Ao Dai :
Agent OrienteD Ambient Intelligence

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- AmI
- Context-awareness
- Agents
- CLAIM
- Agentification
- Interaction
- Anticipation
- Ontologies
- Conclusion
- Demo

Ao Dai : Agent OrienteD Ambient Intelligence

overview

Ambient intelligence is a ubiquitous electronic environment that supports people in their daily tasks, in a proactive, but invisible and non-intrusive manner.

[Ramos et al., 2008, Weiser, 1993]

Ambient Intelligence

Example scenarios:

The large screen can be used to display context-aware advertisements...

Ambient Intelligence

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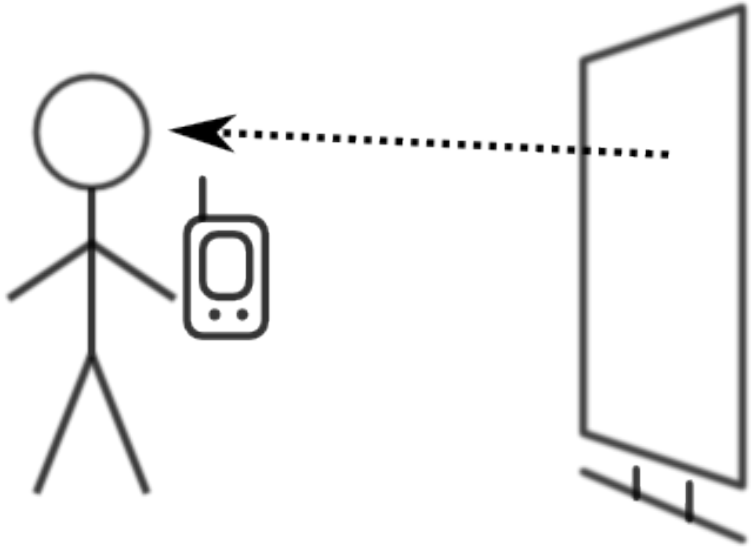
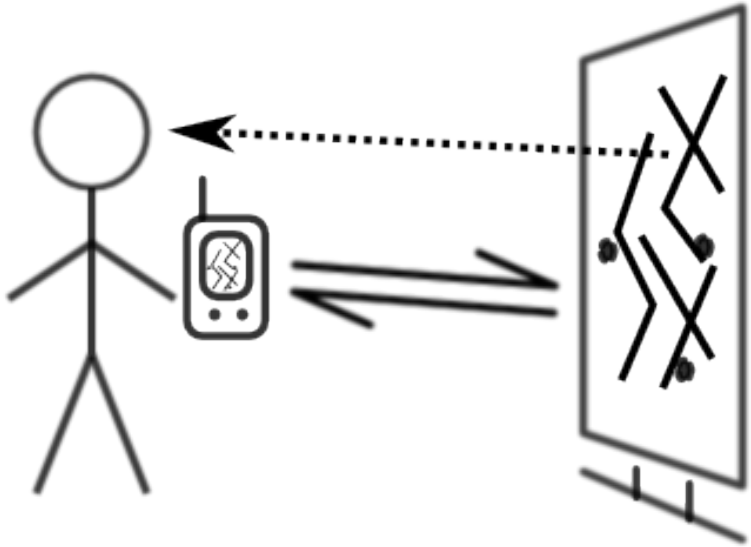
Example scenarios:



...or to draw attention of the user...

