

FRONTS Foundations of Adaptive Networked Societies of Tiny Artefacts (215270)

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Our concept and main objective

The aim of this project is to establish the foundations of adaptive networked societies of small or tiny heterogeneous artefacts. We expect that most such systems will have the form of a large society of networked artefacts. We intend to develop an understanding of such societies that will enable us to establish their fundamental properties and laws, as well as their inherent trade-offs.

- We will provide constructive (algorithmic) distributed adaptation techniques.
- We will provide laws on the effect of adaptation on the system performance, cost of distributed coordination of adaptation, incurred overhead (in terms of communication, energy) and possible trade-offs.
- We will investigate limits of adaptation (how much to adapt, how long to adapt) and cases where adaptation is impossible.
- We will test our theoretical insights in practical scenarios by means of simulations and experiments.

The scientific and technological objectives

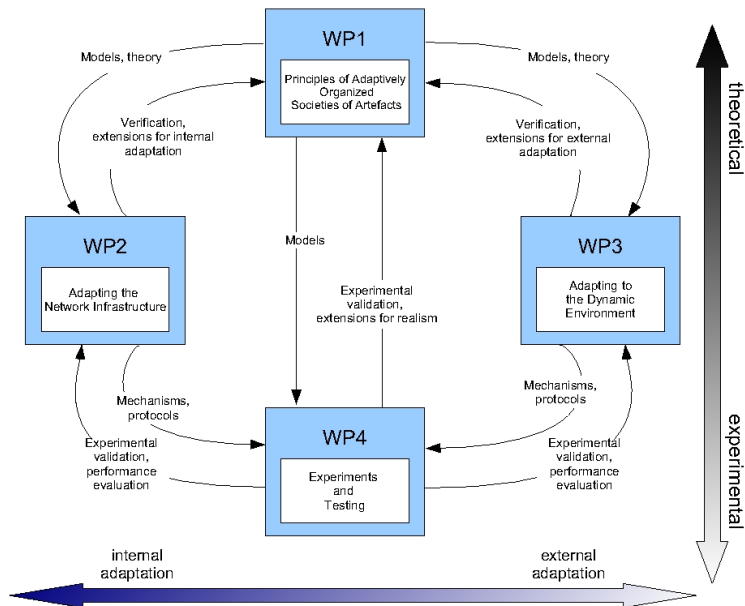
The ability of networked societies of small artefacts to adapt is composed of two almost orthogonal dimensions:

- The ability for internal continual self-organizational of the network.
 - We will characterize the network awareness of components and adaptability to the needs and to changes in the environment and in the operating conditions.
 - We will investigate the necessary technical requirements for the network to be always able to adapt (i.e. be ready).
 - We will examine how fast it responds (in real time) to track variations in the operation of the network.
 - We will investigate the influence on the performance of the network as the individual entities are adapting (how long does it take to reach a “steady state”).
- The ability to adapt to environmental changes in a dynamic way.
 - We will investigate the ability to adapt in cases of alerts.
 - We will provide rules to prioritize the environmental changes (characterization of changes as major/critical where adaptation is needed, provide some thresholds).

The importance of our objectives

- Establishing a science of adaptive organization of large nets of small or tiny artefacts will allow researchers to use our models, laws and fundamental properties in order to further investigate the operation of such systems in particular cases, specific to real application scenarios.
- System designers and solution developers will be able to apply the fundamental principles during the design process in order to investigate the performance of the systems under development and better understand the inherent trade-offs of the resulting network.
- We will provide mechanisms that can be used directly to ensure the adaptiveness, self-stabilization and self-organization design criteria or they can be integrated as part of larger systems in order to deal with specific problems.
- We foresee a future contribution to embedded systems design.
- System developers of Future Open Systems (e.g., robotic systems) will be able to better understand the ability of systems to achieve particular goals, given the actual conditions of the environment.

The work packages and their relation



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The most fundamental question here is: *is there a single, unifying, abstract model for such adapting, massive nets of tiny artefacts, that can explain their emergent behavior ?*

- Our objective is to create a unifying framework for adaptive networks.
- We apply an iterative research & development process that employs three iterations (one per year of FRONTS).

