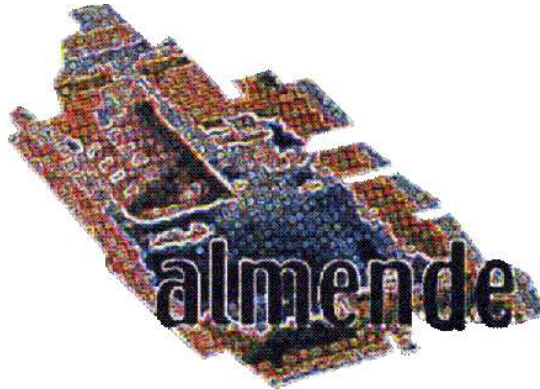


Future Internet PPP - Second Usage Area Workshop

Position Paper



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Who we are

Almende is a research company specialized in information communication technologies, mechanisms and networks which support *self-organization* within so-called *hybrid agent networks*: humans and computers working together in one system.

Software agents form the Almende heart of *organizing networks*. Agents ideally allow for bottom-up modeling of actors and organizations. Be it humans in *networks of people*, things in *networks of entities*, or states of the world within *sensor networks*.

Almende's principal activities include fundamental and applied research. Participation in European and national research projects enable Almende to investigate feedback, escalation and (dynamic) learning mechanisms using an in-house developed multi-agent platform called *CHAP* (Common Hybrid Agent Platform).

Newly acquired multi-agent technologies from fundamental research are implemented in applied research projects. Validation and extending of these technologies in the practice of different domains (e.g. logistics, health care, and security) in cooperation with experts from the field is crucial.

Spin-offs as part of Almende Investments are created once technologies have proven their functionality and value in practice. A maximum synergy between Almende and the spin-off is achieved: spin-offs focus on tailoring and improving the practical

specifications of its application for customers, and Almende focuses on the research aspects of its application.

Information and communication technology, especially multi-agent technology, can be used to organize networks. We explore the fundamentals of self-organization and ways to incorporate them into the following networks:

- Networks of people: Agents can communicate much faster and with more others than humans can. We use agents to take care of highly frequent and dynamic communication to support human organizations. Agents adapt based on human interaction.
- Networks of entities: We investigate how distributed coordination can be used to support organizations in last-minute planning and scheduling. Trucks and packages are represented by software-agents and they negotiate to provide an effective solution.
- Sensor networks: The challenge is to develop ways to introduce learning / conditioning in the sensor network to create a dynamic filtering and escalation system that triggers reaction when necessary.

Underlying the research, we have developed a technology platform called CHAP: Common Hybrid Agent Platform. The goal is to provide a rich base architecture for building adaptive distributed systems comprising both artificial entities and human actors.

What we contribute

Crucial in the development of the future internet is that we take a *holistic* perspective on society, society-supporting applications, services and infrastructure. The future internet is not something that can be completely designed in advance: it will be the emergent outcome of an inherently distributed and heterogeneous integration process without any central management. The adoption of a *meta-design* by means of integrating *learning and escalation mechanisms* at all technological levels is necessary in order to let *the technology take certain design decisions* – decisions which heavily depend on an unknown future context to be made by engineers in advance. This is where Almende can contribute to the development of the future internet.

Our contribution includes, but is not limited to:

- experience with the development of *hybrid multi-agent systems*, in which e.g. feedback loops are used to allow application services to adapt to specific user contexts, and escalation mechanisms are incorporated to let services support unforeseen use cases.
- knowledge of concepts of *self-organization* and their application in a variety of fields including distributed service development, communication platforms, virtualization technologies, energy-aware hardware management, wireless sensor networks, embedded devices, etc.
- a broad research experience with the application of self-organization concepts in various past and current European and Dutch research projects, like Credo (FP6), Replicator (FP7), Fit4Green (FP7), and Metaverse (ITEA2).