

The Definition of Legal Relations in a BDI Multiagent Framework

Guido Boella, Leonardo Lesmo

Dipartimento di Informatica e Centro di Scienza Cognitiva

Università di Torino - Cso Svizzera 185 - Torino ITALY

guido@di.unito.it

Lyda Favali

Dipartimento di Scienze Giuridiche

Università di Torino - V. S.Ottavio 54 - Torino ITALY

lyfavali@tin.it

Abstract.

This paper aims at linking the AI notion of multi agent system with the notion of LEGAL RELATION [Allen & Saxon 95]. The paper is based on the idea that legal rules concern actions to accomplish or to exclude and states to achieve or to avoid or actions for changing existing legal relations. The body of the rule establishes who and under which conditions must respect the obligation. The notion of ‘obligation’ has been defined elsewhere [Boella & Lesmo 01] and will be reviewed here. In this paper it is used as an ontological basis to define the LEGAL RELATIONS appearing in the A-Hohfeld language, and the concepts of ‘bearer of the obligation’ (who undergoes the rule) and of ‘normative agent’ (who watches on the rule) are connected to an ontology of legal entities.

INTRODUCTION

In recent years, there have been two parallel lines of research in AI and law. Intelligent agents have been one of the main-streams in AI. Legal Relations have been shown to be one of the main tools to rationalize legal reasoning. This paper aims at building a bridge between the two fields.

Agent based systems are based on a similarity to human behavior. So it is not strange that agent theories have evolved to model not only software agents, but also their human counterpart. This is useful from a twofold perspective: human agents (i.e. the users of computer systems) must interact with software tools, so it is important that such tools have understandable (on their side) models of their human users, in order to devise the ways to serve them better; second, if software agents are modelled in a way similar to human users, the users can have a better understanding of their behavior and find them more friendly and usable.

On the legal side, it has been claimed that many legal terms, as ‘right’ are often used in an approximate way so that as early as at the beginning of this century, it has been tried to determine a set of basic legal terms able to define in an unambiguous way legal rules. This early attempt has evolved in a more precise formalization, i.e. the A-Hohfeld language [Allen & Saxon 95]. This was born as a semi-formal definition of the basic LEGAL RELATIONS, and developed into a complex system of EXTENDED LEGAL RELATIONS, claimed to cover all concepts useful for describing legal rules [Allen & Saxon 98, 99].

But legal rules aim at constraining the behavior of the individual subject to them, in order to make it compatible with a desired social harmony. So, there is an apparent relationship between the legal system and multi agent systems. It seems reasonable to attempt to connect the two points of view: formal models of behavior, and formal models of constraints on behavior.

Most works in the field of AI and law have focused on the representational issues of norms (see [Tiscornia & Turchi 97]) or on the problem of the possible combinations of normative positions [Sergot 98]. On the contrary, in the MAS community, more and more attention is being devoted to the problem of generating norm abiding behavior and of modeling the decision process of agents under obligations ([Dignum 96], [Castelfranchi 98]).

In the past years, we have developed a model of agents, able to account for some complex phenomena concerning human behavior in dialogue [Ardissono et al. 00], and for the basic principles of rational behavior in the interaction with other agents [Boella 00]. More recently, we have shown that this model is able to cope with obligations [Boella & Lesmo 01].

In this paper, we want to draw a connection between these two fields by introducing our treatment of norms and obligations in the definition of the Legal Relations of the A-Hohfeld language [Allen & Saxon 95]. The main contribution of this attempt is to make explicit the *operational* component underlying legal reasoning, which is left implicit in many works, starting from [Allen & Saxon 95]. A new link is established between a rule expressed in terms of Legal Relations, and the required behavior of the individuals mentioned in the rule. On this basis, it is possible to define rules which are applicable both to human and to software agents, and to introduce new formal ways to reason about the applicability of rules.

The paper is organized as follows: the next section introduces the basic concepts of the underlying model of agents; the third section gives a formal definition of obligations; the last section shows how LEGAL RELATIONS can be specified in terms of actions and obligations; finally, the Conclusions close the paper.

AGENTS, ACTIONS, AND OBLIGATIONS

Although the theory of BDI (Belief-Desires-Intentions) agents need not be examined in depth in the present context, there are some aspects which are relevant. Perhaps, the most important are that agents have goals and are capable to act in order to achieve these goals. One of the aspects that are usually disregarded is where these goals come from. It is usually assumed that an agent has personal desires that concur in forming his goals; moreover, the social desire to maintain good relations with other agents (i.e. social goals), or the necessity to coordinate cooperation (goal adoption [Castelfranchi 98]) can lead to the formation of goals. But there is at least another source of goals which we consider: it consists in *obligations*.

