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A Formal Specification for Organizational Adaptation

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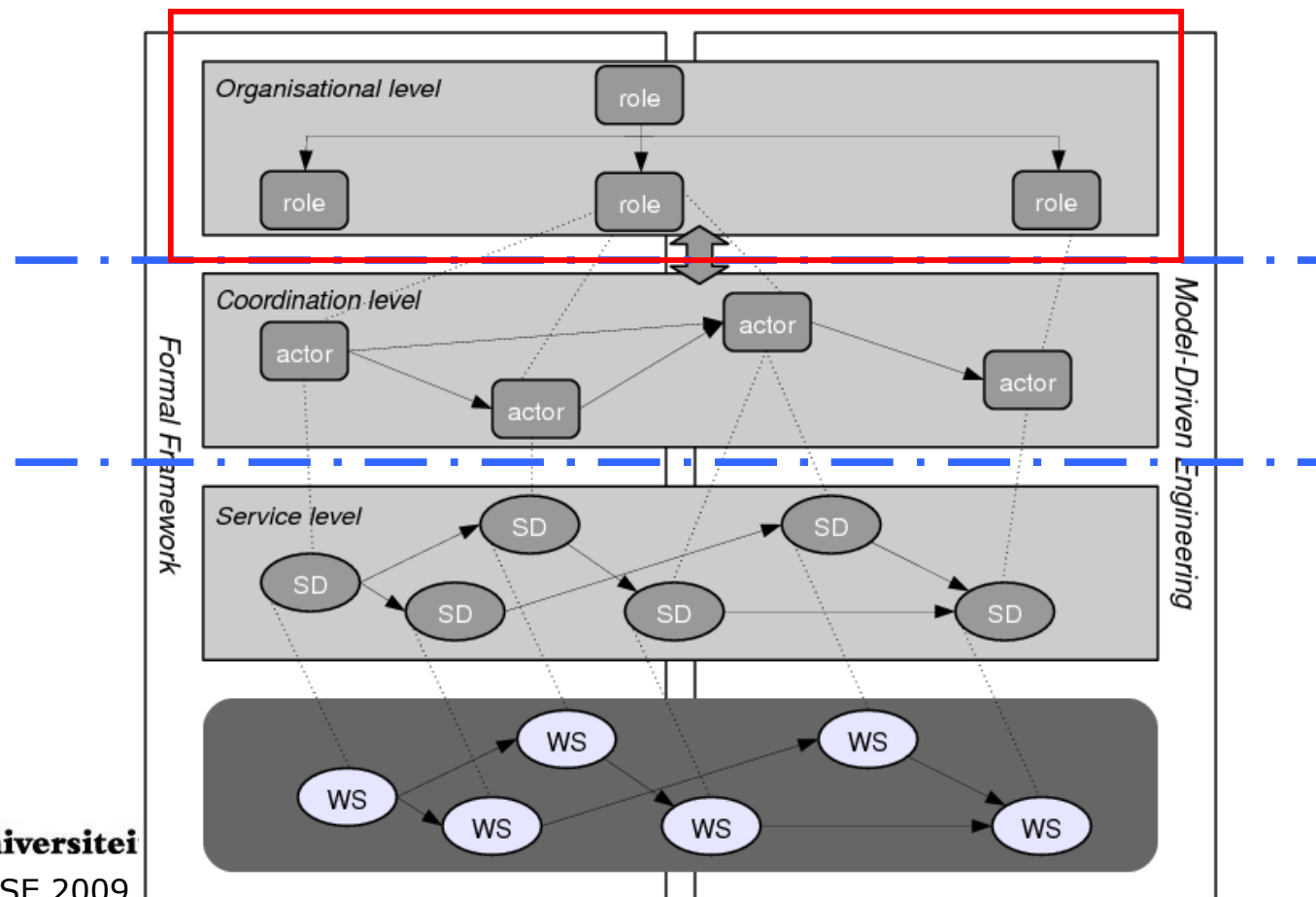
a join work with
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General Aim

As a partner in the EU FP7 **ALIVE** project, we aim at contributing to its objectives achievement. In particular, we focus on how to characterize the adaptivity at organizational level.



