

# Contracts in the Swedish Crisis Management System

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# Presentation

- Swedish Crisis Management System
- Examples of Contracts and Operations
- Challenges, Problems and Approach
- Contracts for Controlling Business Processes in Dynamic Environments (Björn Bjurling, Pablo Giambiagi 2008)
  - Contract Language
  - High Level Petri Nets as a model for contracts
  - Interpretation of contracts

# Project

- Contracts for shared limited resources in Crises
- Swedish Emergency Management Agency
  - 2007 to 2009
- Collaboration with Swedish Agencies
- SICS: Applied research in Computer Science
  - applying rights management to civil security area

# Swedish Crisis Management System

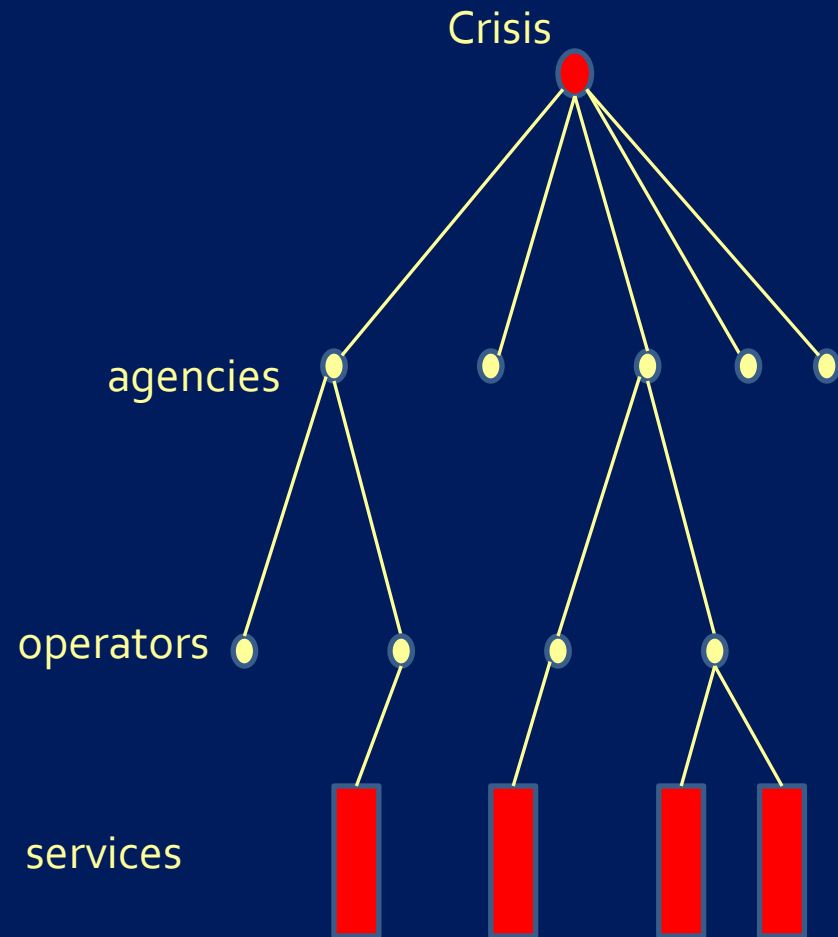
- Crisis:
  - Unexpected, requires immediate action
  - Affects many citizens and fundamental societal functions
  - Extreme Stress on Resources
  - Threatens fundamental values
  - E.g. Natural disasters, Invasion, Accidents, Pandemics
- Crises can be Local, Regional, or National
  - or International

# Swedish Crisis Management System

- Areas of coordination
  - Transport, Toxics, Protection & Rescue, ...
- Responsible agencies
  - E.g., Protection and Rescue
    - National Police Board
    - Aviation Authorities
    - Coast Guard
    - Rescue Services
    - Customs
    - National Medical Board

# Swedish Crisis Management System

- Decentralized Crisis Management
  - government appoints agencies,
  - which in turn appoint resource and service providers
- The responsibility for the critical services are distributed among independent actors
  - Resources and capabilities
  - Planning
- Swedish crisis management relies to a great extent on independently made agreements
- Can this go wrong?
  - Yes, sometimes:
    - Lack of resource sharing agreements (e.g. the storm Gudrun 2005)
    - Delay in activating a resource (Tsunami 2004)
    - Difficulty in interpretation of contracts (Gothenburg 1995)



# Challenges

- Trend towards outsourcing and collaboration
- Resource usage management
  - resource modelling
  - usage modelling
- Dynamic gearing-up of a crisis
  - mandate issues
  - Bridging the gap between central planning and service execution
  - Flexible organisations
    - orchestrations and choreographies
- Analysis of sets of contracts

# Problem Formulation

- How can we know that a set of independent agreements form an adequate crisis management capability?
  - Can required resources be activated (supply, mandate, know-how)?
  - Can conflicts arise among resource users?
  - Is there a need for appointing more resources or capabilities?
- How extend access rights to usage rights for controlling crisis engagements?



