

# FORMATION AND FULFILLMENT OF ELECTRONIC CONTRACTS IN ICS

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**Abstract:** This work is part of the ICS project (Intelligent Commerce System) whose aim is to design and implement an effective B2B E-commerce system based on mobile and intelligent agents. The ICS lifecycle is based on five phases: User Modeling, Matchmaking, Negotiation, Contract Formation and Contract Fulfillment. We propose here an automated process for the Contract Formation and Fulfillment phases. We propose ontology for sharing knowledge between agents that participate in the configuration process of contract, besides a repository to store contract templates and contract instances. For managing the contract fulfillment, a Temporal Workflow and active rules based on ECA paradigm of Active Database System are applied in order to develop this process.

## 1 INTRODUCTION

Electronic commerce is increasingly applied in organizations. This is encouraged by the fact that it's offering opportunities to discover new ways and to improve the existing ones. E-commerce aggregates more activities than purchase and sale: marketing, invoicing, negotiation, contracting, payment, delivery and so on. This and other facts prove that doing electronic commerce on the Internet became attractive and made it one of the most important areas of investment in information technology.

Researches showed that the progress on sophistication of automation turns the e-commerce more dynamic and personalized. Examples are applications that use intelligent agents to act on behalf of its users, developing things like: making commercial decisions, negotiations, participating on auctions, playing important roles on electronic markets as mediators, matchmakers, and other ones (Jennings, 1998). One of the most growing e-commerce areas are B2B applications that had received increased interest by companies. But many still have worried about the trust in transactions made through Internet. To resolve this problem, the ICS included two important phases on its lifecycle: Contract Formation and Contract Fulfillment. This paper focuses on the development of these two last phases of ICS (Intelligent Commerce System) (Labidi et al., 2003). We adopt the use of electronic

contracts on ICS to provide guarantees and, consequently, to reduce the uncertainty associated with transactions realized through this system. Defining obligations that each party must fulfill and making it enforceable by law, could reach these guarantees we are referring.

We propose an automated process to implement the Contract Formation phase. It uses intelligent agents, ontology and XML. This includes two aspects: a modeling of contracts that are manipulated by a special agent and the behaviour of this agent. We decide to apply the concepts of Semantic Web to deal with this project because it makes possible the improvement of the interpretation and recuperation of information by agents, besides the exchange information between them.

In the Fulfillment phase, we propose the use of Temporal Workflow and active rules based on ECAA paradigm's Active Database System to achieve the monitoring and management of the activities to be performed by the parties of a contract.

The paper is structured as follow. The section 2 presents the ICS system and its architecture. This is continued by a brief description of ICS life cycle and its phases. Section 4 and 5 details the process of Contract Formation and Fulfillment phases. Finally, section 6 outlines our conclusions and future works.

## 2 THE INTELLIGENT COMMERCE SYSTEM - ICS

The ICS is an implementation of Business to Business Electronic Commerce that apply mobile and intelligent agents to carry out the process of business making. The mobiles are responsible to represent the ICS' users, while the others have to implement internal functions that take this system work.

In the ICS system, negotiating agents work in an open environment like Internet (or Intranet), moving through the network to meet a potential negotiation area with other agents looking for opportunities to do business.

Fig. 1 shows the architecture of ICS that is made by eight main components: marketplace, region, matchmaker, mediator, contractor, negotiators, ontology repository and contracts repository.

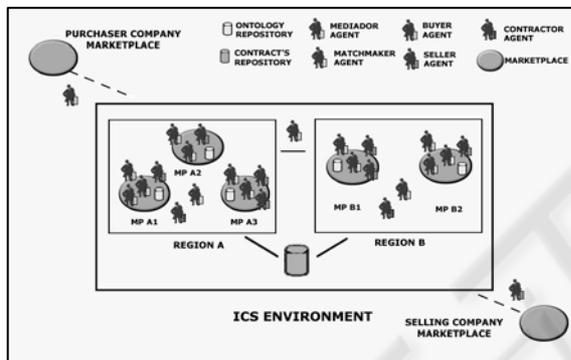


Figure 1: The ICS Environment

A marketplace is an environment that provides a context within the system in which an agent performs its tasks.

