COMPLIANCE FOR SERVICE BASED SYSTEMS THROUGH FORMALIZATION OF LAW

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Abstract: As with the advancement in Web-based infrastructures applications can be composed of services by different providers across the Internet, it is not possible to foresee legal requirements for every situation. Therefore, new legal challenges arise for modular applications in an Internet of Services. However, since such service based systems become more and more self describing by using sophisticated description schemas, we propose to apply standard legal methodology on this situation.
By formalizing legal norms and the process of legal assessment to obtain legal rights and obligations we envision an autarchic system which can subsume service description facts under the terms of legal regulations in order to obtain legal consequences.
This paper contributes the scientific concept to transfer legal methodology, as known in the offline world for decades, to a distributed and modular online business world, which composes its applications dynamically with services from different providers.

1 INTRODUCTION

The advancement in Web-based infrastructures[1] facilitates utilization of service based systems for business as well as consumer applications. This development fosters modularization of functionality across different providers using the Internet as a distribution platform. By combining simple services to more complex services applications can dynamically be composed and serve special needs, therewith generating new economic value (Blau et al., 2009). This new phenomena is described through the notion of the Internet of Services (IoS) (Janiesch et al., 2008) (Heuser et al., 2008, S. 100), which already indicates the upcoming trading of services like conventional goods in the Internet.

However, service development, composition and consumption occur in an open and distributed environment, the Internet, resulting in new legal challenges for real world applications.

During service composition or consumption legal relationships between legal entities are established, thus, the need for agreements pertaining to private law arises. This is in particular true for composed services involving several service providers which, for example, should clarify liability questions in case of claims. Also copyright issues concerning the compatibility of different licenses (Jäger, 2008) during service composition of a complex application is such an aspect. (Baumann, 2008)

Moreover, composed services reduce the transparency of the usage of personal data of service users, and, thus, stronger privacy precautions are required to protect the customers. Even if personal data is collected with reason, the consumer may not be able to control who else receives this information in the complex and distributed environment. The aforementioned examples are even multiplied for ad hoc service composition, a paradigm the IoS states.

Addressing these issues is a critical requirement for the success of such composed and distributed applications. Otherwise legal uncertainty and the lack of trustworthiness threaten to hinder commercial appli-

[1]The German lighthouse project TEXO, for example, aims at developing such an Internet-based infrastructure (http://theseus-programm.de).

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ance. Unfortunately, the modular character of composed services makes it difficult to foresee legal requirements when designing an atomic service.

However, from a legal perspective the technical foundation for service based systems provides a significant advantage. The "find and combine" paradigm requires a comprehensive service description, not only in a technical but also in an economical way. For instance a technical interface description in WSDL[2] provides information of data input and output, and such description schemas like USDL[3] or Ontologies (Staab and Studer, 2004) even extend the descriptions with non-functional requirements or formalized usage policies.

These descriptions present formalized information for a legal assessment. Thus, facts for an assessment under private or public law have not necessarily to be extracted from raw text or obtained by other sources, but structured service and process descriptions can be used as a starting point.

Moreover, in continental Europe laws are codified in a comprehensive and systematic way, similar to an ontology structure, and also including rules for legal consequences. This provides the opportunity to model legal norms and the procedure of the legal assessment.

In fact, the legal assessment can in turn also be considered as a service during service development, composition and runtime, which can identify legal obligations and requirements. That is, regarding the aforementioned examples, a suggestion of a suitable contract to guarantee an adequate balance of interests for the participating service provider. In the case of copyright infringement license incompatibilities can be disclosed to facilitate legal certainty. Also obligations arising from privacy laws can be considered.

However, for such a technical legal assessment based on formal descriptions there is a need to subsume the facts describing a service under the terms used in codified law.

In Sec. 2 we propose a separation of the technical application and the legal model. This has the advantage to not statically include legal regulations in services or composed applications, but to reuse the formalized legal rules. In consequence we outline in Sec. 3 the principles to subsume both worlds to obtain legal consequences for a specific situation. Section 4 provides the conclusion and indicates further directions for the research area.

[2]http://www.w3.org/TR/wsdl, http://www.w3.org/TR/wsdl20

[3]See USDL Information Sheet: http://internet-of-services.com/uploads/media/USDL-Information.Sheet.pdf

2 TWO WORLDS: APPLICATIONS AND LEGAL NORMS

The possibility to compose applications from atomic services raises the problem, that not every situation and its legal requirements can be foreseen. Therefore, we argue to use the self describing services and its information for a legal assessment. The legal assessment, in turn, can be kept in its own system, just subsuming the collected information for obtaining legal consequences.

In the section at hand we first discuss sources to obtain information about service based systems for a legal assessment. Following, we explain the principles of our approach to formalize legal norms.