# Approach

- *Main assumptions*: a set of agreements implicitly encodes a workflow representation of the Swedish crisis management. The workflow can be controlled through contracts.
- *Approach*: we want to make that workflow explicit by
  - Formalizing the contracts used in crisis management
  - Translating the contracts into a workflow formalism, (we have used High Level Petri Nets)
  - Using HLPN techniques to analyse the workflow model
- *Question*: does a given set of contracts yield an adequate crisis management capability?

# Contracts (what to capture)

- Subjects are appointed to provide a resource or a capability for the completion of a service.  
Subject to
  - Time constraints
  - Resource usage constraints
- A subject has a given capacity w.r.t resources or capabilities
  - abstract measures for simplicity

# Contract Language

- Sorted first order fragment, with subjects, services, resources, capabilities, time points, and measures as constant symbols.
- Function symbols:
  - begin, end (svc  $\rightarrow$  time)
  - appointed (svc X rcs  $\rightarrow$  subject)
  - requires, returns (svc X rcs  $\rightarrow$  measure)
  - capacity (subject X rcs  $\rightarrow$  measure)
- operators and binary relations on the real and the natural numbers.

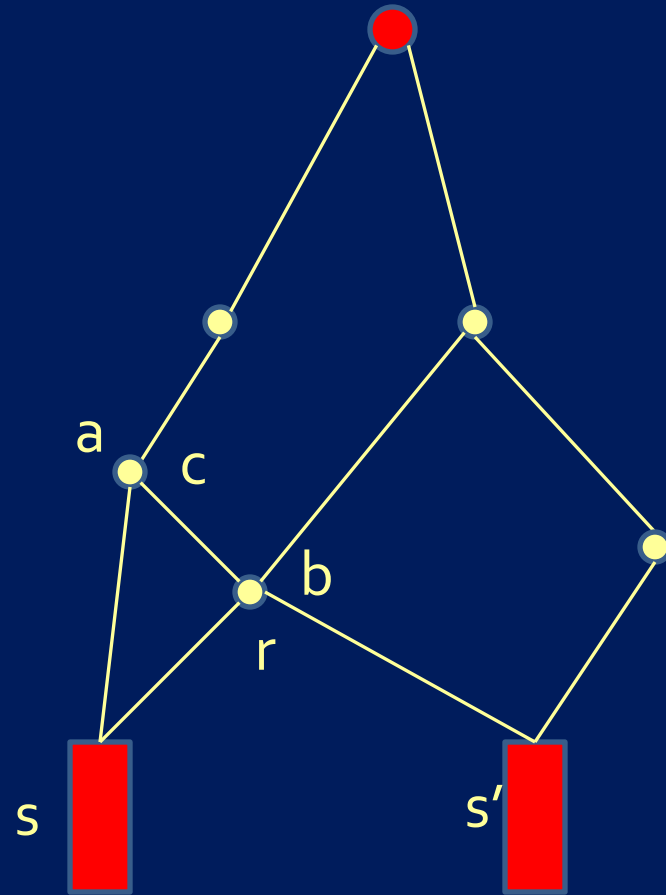
# Contract examples

- $s.\text{appointed}(c) = a$
- $s.\text{requires}(c) = 10, \quad s.\text{returns}(c) = 10$
- $s.\text{requires}(r) = 4, \quad r.\text{returns}(r) = 0$
- $s.\text{begin} > s'.\text{end}$
- $s.\text{end} < t1.$
- A contract is a set of contract formulas, where exactly one is an appointment formula.
- A crisis management plan is the union of a set of contracts.

# Formalization

s.appointed(c) = a  
s.requires(c) = 10,  
s.returns(c) = 10  
s.begin > s'.end  
s.end < t1.

s.appointed(r) = b  
s.requires(r) = 4  
r.returns(r) = 0



# Example

- $A.\text{capacity}(r) = 10$
- $C_1 = \{ s_1.\text{app}(r) = A, s_1.\text{req}(r) = 5, s_1.\text{ret}(r) = 5 \}$
- $C_2 = \{ s_2.\text{app}(r) = A, s_2.\text{req}(r) = 7, s_2.\text{ret}(r) = 0, H \}$
- where  $H$  is a contract formula
  - $H = s_1.\text{end} < s_2.\text{begin}$  (OK for  $A$ )
  - $H = s_2.\text{end} < s_1.\text{begin}$  (not OK for  $A$ )
  - $H$  is neither of the two above. (potentially not OK for  $A$ , since  $s_1$  and  $s_2$  may run in parallel)

# Conclusion and Future Work

- Applied research in a real and active application domain
- Seems to be an interesting area for contracts research
- Main Problem: does a set of agreements about appointments, resources, and capabilities form an adequate crisis management capability
  - formalizing the problem in terms of contracts
  - extracting workflows from sets of agreements
- Future Work:
  - Field studies with Swedish agencies
  - Extending the language (and the semantics)