These tasks include details about communication protocols, negotiation, storage information in repositories, contract formation, besides functions like access and control negotiation.

A region is a cluster of marketplaces operating on the same domain ontology that represents the business areas (sales of vehicles, food, electronic products, etc). It also provides a higher level of abstraction for communication among agents from different regions. Whenever a new marketplace is created it is identified as member of a region.

Only marketplaces of the same region can communicate with each other. The objective is to resolve the context problems.

The negotiators are mobile agents that represent the users of ICS (companies that want make business on the Internet). They should be responsible for making commercial transactions such as making survey of prices, analyzing business-

oriented proposals, etc, and put announcements in appropriate repositories placed on regions.

The matchmaker agent makes queries in these repositories to match similar interests and contact possible business partners. There is just one instance of this agent per region. This agent with its complete functional and design requirements is detailed in (Tomaz et al., 2003).

The mediator agent treats to guarantee the management of the process negotiation governed by a protocol – placed in the ontology repository –, coordinating the participation, execution, resolution and termination of negotiation.

In the case of a successful negotiation, the contractor should validate the contract obtained through negotiation using the same protocol, store it in the repository (contracts repository) and produces a workflow with the obligations established between the parties.

The used protocol, called Negotiation Protocol, coordinates messages flow among participants and imposes rules for negotiation “game”. Each marketplace implements a kind of it, which can be: auction, procurement, bargain, etc.

## 3 ICS LIFECYCLE

The ICS lifecycle adopted in our system is an extension of the model proposed in (Jennings, 1996) and (Bartolini, 2001). A previous work (Fonseca et al., 2003) has already introduced the user modeling, matchmaking and negotiation phases, concept of information feedback and has described ontologies for each of these phases. As shown in Fig. 2, the new model is composed by five phases.

*User Modeling:* In this phase the system capture the users' preferences and restrictions from queries based on a domain specific ontology (Mukherjee, 2000).

*Matchmaking:* A trader locates other traders that could potentially do business. This is made placing advertisements in a shared repository.

*Negotiation:* The trader enters into negotiation with one or more of these potential business partners to agree or disagree to mutually acceptable terms of business. These terms are placed in contract templates and include some definitions like the goods or service being traded, price, delivery date, etc.

*Contract Formation:* All agreed terms are placed into a legally bidding contract and it is stored in an appropriate repository.

*Contract Fulfillment:* The parties carry out the agreed transaction, within the parameters specified in the contract, monitored by workflow.

The results of Contract Fulfillment may be returned, giving a feedback and reused during a new modeling enriching the user models. The next sections detail the Contract Formation and Fulfillment phases of ICS lifecycle.

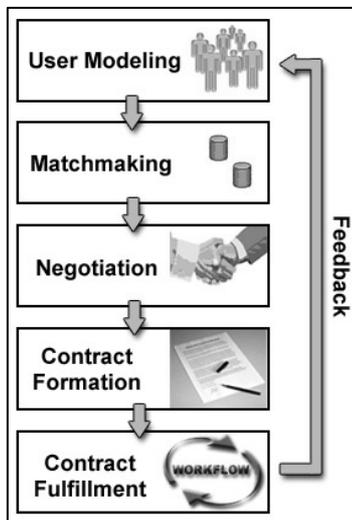


Figure 2: The ICS E-Commerce Lifecycle

## 4 CONTRACT FORMATION

### 4.1 Definition

Contract is an agreement between two or more parties about certain object that establishes rights and obligations to each one. As a legal standpoint, a contract serves to alleviate mistrust in a world of uncertainty by constraining the unpredictable activities of the other autonomous parties (Milosevic, 1995).