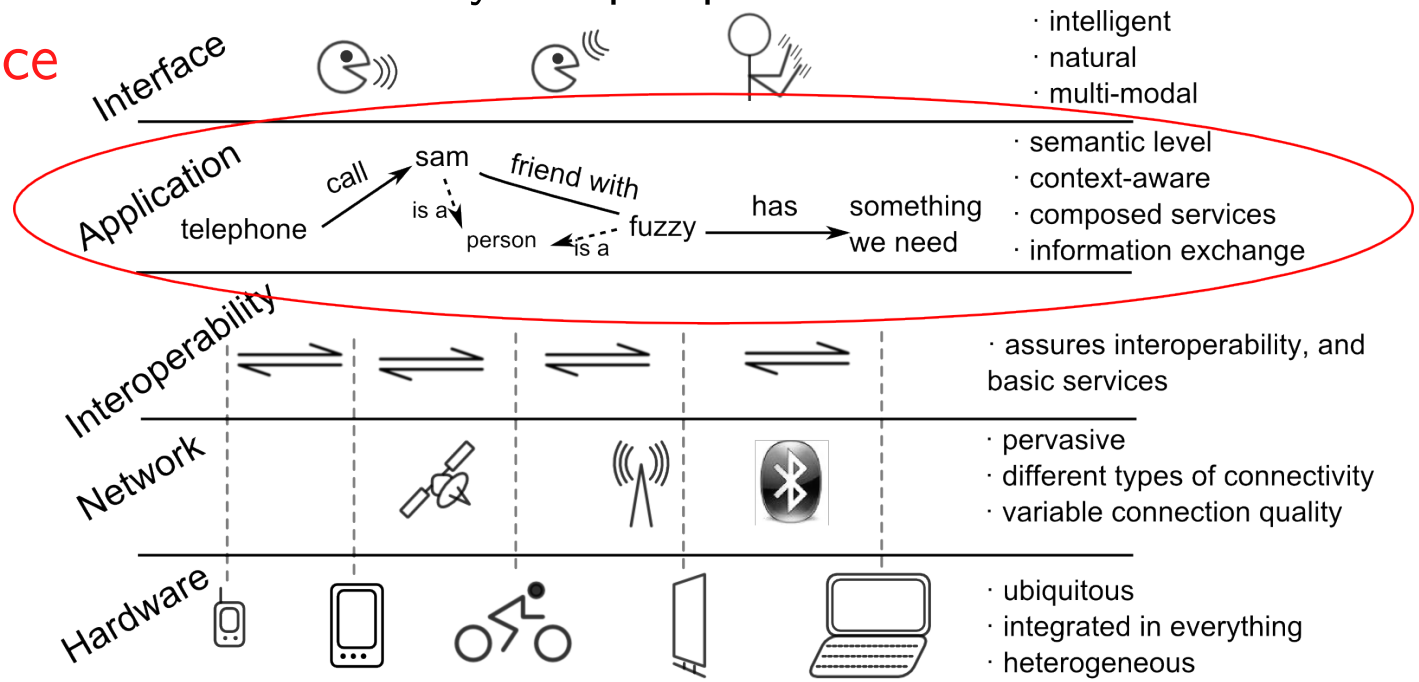
Ambient Intelligence

Example scenarios:



...to show an interactive map for which the mobile phone is too small [Canut et al., 2009]...

A layered perspective on AmI



[Seghrouchni, 2008]

The applicative (or "intelligent") layer can use AI methods and techniques like software agents and ontologies.

[Ramos et al., 2008].

Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves. [Dey and Abowd, 2000]

Aspects: [Chen and Kotz, 2000]

- physical aspect (location, conditions)
- temporal aspect
- user profile and preferences
- social aspect
- computing resources
- activity
- associations (e.g. time – place – activity) [Henricksen et al., 2002]

Relevance of new information is related to its compatibility with the user's context.

· can be considered as a measure of proximity in space, time, activity, social relations, preferences and available resources.

In the Ao Dai project, we have so far considered:

- the spatial location of the user
- the user's preferences
- the available computing resources

Software agents are an appropriate implementation for AmI, considering they satisfy the needs of AmI in terms of:

- reactivity
- proactivity
- autonomy
- anticipation
- reasoning

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For Ao Dai, we use CLAIM + Sympa as agent-oriented programming language and platform.

