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Engineering Commitment-based Business Protocols with the 2CL Methodology

(Extended Abstract)

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1. INTRODUCTION

Business protocols are a means for specifying the interaction of a set of autonomous parties with heterogeneous software designs and implementations. They have a normative value in that parties are expected to behave accordingly. Often the reality in which parties operate is characterized by a *high degree of regulation*. This is, for instance, the case of banking and of trading services. As new regulations are issued, there is the need of adapting business protocols to the new dictates, which usually restrict – e.g. by adding new commitments and new constraints – the possible interactions, or require the combination of different protocols. When this happens, it is important for those organizations, whose conducts are affected by the new regulation, to have the means for identifying their *exposure to risks of violation*.

The commitment-based approach (e.g. [7, 5]) allows expressing interaction in terms of actions, whose social meaning is shared by the interacting parties. The execution of such actions affects the world and can either cause the creation of social commitments between the parties or the manipulation of already existing ones (e.g. by delegating, canceling, assigning them). Thus, commitment-based approaches naturally capture the contractual relationships among the partners rather than strictly encoding the order in which messages are to be exchanged. 2CL [2, 4] extends classical commitment-based protocols with the possibility to express temporal *constraints among commitments*.

The article introduces 2CL Methodology, a *software engineering methodology* for the business protocol language 2CL, by which business protocols are specified in a declarative way by means of social commitments. Besides supporting 2CL protocol specification, 2CL Methodology includes specific guidelines for the *composition* and the *specialization* of protocols. The latter is used in the case in which a protocol must take in a new regulation or, as we say, a regulation is to be *grafted* upon an existing protocol [3, 1]. As an example of usage, the article applies the 2CL Methodology to the Markets in Financial Instruments Directive (MiFID) which is an important example of EU regulation having an impact on trading procedures. The article also describes an integrated set of software tools, that support the design and the analysis of 2CL business protocols.

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2. BACKGROUND

We maintain that *commitments* and *constraints* supply the right abstractions for capturing the intents of the specification without being overly prescriptive: the former, by capturing contractual engagements between the interacting parties, the latter, by expressing agreements, norms, conventions, habits and such like on the evolution of the interaction. So, we build upon 2CL and introduce 2CL Methodology, a modeling methodology aimed at harnessing the complexity of the analysis and the design of evolving business protocols. 2CL Methodology is an enhanced version of the Amoeba methodology [6], which is specifically thought for realizing commitment-based business protocols, either designing them from scratch or by adapting already existing ones. The version that we propose is conceived for tackling not only commitments but also temporal constraints, the two chief components of 2CL specifications. It also includes steps that are conceived for performing the *composition* and the *specialization* of business protocols, the latter of which is used for performing the grafting of regulations.

A 2CL business protocol models business interactions based on the two main notions of *commitment* and of *constraint*. It is an aggregation of various elements:

- *Role*: conceptualizes a possible actor in a protocol. Roles are played by specific actors when protocols are enacted;
- *Domain Element*: is an element of the *universe of discourse*;
- *Initial State*: is a set of items belonging to *Domain Element* and represents the initial state of an interaction that respects the business protocol;
- *Action*: represents a move that players of roles may execute. It conceptualizes the "counts as" relationship between the move at issue and its social meaning, given in terms of modifications to the social state;
- *Constraint*: conceptualizes an interaction pattern that is to be respected.

Actions and constraints are both defined based on *facts* and *commitments* which are part of a set of *Domain Elements*. Facts are positive or negative propositions that do not concern commitments and which contribute to the social state.

3. THE 2CL METHODOLOGY

Due to lack of space we sketch only the part of the methodology that concerns proocol specification, the parts for protocol composition and specialization can be found in the paper [1]. When defining a 2CL protocol, the designer should identify a set of roles, a set of domain elements, the content of the initial state, a set of actions, and a set of constraints.

***M1:* Roles Identification.** The set of roles of a protocol is obtained, first, by identifying the set of participants to the interaction that it is of interest to represent; second, by abstracting from players the roles they play in the protocol.

***M2:* Contractual Relationships Identification.** This step is structured in three substeps which basically aim at determining:

M2.1 the domain elements (or universe of discourse) on which the protocol relies;

M2.2 the contractual relationships and conditions of interest that are involved in the interaction;

M2.3 the contractual relationships and conditions of interest that exist prior to the interaction and that belong to the initial state.

***M3:* Identify Actions Social Meanings.** The analyst considers the set of commitments and facts individuated at the previous step. By following the extracted information on their creation, satisfaction and manipulation, she determines which actions have an impact (and which) on the set of domain elements. Accordingly, she associates to each action a meaning, given in terms of operations on commitments or assertion of facts, and if necessary also a context.

***M4:* Identify Constraints.** The analyst is expected to identify a set of temporal requirements, or co-occurrence relations, the interaction is desired to respect and to find a suitable representation in terms of 2CL constraints.

4. GRAFTING

We describe how the MiFID regulation that applies to the offer of investment services off-site, i.e., the case when a bank promotes and sells financial products with the help of external collaborators (intermediaries), can be grafted on a previously existing financial product sale protocol. Notice that if an intermediary buys a financial product for a client, *violating* some of the constraints imposed by MiFID, the sale is however valid, the client results to be the owner of the product. This happens because MiFID does not define "sale" (sale is defined by a different regulation) but dictates how the interaction with the client should be carried on by adding a new layer of regulations on top of existing ones. So, the violation of some constraint does not affect the sale directly but creates both a risk of sanction and a risk of exposure for the intermediary. The article shows how such risks can be identified by way of the tools we developed, and how, by following the steps of the methodology that were devised for protocol specialization, it is possible to upgrade the business protocols in a way that accounts for the new regulation.

5. 2CL TOOLS

We developed a suite of tools that enable the verification of exposure to risk on the graph of the possible executions, and support taking decisions about how to behave (or how to modify the protocol) so to avoid such a risk. The realized system, an Eclipse plug-in (java-based and open source IDE), is available at the URL `http://di.unito.it/2CL`. Its functionalities can be grouped into three components: design, reasoning and visualization. The *design component* supports the definition of business protocols. It supplies the action (textual) editor, and the constraint (graphical) editor. Constraints graphical representation can be converted into a textual one, that can be used to generate a Prolog program. The *reasoning component* allows generating all the possible interactions, which are allowed by a protocol actions, labelling them as legal or not according to the protocol constraints. The program is realized in tuProlog and builds upon the enhanced commitment machine by Winikoff et al. Annotations account for all the regulative aspects concerning both commitments and constraints. So each illegal state of the graph has a set of labels that capture the violation of some constraints, the presence of pending conditions, or the presence of unsatisfied active commitments. The *Graph Explorer* supplies many functionalities, among which: the visualization of the shortest path between two states, the visualisation of legal (or illegal) paths only, hand-made addition or deletion of a node in a path, the search of all the states that contain a certain fact or commitment, the exploration of the graph one state at a time, by choosing which node to expand, the incremental construction of the graph.

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