We are working on B2B contracts - contracts that deal with business transactions. For a while, the ICS aims to provide some species of contracts that are more common in B2B transactions: **buy and sell, rent, permute and service.**

### 4.2 Contract Template and Instances

In our work, we propose modeling electronic contracts through a kind of representation that are orient to the reading and understanding of intelligent agents. To deal with this modeling of contract formation, we propose the use of a repository to store contract templates (Ludwig, 2001) and contract instances. Contract templates, in our approach, are full standard contract forms that include fields to be filled. These forms, in principle, correspond to the

species above mentioned. So, we decided to use XML and build ontology.

The templates were modeled using XML, giving structuring and representation to textual information. We present in this paper a simple contract template modeled with XML given in Appendix.

However, contract instances are contracts agreed by parties, i.e., templates that already have been filled after a successful negotiation.

The full standard contract forms have their structure fixed and pre-defined. So, the negotiation is obtained through the agreeing on the values in the contract as defined in the standard contract forms.

Templates were introduced to reduce the cost of setting up the contract formation, based on our observation that there are a number of elements which are common to many contracts and that this is a frequently practice adopted by lawyers.

In addition, the repository should provide related management operations, for example: addition of new contract templates, specialization of contract templates from existing ones, establishing other possible relationships between them, besides add and remove contract instances.

### 4.3 Contract Ontology

In the Negotiation phase, as we have already mentioned, the negotiators agents start the process of negotiation following a protocol. This protocol is a common sense knowledge shared into ICS's marketplace, which was modeled as ontology like proposed by (Tamma, 2002).

We extend this ontology adding the concept of Contract, its types and parameters, bringing advantages such as improving the negotiation and allowing validation of templates.

The Fig. 3 shows the new Negotiation Protocol ontology modeled on Protegé Ontology Editor (Noy et al., 2001). This ontology approach has been designed to support multiple kinds of negotiation, cardinality among traders and some species of contracts. It is stored in the marketplaces - on ontology repository - and shared by all agents that participate in the negotiation.

### 4.4 The Automated Process of Electronic Contract Formation

One of the paper's objectives was the development of contractor agent's function: management of electronic contract configuration. To develop this, the contractor should make a lot of activities. The scene where interactions among contractor and

negotiators agents happen is illustrated below on the Fig.4.

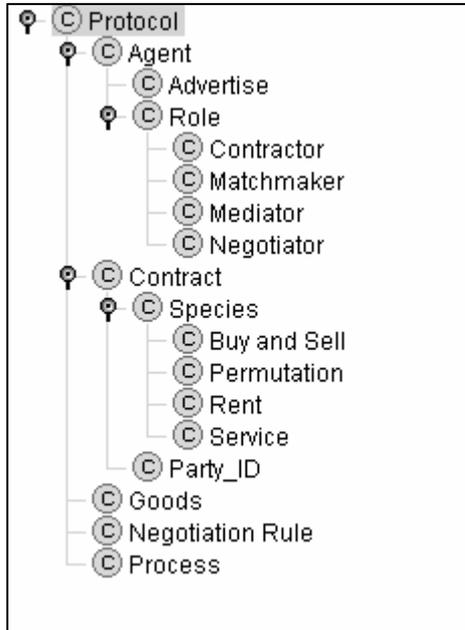


Figure 3: The Shared Protocol Ontology

A sequence of contractor’s actions is:

- 1) The negotiators that had closed an agreement should communicate this to contractor;
- 2) Contractor accesses the repository to take an appropriate template;
- 3) After, it requests the negotiation parameters from these negotiators;
- 4) When it had received, should validate it using the Protocol ontology already showed;
- 5) Then, it fills the template and stores it on the repository – now becoming a contract instance – to keep the evidence of transaction.

In Fulfillment phase, the contractor will produce a workflow based on parties’ obligations.