· Agent-Oriented programming language

- Created by Alexandru Suna, during his Thesis in Paris 6 [Suna and El Fallah Seghrouchni, 2007]

· Eases the programming task involving a Multi-Agent System

· Objectives

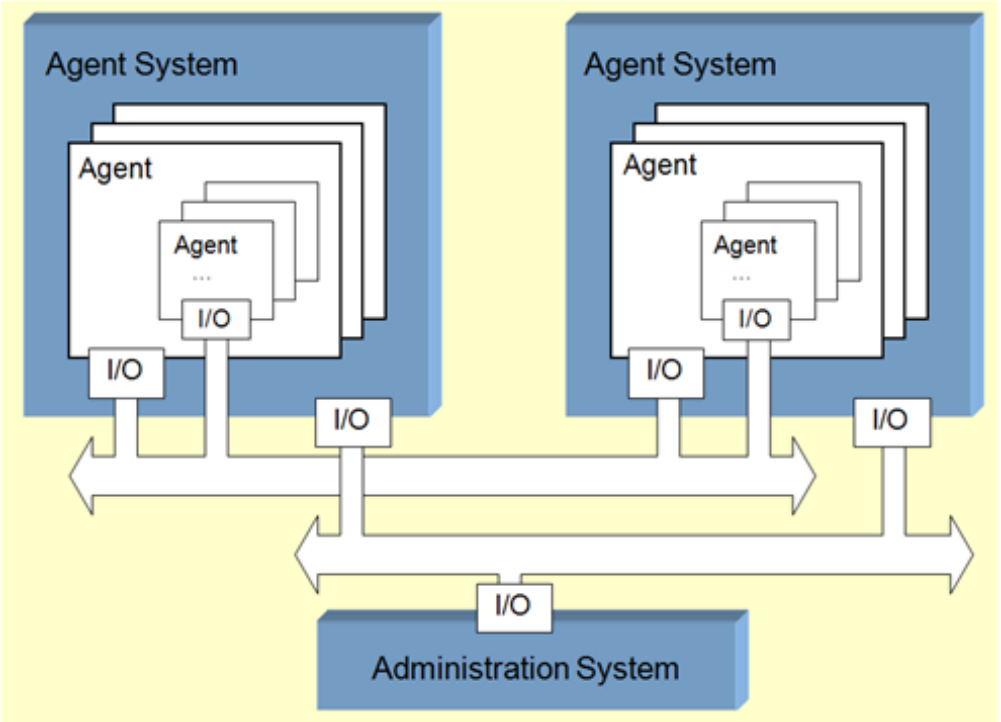
- Intelligence, Communication and Mobility
- Network Distribution and Adaptability
- Possibility of a Formal Verification

CLAIM is based on explicit declaration of agent's characteristics:

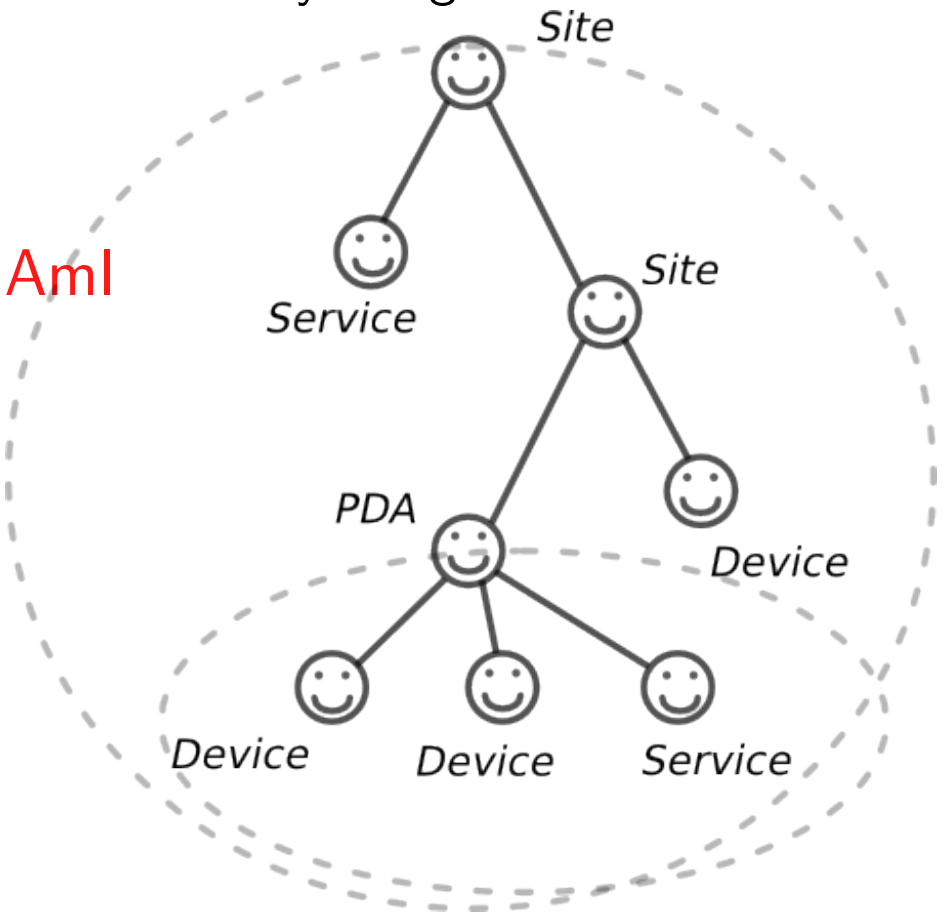
- Capabilities
- Procedures
  - Conditions
  - Triggers
  - ...

```
defineAgentClass className(?v1, ?v2, ..., ?vn) {
        authority = null | authority ;
        parent = null | agentName ;
        knowledge = null ;| {knowledge1; ...; knowledgek}
        goals = null ;| {goal1; ... ; goalg}
        messages = null ; {qMessage1; ... ; qMessagem}
        capabilities = null ; {capability1 ... capabilityc}
        agents = null ; | {agName1, agName2, ..., agNamea}
        effects = null ; | {effect1, effect2, ..., effecte}
}
```