2.1 Self Describing Service based Systems

Service descriptions have evolved over the past years from simple interface descriptions like WSDL to comprehensive semantic service descriptions that cover functional as well as non-functional aspects. Examples for such service description approaches are WSMO[4], OWS-S[5] or the novel Service Ontologie (Oberle et al., 2009) developed in the THESEUS/TEXO program[6].

The main reason for the introduction of these ontology based service descriptions was the need for richer information about services beyond the purely technical descriptions of input and output parameters. Ontologies provide a way to describe the actual semantic of a service, including non-functional aspects like the pricing schema or quality of service (QoS) parameter. The main use case for this rich service descriptions is the service discovery, where a service demand is matched against all available services. In our work, we propose to use these service descriptions as basis for an automated legal subsumtion, where comprehensive descriptions are needed to match terms in codified law.

In addition to the service description extra information is given through the context of a service. In many real world scenarios services are used to execute parts of business processes. These are typically modeled using BPMN[7], but semantic approaches are developed for this area as well (Hepp et al., 2005). The context information provides an additional source

[4]http://www.wsmo.org

[5]http://www.w3.org/Submission/OWL-S/

[6]http://theseus-programm.de

[7]http://www.bpmn.org

of semantic information that can be used in our approach.

2.2 Formalizing Legal Norms

Our approach in formalizing legal norms is driven by the basic idea to reproduce the legal methodology used by legal practitioners in continental Europe. This ensures the appliance of a standard methodology to solve a case.[8]

2.2.1 Legal Methodology

Legal practitioners apply a standard methodology to solve a case. In essence, the circumstances of a situation are identified and subsumed under the abstract facts of the case of a norm. If all abstract facts of the case are fulfilled by the situation, the corresponding norm rules the specific legal consequence.

The concrete circumstances of a situation are basically the information described in Sec. 2.1, the facts of the case are codified in legal text. The subsumtion process itself guarantees an objective, reproducible and justifiable result. These characteristics are of critical importance because the result of a legal examination is only valid, if the justification is reproducible and based on a valid path of legal argumentation. For instance the legal text might mention the fact "natural person" under which the concrete circumstance "John Smith" can be subsumed, but not "Smith Corp.". If the fact "natural person", alongside with other requirements, is fulfilled, data protection laws for personal data might rule special requirements for the application processing this information.

2.2.2 Formalizing Legal Norms

To formalize legal norms two tasks have to be achieved. First, the abstract legal terms (concepts) have to be represented in a taxonomy. For this purpose we can create an ontology of legal terms, the structure of ontologies are similar to laws. Second, there is need to build rules to obtain conclusions. For building these rules the formerly defined ontology of legal terms can be utilized. Having rules is one prerequisite to obtain legal consequences stated by norms.

Additional characteristics arising from interdependencies of legal regulations are in particular the following:

- Legal terms have to be connected con- or disjunctively.
- Identity: A norm uses a concept, which is defined in the conclusion of another norm.
- Hierarchy: A norm using a concept on an upper level of abstraction affects all norms that consist of a concept on a lower level.
- Exception or extension: An exception reduces the set of real world situations covered by a norm, an extension increases this set.
- Specialty[9]: The conclusion of a general norm is overwritten by the result of a more specialized one.

These characteristics result in certain requirements for a modeling language as follows:

- a formal language for logic rules, that supports the operators conjunction, disjunction and negation
- legal concepts have to be defined as predicate symbols in a controlled vocabulary
- support of modeling sub-superconcept relationships

In addition, a reasoning engine to evaluate the rules and compute legal consequences is required. Our research indicates that F-Logic (Kifer et al., 1995) meets the requirements, and is also supported by mature modeling environments. An example modeling and implementation can be found at (Raabe et al., 2010). A promising alternative for the future is ELP, tractable rules for OWL 2 (Krötzsch et al., 2008). However, at present the tool support is hardly given.

3 BRINGING THE WORLDS TOGETHER

In the previous section we motivated the separation of the (semantic) service description and formalized law. With this separation a gap is opened between the elements of legal rules and the elements of the service description, thus, (static) connections are not established between the two models. To apply formalized law on a given service description we have to bridge this gap and find the matching definitions given in the ontology of law for the service description elements. Figure 1 shows an overview of the mapping problem. This mapping is usually solved by legal practitioners using legal subsumtion as introduced in Sec. 2.2.1. Below we elaborate on the process of legal subsumtion in more detail and present a concept for an automated subsumtion using semantic techniques.

[8] In this paper we apply a widely accepted methodology described in (Larenz, 1983).

[9] This case can be treated as a special case of exception.