### 5 CONTRACT FULFILLMENT

Although the parties have compromised to each other, there is the possibility of contract breach.

Contract Fulfillment phase treats to verify the execution of obligations defined by parties. So, if a contracting part deviates from its prescribed behavior, - intentionally or not – some mechanism should be programmed to inform what kind of problem has occurred.

A contract can be seen as a kind of business process that usually defines deadlines dates to it execution, fact that made us apply one of execution

system technologies existents - Temporal Workflow - in conjunction with active rules to coordinate this

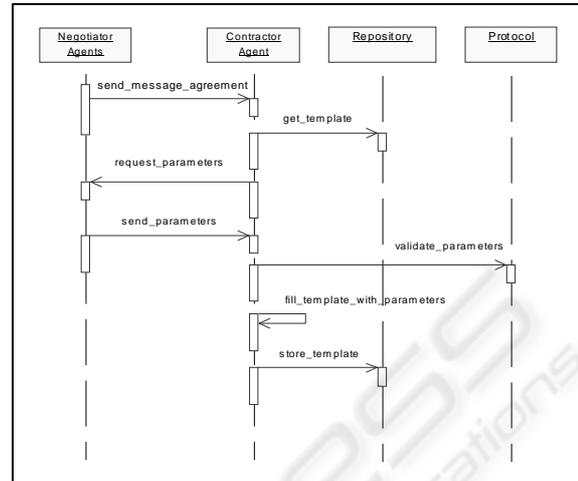


Figure 4: The Contractor Agent Scenario

whole process.

Temporal Workflow produces all the obligations and related activities that each party must fulfill, defining the start time, duration and finish time. This temporal model used is based on work in (Labidi, 2000). Active rules enable monitoring the obligation’s deadlines, based on finish time of each obligation and notify the agent to verify the status of next activity. This approach was adapted from (Kappel, 1998) work.

The results of the Fulfillment phase – performance or non-performance of obligations – will be returned to User Modelling phase. This fact helps to enrich the User Model through the reusing of these informations during a new modeling (Fonseca, 2003).

Fig. 5 shows an example of temporal workflow produced from a buy and sell contract.

### 6 CONCLUSION AND FUTURE WORKS

The fast growing of electronic commerce, mainly in B2B, requires a sophistication of its functionality. The applications of intelligent and mobile agents bring many advantages as personalized queries of consumers and business suppliers, real-time access from remote resources, lower computational cost and so on.

The contributions of ICS relative of ontologies proposed on some phases, permit sharing the knowledge about negotiation and contracting process between all agents that shall communicate.

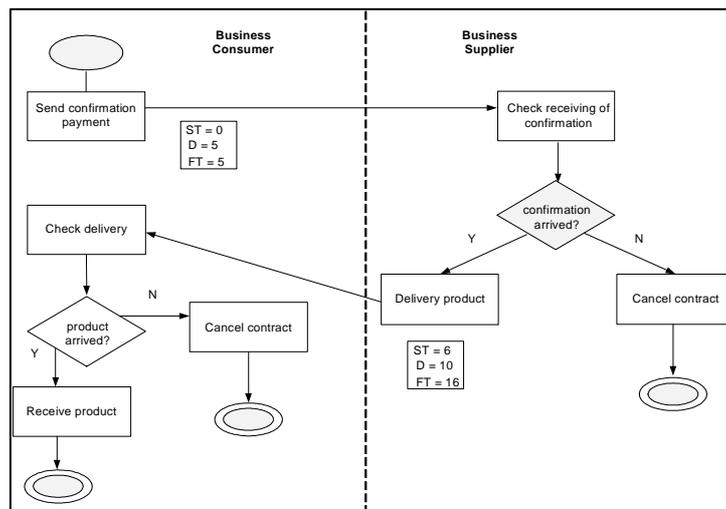


Figure 5: Example of Temporal Workflow

Contracts make any business more attractive. The fulfillment of obligations enforceable by law provides some guarantee that either it will be done or the legislation will carry out until the final resolution.