In previous papers, we outlined a theory of norms and a reasoning framework for taking deliberations dealing with obligations, which is inspired by the work of [Goffman 70] in the sociological field. According to Goffman, a norm is a kind of guide to action which is supported by social sanctions. Moreover, he defines as *sanction* a reaction of others to the behavior of an individual or a group, a reaction aiming at enforcing the respect of a given norm. Hence, from the point of view of sociology, norms come always together with sanctions; since sanctions are actions, they presuppose, in turn, someone to perform them. As noted in [Tiscornia & Turchi 97]: “in general, every prescription requires a sanction. [...] prescriptions are autonomous norms, while sanctions exist in as far as there is also a prescription to which they refer” (p.65). So, there is a strict dependence between sanctions and norms, at least in most cases.

We founded our theory of *obligations* on the following assumptions:

1. There exists a *Bearer* who must fulfill the prescription(s) carried by the obligation.
2. The prescription is represented as an *Action to be done*, an *Action not to be done*, a *State to achieve*, or a *State to avoid*.
3. There exists a *Sanction*, which can be applied in case the prescription is not fulfilled. In principle, the sanction is an action which affects the bearer in a negative way.
4. There exists a *Normative Agent* who acts in case the obligation is not fulfilled and possibly her action results in the application of the sanction to the Bearer.

We have shown that such a formalization of obligations can be embedded in a MAS which is based on the notion of *goal adoption*, *anticipatory coordination* [Castelfranchi 98] and *decision theoretic planning* as the one presented in [Boella 00]. As stated above, the agent's goals do not depend only on his own objectives but he also has to take into account other agents' goals, such as those proposed by obligations.

Second, the decision about which goal to pursue cannot be made only on the basis of the effects of the plan for achieving the different goals. In a multiagent setting, the agent's choices directly affect the behavior of other agents. As [Goffman 70] notices in his discussion on *strategic interaction*, when an agent considers which course of action to follow, before he takes a decision, he will depict in his mind the consequences of his action for the other involved agents, their likely reaction, and the influence of this reaction on his own welfare. He will adapt his actions to the other agents' reaction before it can even happen.

If we want to cope with this kind of reasoning we need both a criterion for comparing actions and some form of *anticipatory coordination* to predict the reactions of the other agents involved in the interaction. To meet the first requirement, we adopted *decision theory* so that we can characterize the preferences of an agent by means of a *utility function*. On the other hand, anticipatory coordination means that the state that results from the execution of an action (or, in general, a plan) cannot be used to evaluate the utility of the action. Rather, each outcome of the agent's action must be first updated with the effects of the (predicted) reaction of the other agent. The other agent must be (recursively) modeled as a BDI agent, with his own beliefs, goals and preferences.

This is particularly relevant in the case of obligations. In this case, the 'other agents' can be reduced to the Normative Agent, so that, in choosing what to do, the Bearer of the obligation must try to foresee whether the Normative Agent will sanction him in case he does not fulfill the obligation which the Normative Agent must enforce.

It may well happen that the choice falls on a plan which does not fulfill the obligation, in case all plans that fulfill it lead to a very negative state for the agent. More interestingly, the Bearer could also devise plans to mislead (or corrupt) the Normative Agent, so that the Sanction is not applied even if the obligation has not been fulfilled. We have also argued that this modelling of dishonest agents (even if morally questionable) could be essential in order to let Normative Agents recognize dishonest behaviors.

As a consequence, norms need not be represented by another primitive propositional attitude with a distinct ontological status, but as a combination of beliefs and goals of the agent subject to the norm and of the agent who has to enforce the respect of the norm: in particular, the goal of avoiding sanctions, the goal of not violating the norm and the belief that there is another agent who has the goal of sanctioning violations.

The technical tools we adopted to implement the model is decision theoretic planning (i.e., non classical planning based on decision theory and/or game theory, see [Haddawy & Hanks 98]). It is useful to remember that decision and game theoretic planning have an important role in modelling multi agent situations, as, for example, [Boutilier 99] and [Gmytrasiewicz & Durfee 00] have recently argued.