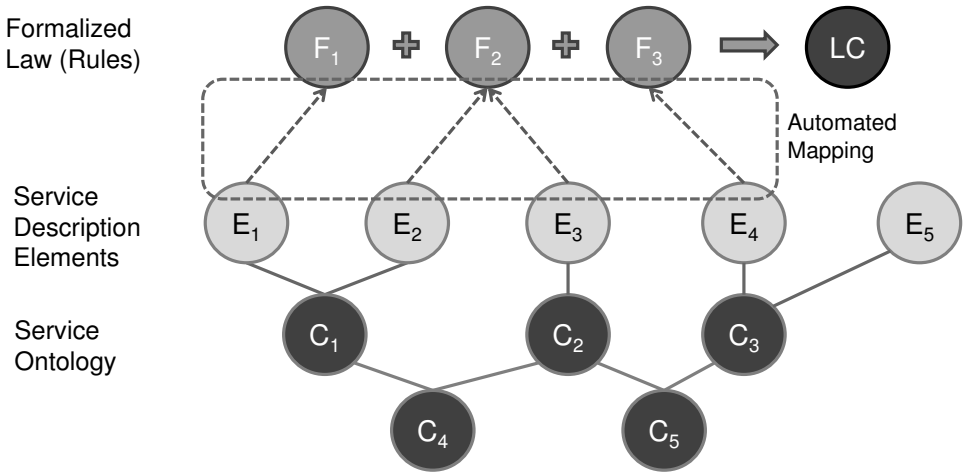

Figure 1: Mapping Overview.

3.1 Legal Subsumtion

As the rules given in law have to cover all possible situations, abstract terms and definitions are used to cover a wide range of concrete cases. Some of these terms are further defined in other paragraphs, so the first step of the subsumtion is to recursively resolve all terms to find a complete legal prerequisite.

On the other hand we have the concrete circumstances of the situation, which, in our work, are the service description elements, the run time data and the context information. These elements can now be subsumed under the abstract definitions in the law. In this subsumtion process it is important to consider the semantic of the elements, which is typically trivial for a human, but hard to achieve for a computer.

3.2 A Concept for Implementation

Our concept uses the ontologies introduced in Sec. 2 to automate the subsumtion process by using a reasoner, but keeping the process as close as possible to the legal methodology as normally applied by a legal practitioner.

When designing an automated algorithm to implement legal subsumtion we have to consider the constraints that are given by the legal methodology: our results have to be reproducible and tractable. We use the information that is stored in the ontologies, at foremost the knowledge about the hierarchical relations between the elements of the service description and the classes of the service ontology. This hierarchy can be used to find more abstract terms for the service instances. An example would be the element "provider", which is a subclass of "company", thus it is not a natural person.

In the first step of the algorithm we gather all information of the service: from the service description we get the functional parameter (inputs and outputs) and the non-functional aspects. The second data source is the run-time data that is passed to and returned from the service during an actual service call. Finally, we utilize additional context information like a business process model in which the service call takes place.

For each of these data elements we try to get the information that is encoded in the ontologies, like the subclass hierarchy or the relation to other classes. These enriched elements are the basis for the actual mapping where they are compared with the elements of the formalized law.

As tool support we already work on an realization based on NeOn toolkit[10] which integrates the KAON2[11] API reasoning engine, including support for F-Logic.

4 CONCLUSIONS

In this paper we pictured the legal challenges rising with the development of modular applications built upon atomic services. As applications can be composed of services by different providers across the Internet, we argue, that it is not possible to foresee legal requirements for every situation.

To address this issue we propose to apply standard legal methodology when formalizing legal norms and the legal assessment to obtain legal rights and obligations for a specific situation. Upon this foundation

[10] http://neon-toolkit.org
[11] http://kaon2.semanticweb.org

an autarchic system which can subsume service description facts under the terms of legal text in order to obtain legal consequences can be build. The key is not to merge both worlds, but to keep them separated for flexibility and progress reasons – exactly the way legal norms are utilized for real world situations in the offline world.

We gave an outlook to a possible concept for implementing such a subsumtion. Formal service descriptions and formalized legal norms including rules to obtain legal consequences can be found in recent literature.

The subject-matter of this research area is highly topical, as distributed and ad hoc service development as well as usage becomes more and more common for economical applications. In the area of copyright the formal description of content, which is basically the same as the description of usage policies for applications (licenses), is already common. For instance the Creative Commons[12] project provides formalized license attribution, which have already been picked up by other applications such as browsers to analyse the usage permission. This is a simple example, however, the inter-connectivity increases and next steps will have to be more professional assessments on the compliance of such disclosed legal information under (national) laws.

In our opinion the next most critical upcoming legal area will be data privacy. The rising integration of applications, and therewith also (user) data, across companies and the "open" Internet, will challenge composed service based systems – e.g. the social network platform Facebook is already integrated with the microblocking platform Twitter[13]. This simple example indicates first data privacy issues for application integration. It is easy to think ahead to apply such integrations in commercial as well as non-commercial web information systems. This phenomena requires advanced applications to assist in legal issues for all involved parties: developers, providers, users etc.

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[12]http://www.creativecommons.org

[13]http://www.facebook.com/twitter/

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