Future works in this area can include a feedback of contract filled to the users of ICS (companies) that had closed an agreement. This make that they can confirm if what did they negotiate is correct. This implies in adoption of infrastructure's supply security in transactions involving the transference of contract information. Issues like Cryptography and Digital Signatures must be considered in terms of Contract Formation's implementation.

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## APPENDIX: THE SIMPLE CONTRACT TEMPLATE MODELLED IN XML

```

<Contract>
  <Title>Contrato de Compra e Venda</Title>
  <Party_ID>
    <body>This private Agreement Promise of Buying and Selling which is done between (hereby
called The Seller) , located at here being represented according to the Social Contract, and on the other
side (The Buyer), located at here being represented according to the Social Contract have the following
agreement according to the clause and conditions below:</body>
    <name1/>
    <cod1/>
    <address1/>
    <name2/>
    <cod2/>
    <address2/>
  </Party_Identification>
  <Chapters>
    <ChapterI Name="Chapter I - Object">
      <ClauseI.I Name="First Clause">
        <body_cI.I>The seller is the legally onwer of the instrument which is being described
below:</body_cI.I>
        <object/>
      </ClauseI.I>
    </ChapterI>
    <ChapterII Name="Chapter II - The Amount and Way of Payment">
      <ClauseII.I Name="First Clause">
        <body_cII.I>On this selling and buying instrument and in the best way the seller
compromises to sell to buyer and this is compromises to buy form buyer the instrument above described
by the price of to be paid on the following conditions:
        </body_cII.I>
          <price/>
          <price_desc/>
          <paym_cond/>
        </ClauseII.I>
        <ClauseII.II Name="Second Clause">
          <body_cII.II>It is determined the equivalent fee to be applied in case of unjustified
delay applicable in the payment of remaining parcels paid by buyer to seller plus interests every month
and monetary update.</body_cII.II>
          <fee_value/>
          <fee_desc/>
          <interests_value/>
          <interests_desc/>
        </ClauseII.II>
      </ChapterII>
    <ChapterIII Name="Chapter III - Time of Delivery">
      <ClauseIII.I Name="First Clause">
        <body_cIII.I>The time of delivery has to be in , counted from the date of signature of
the agreement except in case of happening any disaster or inevitable actions.</body_cIII.I>
        <n_days/>
      </ClauseIII.I>
    </ChapterIII>
  </Chapters>

```

```

<ChapterIV Name="Chapter IV - Obligations">
  <ClauseIV.I Name="First Clause">
    <bodyc_IV.I>Obligations Seller:</bodyc_IV.I>
    <list_obligations1/>
  </ClauseIV.I>
  <ClauseIV.II Name="Second Clause">
    <bodyc_IV.II>Obligations Buyer:</bodyc_IV.II>
    <list_obligations2/>
  </ClauseIV.II>
</ChapterIV>
<ChapterV Name="Chapter V - Responsibilities">
  <ClauseV.I Name="First Clause">
    <bodyc_V.I>Responsibilities of Seller:</bodyc_V.I>
    <list_responsabilities1/>
  </ClauseV.I>
  <ClauseV.II Name="Second Clause">
    <bodyc_V.II>Responsibilities of Buyer:</bodyc_V.II>
    <list_responsabilities2/>
  </ClauseV.II>
</ChapterV>
</Chapters>
<Final>
  <body_dg>Is elected the Court of   to have all the registration and not any other one to be
questioned in case of any doubts about this agreement.
  Being this the agreement the parties below agree and sign this present instrument in 02 (two) copies of
equal form and pages in the presence of witness:</body_dg>
  <court/>
  <local/>
  <date/>
  <witness1/>
  <name_witness1/>
  <cod_witness1/>
  <witness2/>
  <name_witness2/>
  <cod_witness2/>
</Final>
</Contract>

```