</td>
</tr>
<tr>
<td>Notification Sending API</td>
<td>Automatic Contracting Tool</td>
<td>Data owner, Data Processor</td>
<td>Sequence diagram for broken consent chain compliance scenario and Sequence diagram compliance engine</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Endpoint Name</th>
<th>CRUD Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>User ID/Username</td>
<td>Create, Read, Delete</td>
</tr>
<tr>
<td>Consent Request</td>
<td>Create, Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Decision</td>
<td>Create, Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Decision Time</td>
<td>Create, Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Decision Date</td>
<td>Create, Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Purpose</td>
<td>Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Data Type</td>
<td>Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Data Processing</td>
<td>Read, Update, Delete</td>
</tr>
<tr>
<td>Data Controller Identity</td>
<td>Read, Update, Delete</td>
</tr>
<tr>
<td>Consent Requester</td>
<td>Read, Update, Delete</td>
</tr>
</tbody>
</table>
## Automatic Contracting Tool (ACT): Contract APIs

<table>
<thead>
<tr>
<th>Contract Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ContractId</td>
<td>GET  /contract/@&lt;br&gt;create Contract&lt;br&gt;Contract By Contract Id&lt;br&gt;Contract By Contract Provider&lt;br&gt;Contract By Contract Requester&lt;br&gt;Contract revoke By Contract Id</td>
</tr>
<tr>
<td>Create Contract</td>
<td>POST /contract/create/</td>
</tr>
<tr>
<td>Contract revoke By Contract Id</td>
<td>PUT  /contract/query/contractrevokebyid/@</td>
</tr>
</tbody>
</table>

- **ContractId**: string (Contract ID)
- **ContractProvider**: string (Contract Provider)
- **ContractRequester**: string (Contract Requester)
- **ContractType**: string (Contract Type)
- **DataController**: string (Data Controller)
- **DataProtection**: string (Data Protection)
- **EffectiveDate**: string (Effective Date)
- **ExecutionDate**: string (Execution Date)
- **ExpireDate**: string (Expire Date)
- **LimitationOnUse**: string (Limitation On Use)
- **Medium**: string (Medium)
- **MethodOfNotice**: string (Method Of Notice)
- **NoThirdPartyBeneficiaries**: string (No Third Party Beneficiaries)
- **PermittedDisclosure**: string (Permitted Disclosure)
- **Purpose**: string (For What Purpose)
- **ReceiptOfNotice**: string (Receipt Of Notice)
- **Severity**: string (Severity)
- **StartDate**: string (Start Date)
- **TerminationForInsolvency**: string (Termination For Insolvency)
- **TerminationForMaterialBreach**: string (Termination For Material Breach)
- **TerminationOnNotice**: string (Termination On Notice)
- **Waiver**: string (Waiver)
ACT Early Prototype APIs

- Consent Certification Component

Endpoints:

- **Create Consent**
  - POST `/consent/create/`

- **Revoke consent**
  - PUT `/consent/revoke/{consent_id}`
ACT Early Prototype APIs

- Data Use Traceability Component

Endpoints:

All ConsentID

- GET /query/bconsentid/

ConsentID by consentprovider ID

- GET /query/consentid/{consentprovider_id}/
ACT Final Prototype: Contracting

• 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)
Contract Workflow

Contract Management (Based on Knowledge Graph)

1. Contract Request/Offer
   - Web portal (e.g. smashHit Automatic Contract Management Tool (ACT))
   - Parties (e.g. persons, organisation, software agent)
   - Considerations (Purpose, value etc.)
   - Terms and conditions (e.g. Amendments, data protection etc.)
   - Defining Role (data controller, data processor)
   - Obligations

2. Negotiation
   - Approval from both parties
   - Written document
   - Electronic signatures (maybe later digital signature)

3. Approval and Signing
   - Creation date, expiration date
   - Effective, end dates
   - Contract status
   - Obligation states which define by terms and conditions and use in the performance of the contract.

4. Execution
   - Update contract status like signed, expired, terminated etc.
   - Update performance states
   - Breach of contracts
   - Notified the contractors about the breach of contract.

5. Auditing/Controlling
   - Termination or renewal of contracts.
   - Obligation states moves to their initial states (e.g. Inactive)
   - Personal data will be deleted on termination.

6. Termination
   - Renewal

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

- 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/](https://www.dalicc.net/)
Contract Data Model (Ontology)

Current Contract Semantic Model

From our smashHitCore ontology
Breach of Contract (UI)

New Contract Obligation

<table>
<thead>
<tr>
<th>Contract</th>
<th>Term</th>
<th>Description</th>
<th>Start Date</th>
<th>End Date</th>
<th>Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Payment Terms</td>
<td>Obligation to pay</td>
<td>2022-02-22</td>
<td>2022-02-25</td>
<td>Tim</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contract ID</th>
<th>Description</th>
<th>Contractor</th>
<th>Term</th>
<th>Status</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Obligation to pay</td>
<td>Brade</td>
<td>Payment Terms</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Obligation to deliver</td>
<td>Scott</td>
<td>Delivery Terms</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Selling data to third party</td>
<td>Scott</td>
<td>Payment Terms</td>
<td>Pending</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Selling data to third party</td>
<td>Brade</td>
<td>Payment Terms</td>
<td>Fulfilled</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Obligation to pay</td>
<td>Tim</td>
<td>Payment Terms</td>
<td>Violated</td>
<td></td>
</tr>
</tbody>
</table>
Automatic Contracting Tool

• **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!

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