In this paper, we aim at showing that the same kind of formalization can highlight some basic aspects of legal rules. In particular, we claim that obligations, if suitably extended, can provide an ontological basis to the Legal Relations appearing in one of the clearest formulations of the legal language, i.e. A-Hohfeld. This is not an attempt to redefine A-Hohfeld, but just a description of how the legal language is related to the behavior of agents.

A FORMAL DEFINITION OF OBLIGATIONS

In the definition of obligation, we assumed that it consists in a situation where an agent *N* (the *Normative Agent*) has a goal *G* that another (or more than one) agent *B* (the *Bearer*) satisfy a goal *G'*, and who, in every case the agent *B* acts without adopting the goal *G'*, has to decide whether to perform an action *Act* which (negatively) affects some aspect of the world which (presumably) interests *B*. Both agents know these facts.

Differently from what appears at first sight, this definition covers not only “institutional” cases, but also other situations like obligations in dialog (see [Boella et al. 99] and [Ardissono et al. 00]) which share the characteristic that new goals are acquired as a consequence of social inputs.

In the *L* component of an agent, an obligation [f057]i is represented as a 5-tuple *B, N, O, CO, R* where:

1. *B* is the *bearer* of the obligation (actually the description of the class of individuals to which the obligation applies; i.e. it is the *type* of the potential bearers)
2. *N* is the *normative agent* (actually the type of the authorized normative agents)
3. *O* is the *content* of the obligation, i.e., the state or action goal which *N* wants to be adopted by *B*,
4. *CO* is the *condition* of the obligation, i.e., the set of predicates specifying in which states the obligation must be fulfilled,
5. *R* is an action (the *sanction*) which *N* will presumably bring about in case he detects a violation of the obligation.

The content of the obligation [f057]i, i.e. *O*, is not necessarily a state (e.g., “the tank must be full”), but it can be also an action where *B* is the agent (e.g., “the agent should send the credit card number”) or not (e.g., “The parent of the agent must submit his personal certificate”). But it can also be the prescription of not executing an action (“you should not send huge files by mails”) or, almost equivalently, the prescription not to achieve a state (“the tank must not be empty”) or to maintain it true as in the current situation (“the door must remain closed”).

Of course, the sanction is executed only in case the normative agent believes that there is a violation: in order to establish whether a violation occurred the normative agent has to perform a monitoring action. For this reason, in our model, the sanction *R* is represented by a plan to be executed by the normative agent that consists of a monitoring action followed by the very action of affecting the world in a way that is (negatively) relevant for the bearer agent.

Directed Obligations

One of the features which are present in the Language of LEGAL RELATIONS (LLR) is the concept of *directed obligation* (an in-depth analysis of this concept appears in [Herrestad & Krogh 95]). The idea is that most LR are directed to a counterparty. This is not prescribed by the definition of obligation presented above. Obviously, it is possible to extend the definition of obligation by introducing a third privileged individual (beyond the bearer and the normative agent), who plays the role of the beneficiary of the obligation. However, a closer inspection of the role of Normative Agent suggests another solution.

The *Normative Agent* was introduced to model the institutional figure who has the task to check that a particular set of obligations is respected (e.g., policemen). However, it seems that this same role, complemented with the notion of utility we introduced above, can play the role of the counterparty. In fact, there is the possibility that two conditions hold (in the definition of the obligation):

1. The Normative Agent is *positively affected* by the *content O* of the obligation (i.e., he occurs among the Action Participants of *O* and the execution/achievement of *O* provides him with an increase of utility).
2. The sanction consists in opening a legal procedure against the bearer (e.g. a complaint).

In case these conditions hold, we say that the normative agent plays the role of *counterparty* of the bearer of the obligation, and we call the obligations such that these conditions hold *Directed Obligations*.

It seems that the concept of utility and the action-based formalization give substance to the notion of *benefit* (note that these two notions are already present in our framework for independent reasons): “when expressing such a preference, the legal authority regards A to be a *benefit* for j (and j be the *beneficiary* of A)” [Herrestad & Krogh, p.212] (in the quotation, A corresponds to our O, and j to our Normative Agent). Of course, the evaluation of the utility is not carried out by A, but by the legal authority (the Sovereign), who created the rule.

The conditions listed above mirror rather closely a clause in the definition of RIGHT given in [Allen & Saxon 95, p.223]. But what is more important, [Allen & Saxon 95] directly relates deontic notions with the behavior of the normative agent and, in turn, of the legal system:

“Person-p1 has a Right that Person-p2 do s” means [...] “IT IS OBLIGATORY THAT s be done for Person-p1 by Person-p2” *which, in turn, means operationally* [...]