Objectives

- Study how different types of context changes require/force the Organization to adapt. Principal causes of context dynamicity:

changes of stakeholder needs:

e.g., changes in laws and norms that regiment particular organizational protocols and responsibilities;

changes of environmental conditions:

e.g., changes as sensed symptoms that can lead to potential failures during objective achievement;

changes of system functionalities:

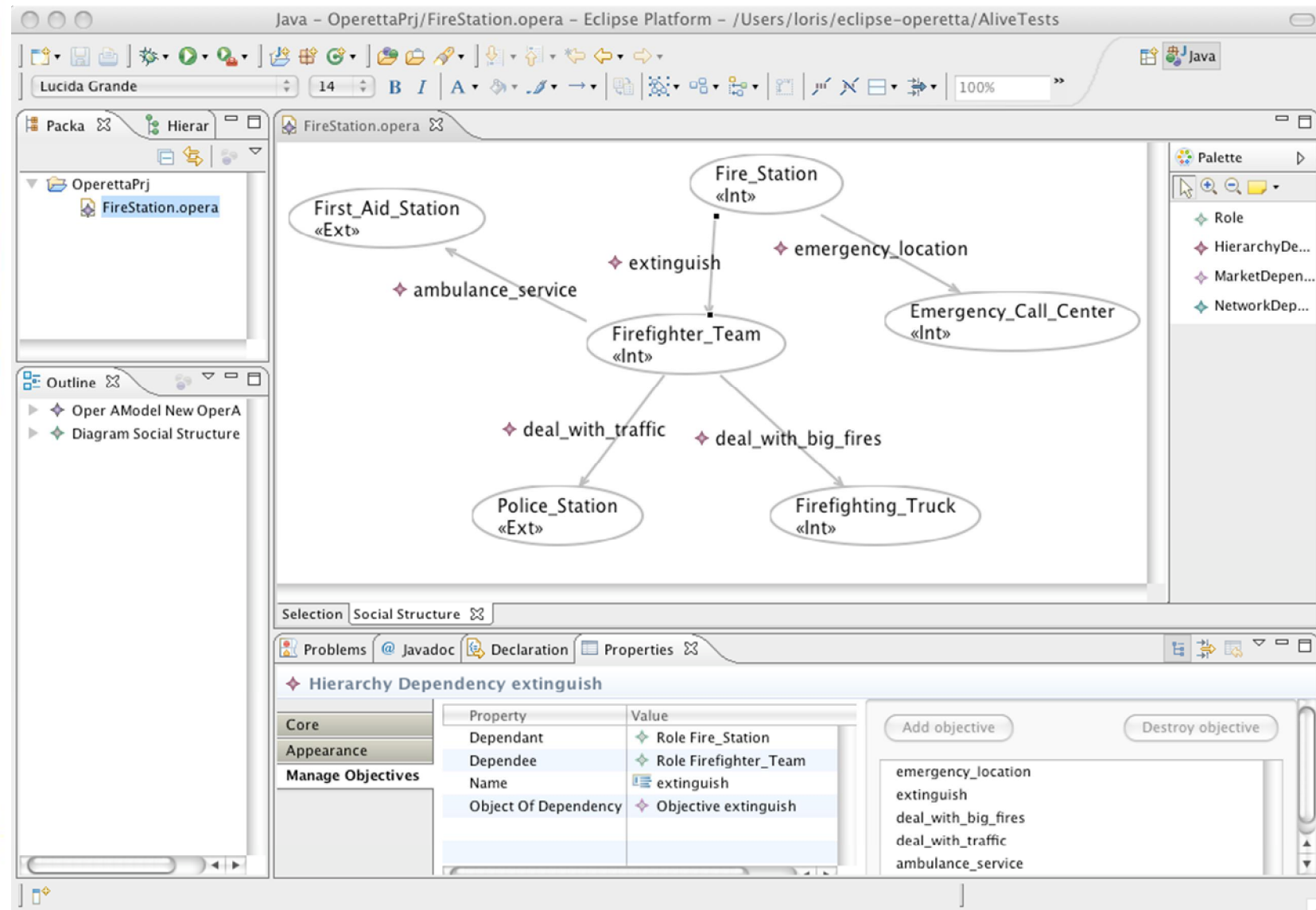
e.g., services that became unavailable or are not correctly used.

- Provide a formal framework to characterize possible kinds of adaptation within organizational structures.



A Crisis Management Scenario

Modelling the Organization's Social Structure by OperA:



When does Organizational Adaptation come to play?



Example Scenario:

While Firefighter_Team (ft) is going towards the accident location, a huge traffic jam hampers the faster ways to reach the accident location and alternative ways make risky the achievement of the objective (extinguish_fire) because of the limited fuel in the car-tank.