Works on top of a Java layer, giving direct access to Java resources if needed

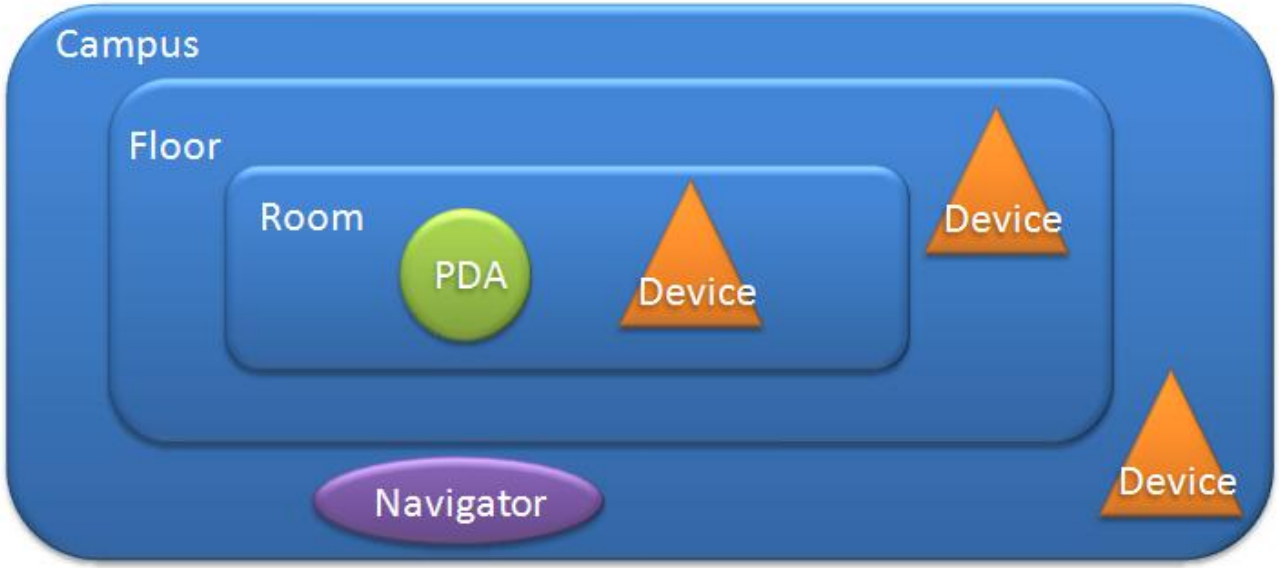


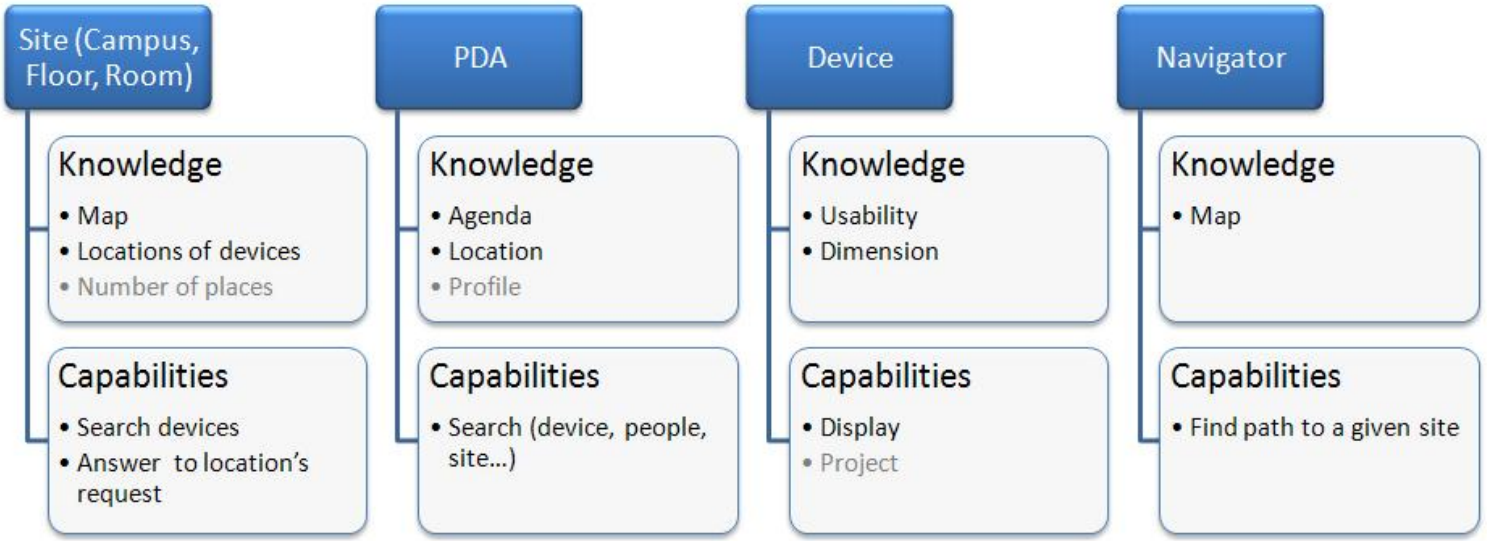
Model context-awareness in terms of location and resources as a hierarchy of agents.



An agent for each site, PDA, and device.

· 4 types of agents:

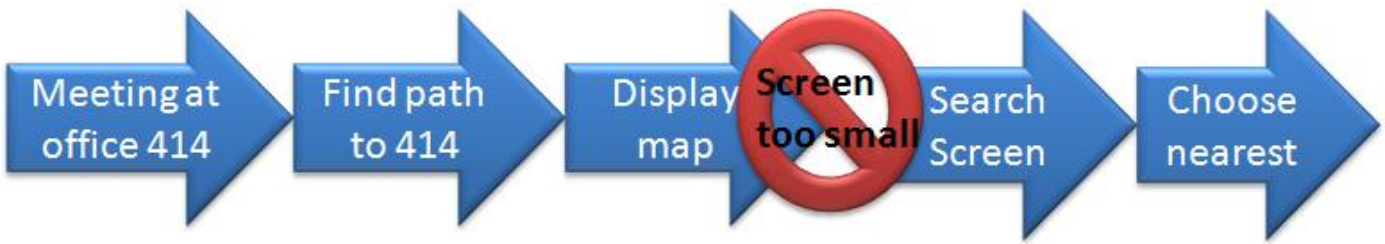




Agent PDA

- Actions are based in agenda of user and context.
  - Context: position of user, status of environment, ...
- Capability: search for device
  - Can search by capability and by criteria created by its own, according to task and context

Example:



Agent Agenda (sub-agent of PDA):

- Reads agenda of user (stored in PDA)
- Extracts tasks
- Activates tasks in PDA agent when it's time

