

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

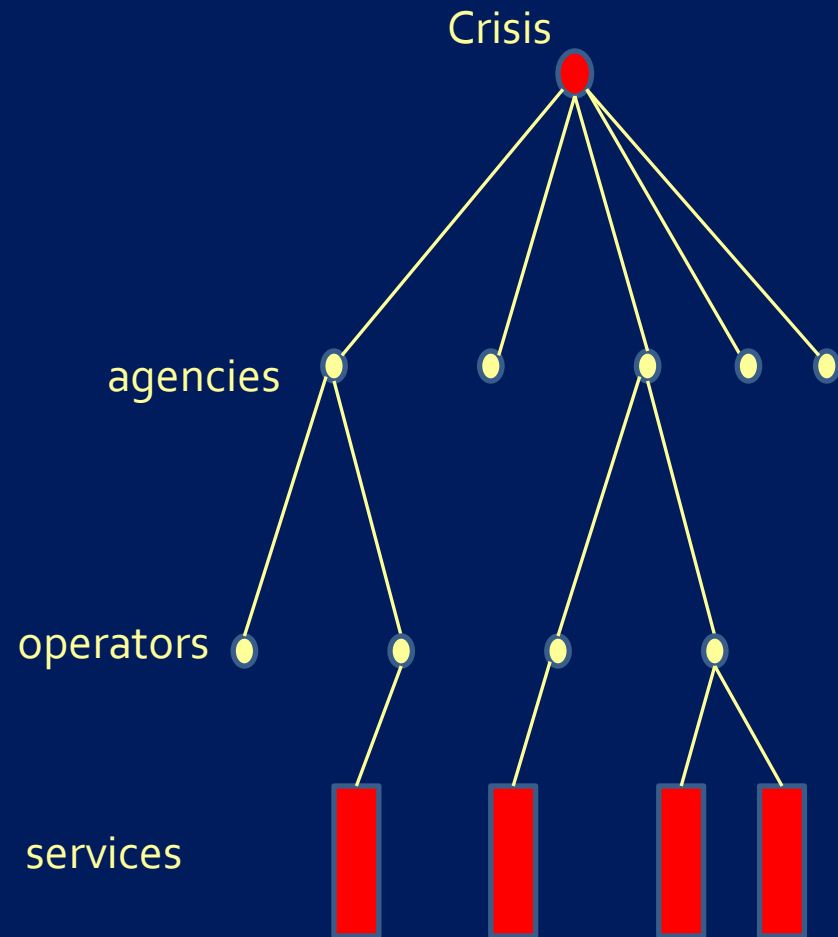
- Crisis:
 - Unexpected, requires immediate action
 - Affects many citizens and fundamental societal functions
 - Extreme Stress on Resources
 - Threatens fundamental values
 - E.g. Natural disasters, Invasion, Accidents, Pandemics
- Crises can be Local, Regional, or National
 - or International

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.

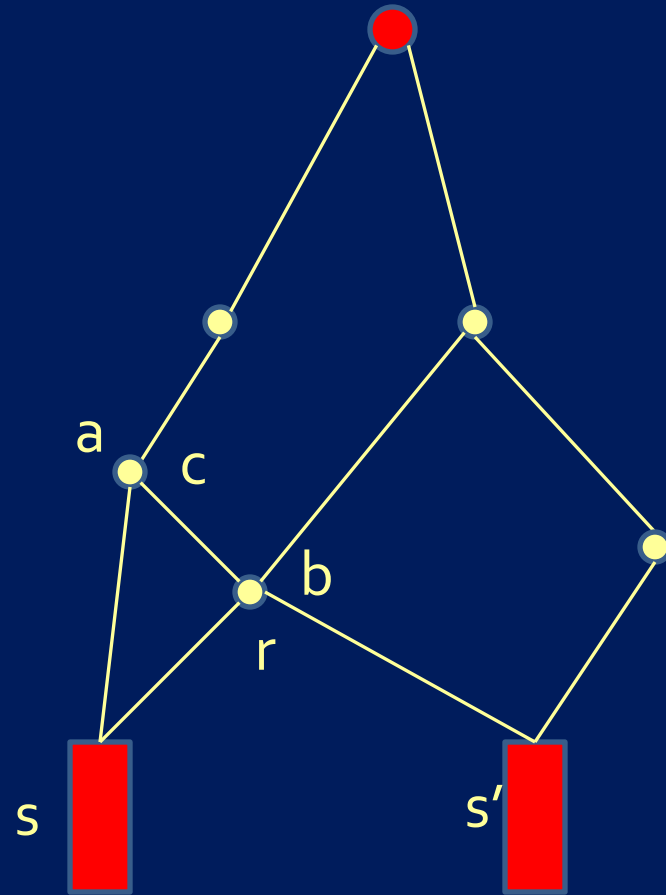
Contract examples

- $s.\text{appointed}(c) = a$
- $s.\text{requires}(c) = 10, \quad s.\text{returns}(c) = 10$
- $s.\text{requires}(r) = 4, \quad r.\text{returns}(r) = 0$
- $s.\text{begin} > s'.\text{end}$
- $s.\text{end} < t1.$
- 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

- $A.capacity(r) = 10$
- $C_1 = \{ s1.app(r) = A, s1.req(r) = 5, s1.ret(r) = 5 \}$
- $C_2 = \{ s2.app(r) = A, s2.req(r) = 7, s2.ret(r) = 0, H \}$
- where H is a contract formula
 - $H = s1.end < s2.begin$ (OK for A)
 - $H = s2.end < s1.begin$ (not OK for A)
 - H is neither of the two above. (potentially not OK for A , since $s1$ and $s2$ 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)