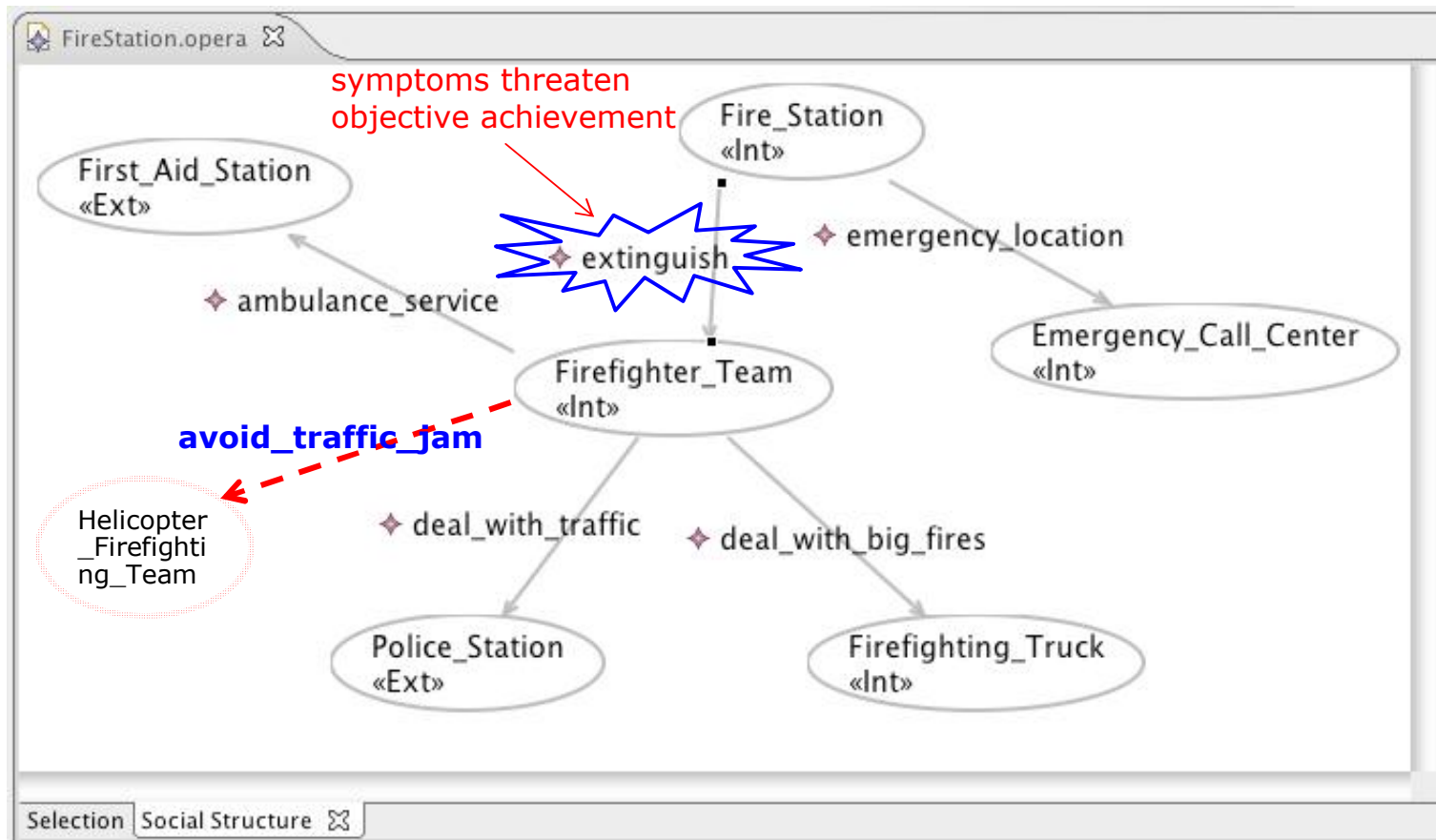
The car's onboard computer has already (autonomously) checked with the Fire_Station (fs) that no other available cars and trucks are there. There is only the Helicopter_Firefighting_Team (hft), ready to take off.



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Adaptation at Structural Level (example)



How do we specify dynamic information needed for defining the organizational adaptation process?