Example:

thu 17/6/2010, 10:00-11h:00 meeting at room 414; 14:00-17:00 course at room 418

· 2 tasks: (meeting,10:00,room 414), (course, 14:00,room 418)

· At 10:00, agenda will inform PDA to activate the action correspond with task "meeting" (find path to room 418)

Agent Site

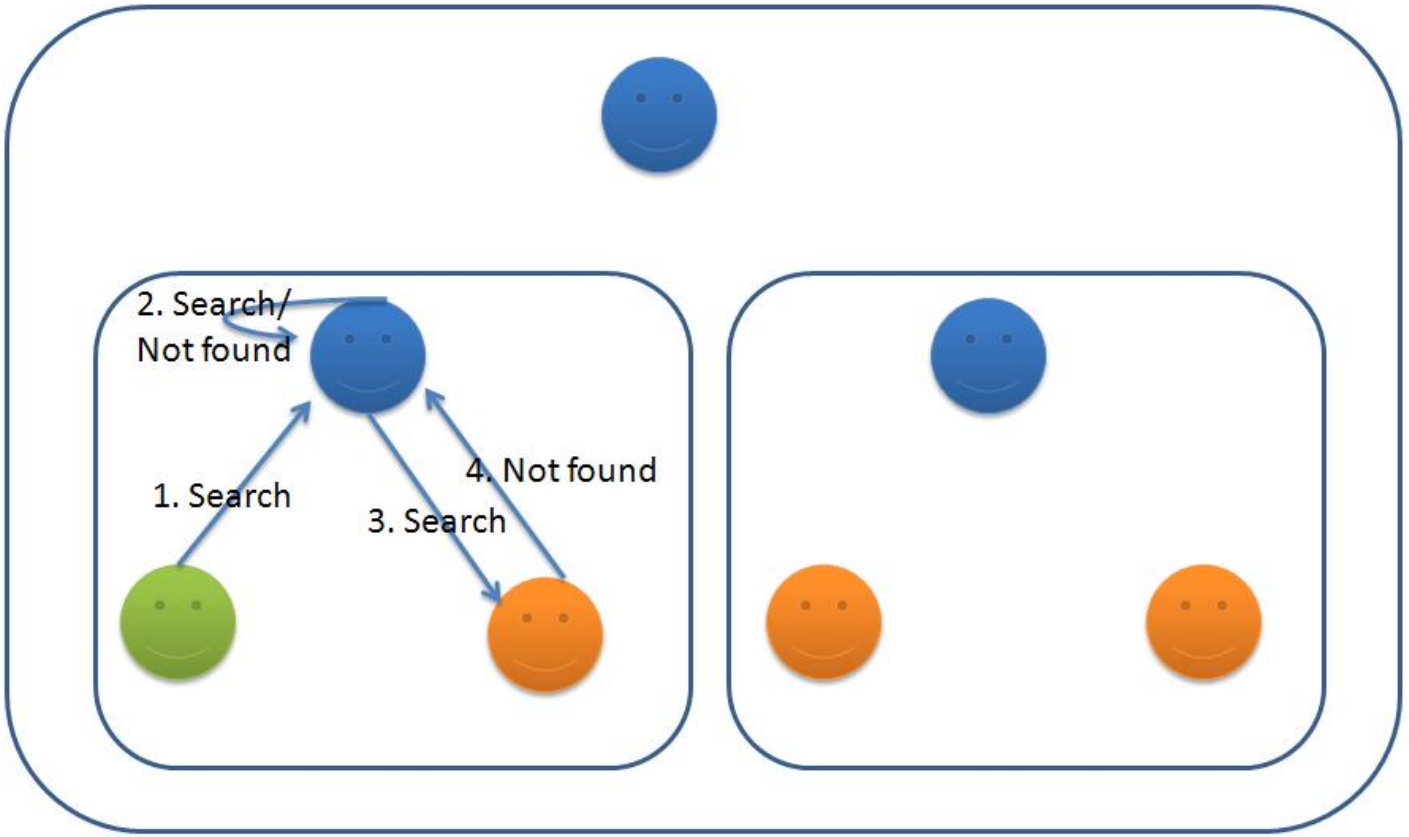
- Can be a room, or a floor, or a campus according to attribute "type" of agent.
- Creates on demand a Navigator agent to help PDA agent in navigating when PDA is in site.
- Behavior "search devices":
  - If site has capability correspond with capability in the request, and satisfied the request, it answers immediately
  - If not, it can search in its children. If its children don't have neither, it searches in its parent.
  - After the search, it sends name of all the devices found to the seeker