IF A. IT IS NOT SO THAT Person-p2 does s for Person-p1

THEN B. Person-p2 has violated her DUTY to Person-p1, AND

C. IF Person-p1 seeks remedy in the legal system by Litigating

THEN the legal system will provide a remedy to
Person-p1 with respect to Person-p2

This is reported as an *operational* definition of RIGHT, *in terms of how the legal system will treat the matter*. Since our perspective is operational, in the sense that we model the behavior of agents, it is not strange that there is a strict correspondence. In fact, our sanctioning of the failure to respect an obligation produces the same effect in two steps: first, the counterparty sanctions the bearer by *seeking remedy in the legal system*; then, the legal system will have the duty (expressed as a general obligation to sanction who does not fulfill an obligation) to *provide remedy*. Note that, in general, the sanction is not ‘obligatory’, unless explicitly stated, so that no counterparty has the obligation to seek remedy. When the bearer of the obligation has to decide whether to comply with the obligation he has to simulate the decision process of the counterparty and see if he will choose to seek remedy (i.e., if he is aware of a violation, if he knows how and if he can do so, if it is useful for him to do so). Note that the normative agent, either with the role of counterparty or not, is not necessarily the *sovereign* agent who created the norm (but see Footnote 2).

Finally, in case there is a counterparty, the act of seeking remedy is not an exercise of POWER (see the definition in the next Section), since no new obligation of the legal system is created, but just one of the conditions of application of an existing obligation of the legal system (to provide remedy) is made true. In this case, the Bearer will have to (recursively) simulate not only the reasoning of the Normative agent but also how the legal system will decide to fulfill his obligation to provide remedy to the violation (see [Boella & Lesmo 01] for a discussion on multiple levels of recursive modelling).

In other situations, where the normative agent watches over the norm on the behalf of some institution (e.g., a policeman), the sanction can be an exercise of POWER (e.g., creating the duty to pay a fine) or even some form of punishment affecting the utility of the bearer of the norm.

OBLIGATIONS AND LEGAL RELATIONS

Given the definition of obligation described in the previous section, it is now possible to provide a definition of the LEGAL RELATIONS. We will show the definition of some of the 8 basic Relations. This should not be seen as a principled choice, but it depends on space constraints. The dual versions can easily be produced.

The relation which is closer to the definition of obligation is DUTY:

Agent D has the DUTY to P iff

1. There exists an obligation O, such that
 - The Bearer XO of O is of type TX
 - The applicability condition of O is CO

- The content of O is P

1. D is of type TX
2. The condition CO holds in the current situation

Clauses 2 and 3 are remarkable, since they impose some conditions on the definition of DUTY. Clause 2 simply transfers to duties the requirement we set forth for obligations that they are defined for specific subclasses of individuals. Clause 3 specifies that any duty is subject to certain conditions. This is partially in contrast with the separation maintained in A-Hohfeld between basic and CONDITIONAL LEGAL RELATIONS. We believe that in most cases DUTIES (as any other LEGAL RELATION) is conditioned to a particular state of affair; clearly, in some special cases, the condition can simply coincide with the truth value “True” (i.e. it always holds), but we claim that these are just exceptions to the more common cases. Notice that it is not specified if CO must be true at the outset or it can become true after some particular action or event. In case there is an event that makes true a condition previously false, then the DUTY is created (or comes about): operationally, this means that from that moment the Bearer must adopt the goal specified by O and decide to pursue it under the light of the anticipation of a possible sanction. Finally, we must observe that there is a universal quantification implicit in the *iff* operator “For each D and P, then ...”, and that the agent variable D can occur in CO.

Agent A has the **RIGHT** to P towards agent D iff

1. There exists an obligation O, such that
 - The Bearer XO of O is of type TX
 - The Normative Agent YO of O is of type TY
 - The applicability condition of O is CO
 - The content of O is P
1. D is of type TX
2. The condition CO holds
3. YO has the role of Counterparty (i.e. it is positively affected by P and may apply the sanction – seeking remedy against XO)
4. A is of type TY

This is directed RIGHT, as the presence of Counterparty (defined above) in clause 4 shows. It can be observed that the condition CO, being any general proposition concerning the situation at hand, could require that YO be in a given relation R with the bearer of the obligation XO; in this case, the RIGHT applies just in case A is in relation R with D.