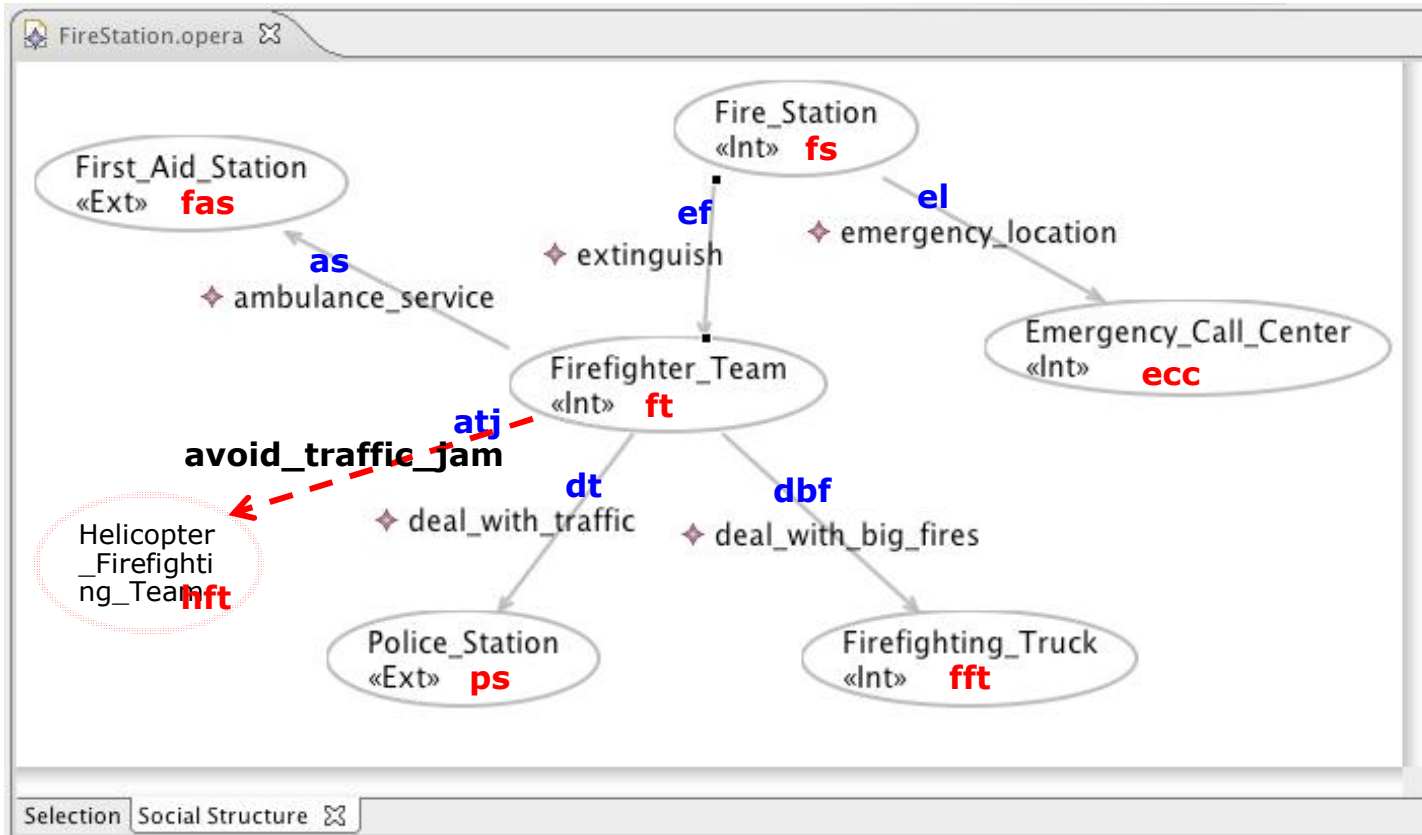
Towards a Formal Specification

The formal model is based on the Logic for Agent Organizations (LAO) [Dignum]. It extends from the semantics of CTL*, distinguishing between path and state formulas.

In LAO, organization's assets are based on the agents' skills (reflecting roles' expertise) required to fulfill objectives of organizational roles.



Adaptation in the Structural Dimension



$$O = \{A_O, D_O, \leq_O, S_O\}$$

$$A_O = \{fs, ft, ecc, fas, ps, fft\}$$

$$\longleftarrow \text{staff}^+(O, hft)$$

$$D_O = \{el, ef, dt, dbf, as\}$$

$$\longleftarrow \text{strateg}^+(O, atj)$$

$$\leq_O = \{fs \leq_O ecc, fs \leq_O ft, ft \leq_O fft, \dots\}$$

$$\longleftarrow \text{struct}^+(O, ft \leq_O hft)$$



Adaptation in the Strategic Dimension



$$\mathbf{O} = \{\mathbf{A}_O, \mathbf{D}_O, \leq_O, \mathbf{S}_O\}$$

\mathbf{S}_O : is the set of organizational assets in terms of agents' skills to effectively deal with the organization's objectives.

The formal model defines different agent's skills: *Capability* ($C_a \phi$), *Ability* ($G_a \phi$), *Attempt* ($H_a \phi$), *Responsibility* ($R_a \phi$) and *Activity* ($E_a \phi$) where $a \sqsubseteq A_O$ and $\phi \sqsubseteq D_O$.

Therefore, an organization may have several strategies $\{s_1, \dots, s_n\}$ to fulfill its objectives. Besides a strategy (s_i) is a composition of agents' skills of the organization.

Ex. A strategy (s_i) for the objective *extinguish* ($ef = rp \wedge le$):

$$s_i: R_{ft} rp \wedge R_{fs} H_{ft} le \xrightarrow{\text{adaptation}} s'_i: R_{ft} H_{hft} rp \wedge R_{fs} H_{ft} le$$



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Conclusions

This work contribution is twofold:

- To study and to describe the adaptation process within organization structures by exploiting the conceptual models of the OperA methodology (i.e., OperettA's diagrams and formal annotations).
- To provide a formal model based on CTL* temporal logic (LAO) to characterize the adaptation process also from a dynamic dimension.

