

# Executable logic-based representation of contracts

(Position paper)

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# Contracts and Trust

- Contracts are a means to foster (well-founded) trust
- There is also trust in contract formation and execution
  
- iTrust implies some sort of automation

# Two key aspects

- **Contract drafting**
  - consistency checks ?
  - legal constraints ?
  - business objectives ?
- **Contract performance monitoring**
  - making contract inferences --- determine the **current contract state**
  - assessing the contract in terms of its **business utility**

# Institutions and e-Institutions

- **Institution**
  - regulated interactions
  - convention: 'institutional facts' vs 'brute facts'
  - procedures and protocols for creating and determining institutional facts
- **e-Institution**
  - computer realisation of the institution's procedures and protocols
  - artificial agents

**e-Institution = 'community'**  
(but without the emphasis on shared goals)

## ‘Building blocks’: one common suggestion ...

- obligation
- permission
- prohibition
- +
- assorted remarks about deontic logic
- +
- temporal
- +
- application specific concepts

# 'Building blocks':

- obligation
  - ~~permission~~
  - prohibition
- { but may be useful in (default) general  
rule + exception structures*

## 'Building blocks':

- obligation
- ~~permission~~  $\left\{ \begin{array}{l} \textit{but may be useful in (default) general} \\ \textit{rule + exception structures} \end{array} \right.$
- prohibition
- `power' (to create institutional facts/relations)

institutionalised  
power/competence  
(‘authority’)

permission  
to exercise  
this power

ability  
to exercise  
this power



# A formal characterisation

*Jones & Sergot 1996*

- 'power' is a special case:

$$\text{Pow}_x^s(F;A) = E_x A \stackrel{s}{\implies} E_x F$$

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- a modality for a kind of 'institutional belief'

$D^s A$  it is a constraint of institution  $s$  that  $A$   
it is a communal belief of institution  $s$  that  $A$

$$A \xRightarrow{s} B \rightarrow D^s(A \rightarrow B)$$

(Other details omitted)

## *The United Nations Convention on Contracts for the International Sale of Goods (1980)*

**Article 31** If the seller is not bound to deliver the goods at any other particular place, his obligation to deliver consists:

- (a) If the contract of sale involves carriage of the goods, in handing the goods over to the first carrier for transmission to the buyer;
- (b) ...

# *The United Nations Convention on Contracts for the International Sale of Goods (1980)*

## **Article 15**

- (1) An offer becomes effective when it reaches the offeree.
- (2) An offer, even if it is irrevocable, may be withdrawn if the withdrawal reaches the offeree before or at the same time as the offer.

## **Article 63**

- (1) The seller may fix an additional period of time of reasonable length for performance of the buyer of his obligation.
- (2) ...

# *The United Nations Convention on Contracts for the International Sale of Goods (1980)*

## **Article 64**

- (1) The seller may declare the contract avoided:
  - (a) if ..., or
  - (b) if the buyer does not, within the additional period of time fixed by the seller in accordance with paragraph (1) of article 63, perform his obligation to pay the price ... or if he declares that he will not do so within the period so fixed.
  
- (2) ...

# 'Building blocks'

- obligation
- ~~permission~~  $\left\{ \begin{array}{l} \textit{but may be useful in (default) general} \\ \textit{rule + exception structures} \end{array} \right.$
- prohibition
- 'power' (to create institutional facts/relations)  
usually also procedure/protocol  
+ (implicit) permission (or right) to execute
- 'counts as'  
+
- entitlement (of  $x$  to resource  $\alpha$  controlled by  $y$ )
  - power of  $x$  to create an obligation on  $y$  to provide  $\alpha$
  - procedure/protocol by which one claims+
- application specific concepts  
+
- temporal component: event calculus (or  $EC+$ )

# Service Level Agreements for Utility Computing

Andrew Farrell, MSc student, summer 2003

(at Hewlett-Packard Labs, Bristol)

## Case studies

- mail service SLA
- rendering service SLA
- hosting service SLA
- +
- standard buyer-seller contract protocol
- +
- *(a set of norms that was not a contract)*

# Informal drafting language (Farrell)

- Initial contract state
- Service provision clauses (Service-level objectives)
- Obligations
- Privileges
- Powers } *not used*
- Counting globals
- Contract parameters
- State declarations
- Contract management clauses
- +
- Event calculus

Sometimes a **very simple** representation scheme is sufficient.

# Current work

- Development of the language  $(C/C+)^{++}$ 
  - extensions of the action language  $(C/C+)$   
(Giunchiglia, Lee, Lifschitz, McCain, Turner)
- Development of  $(EC+)$ 
  - $(C/C+)$  with event calculus style processing of narratives
- Model checking techniques
- Applications
  - to specification and implementation of  
**e-institutions** ('communities')  
not just contracts