Agent D has the **PRIVILEGE** to P iff

1. There exists no obligation O, such that
 - The Bearer XO of O is of type TX
 - The applicability condition of O is CO
 - The contents of O is P
1. Or, if such an obligation exists, either
2. D is not of type TX, or
3. The condition CO does not hold in the current situation

In other words, D has the PRIVILEGE to P if there is no obligation that prevents P, or if such an obligation exists, it does not apply to D, or it does not apply in the current situation. It can be observed that there is a difference between the explicit statement of a privilege and the realization that a given action (P) is not explicitly forbidden. In our view, this is an important matter, which concerns consistency in law. As stated above, we assume that our proposal is in line with the basic assumptions of Hohfeldian Legal Relations. So, we do not argue against the opportunity to include in the language relations as PRIVILEGE. In fact, it seems clear that checking there are no duties that forbid a given action is a difficult task; so it is not unreasonable that the legislator carries out this check just once, and then states explicitly the existence of the privilege. The next time a case must be examined, the full check of existing duties can be bypassed, and the privilege can be applied. However, it seems also clear that stating a PRIVILEGE of D to P, while the current set of rules also state that, in the same situation, D has the DUTY to [f0d8]iP is an inconsistency that should be avoided. Finally, notice that this is a liberal view of law: you can do everything which is not explicitly forbidden. In principle, it is possible to revert to a restrictive view: privileges are defined as basic, and duties as derivative. In this case, you obtain something as: you cannot do anything, unless you are explicitly allowed to.

In order to define the next LEGAL RELATION, POWER, we need to introduce a particular subset of actions. This does not affect the underlying ontologic assumptions, but it simply enables us to introduce the recursion required by POWER:

An Obligation-Affecting-Action related to the LEGAL RELATION P is an action such that, among its effects there is:

1. either a modification of the current set of obligations that produces P,
2. or the modification of the set of Obligation-Affecting-Actions such that this modification produces P.

So in the first case, it is possible to introduce a new obligation (thus creating, for instance, a new DUTY); in the second case, it is possible to introduce an action whose agent creates an obligation (creating the POWER to create a DUTY), or an action whose agent can introduce an action for creating an obligation (two-level application of POWER, in LR terms), etc.

Agent D has the **POWER** to bring about that P iff

1. There exists an obligation-affecting-action R related to P, such that
 - The Agent XR of R is of type TR
 - The applicability condition of R is CR
1. D is of type TR
2. CR holds in the current situation

It can be observed that this definition is rather simple, with respect to the complexity of the concept of POWER. A first reason is that it is not necessary to introduce the notion of *authority*, since the fact that the action exists (with the specified consequences) is sufficient: the ontology of actions is such that the presence of an action says by itself that (under the defined conditions) the action will produce the specified effects; it is just the type of effects which keeps apart the exercise of POWER from any other action.

Finally, the recursive character of POWER is mirrored in the use of the recursive obligation-affecting-action within the definition of POWER.

As [Jones & Sergot 96] discuss, the notion of power must be kept separate from those of *permission* and *practical possibility*. In our model, the first notion is clearly distinct from POWER, since one can have a POWER while having the DUTY not to exercise it: if, instead, he does so, the violation of the DUTY may lead the normative agent to sanction him according to the specification of the related obligation. On the other hand, the *practical possibility* depends on the truth of the applicability conditions of the obligation-affecting-action involved in the POWER.

CONCLUSIONS

In this paper, we have shown that a theoretical framework based on actions and agents can provide a useful basis for expressing the meaning of the LEGAL RELATIONS appearing in the A-HOHFELD language. We claim that this enterprise is useful for connecting the AI concept of agent-based system, and the legal concepts of rule and obligation.

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Of course, there are exceptions; for instance, the so called 'blank norms' or 'natural obligations' lack an explicit sanction component

Actually, there exists another important institutional figure, the *Sovereign*, who created the obligation. Since the model presented in this paper is intended as a model of action under the constraints of obligations (an not as a model of how norms are created), the Sovereign and the Defender Agents have been merged in a single *Normative Agent*.

It must be observed that some scholars have challenged the view of Allen and Saxon, claiming that *Privilege* is not the absence of obligations, but the fact that no obligation affecting the privilege can be created ("there should not exists any obligation such that ...").

Actually, what should be done is to substitute the basic concept of obligation with the inverse concept of permission (actions that one can do without sanctions). Then, privileges are defined in terms of permissions and duties in terms of absence of permissions. But the underlying idea is the same.

Intuitively, POWER is the right to create some new obligations.