Agent Navigator

- Is created by a site, with the knowledge of map of site, for a specific PDA
- Behavior: find path from actual position of PDA to a new location

· Agent interacts only with its parent or its children

Example: Search



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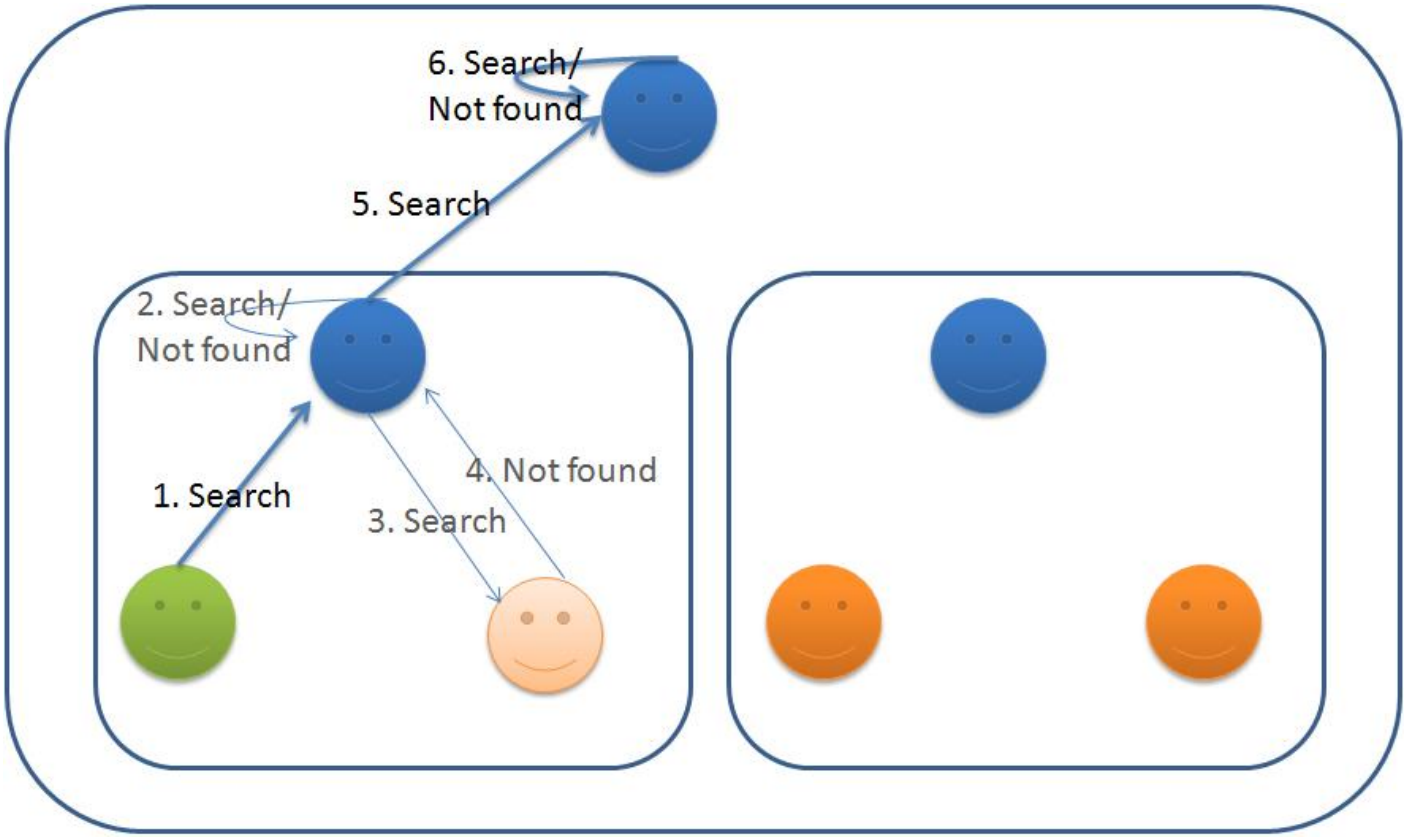

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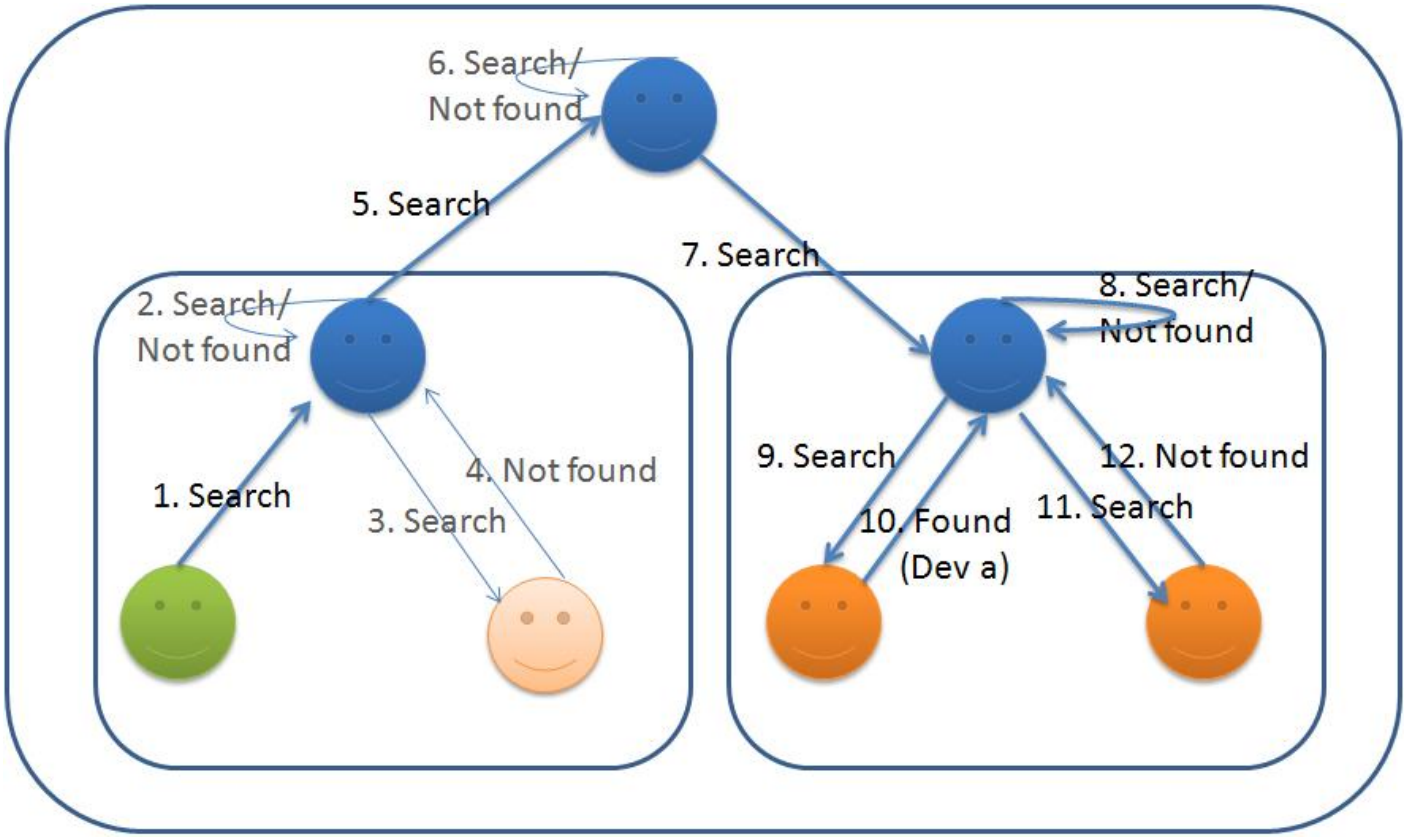

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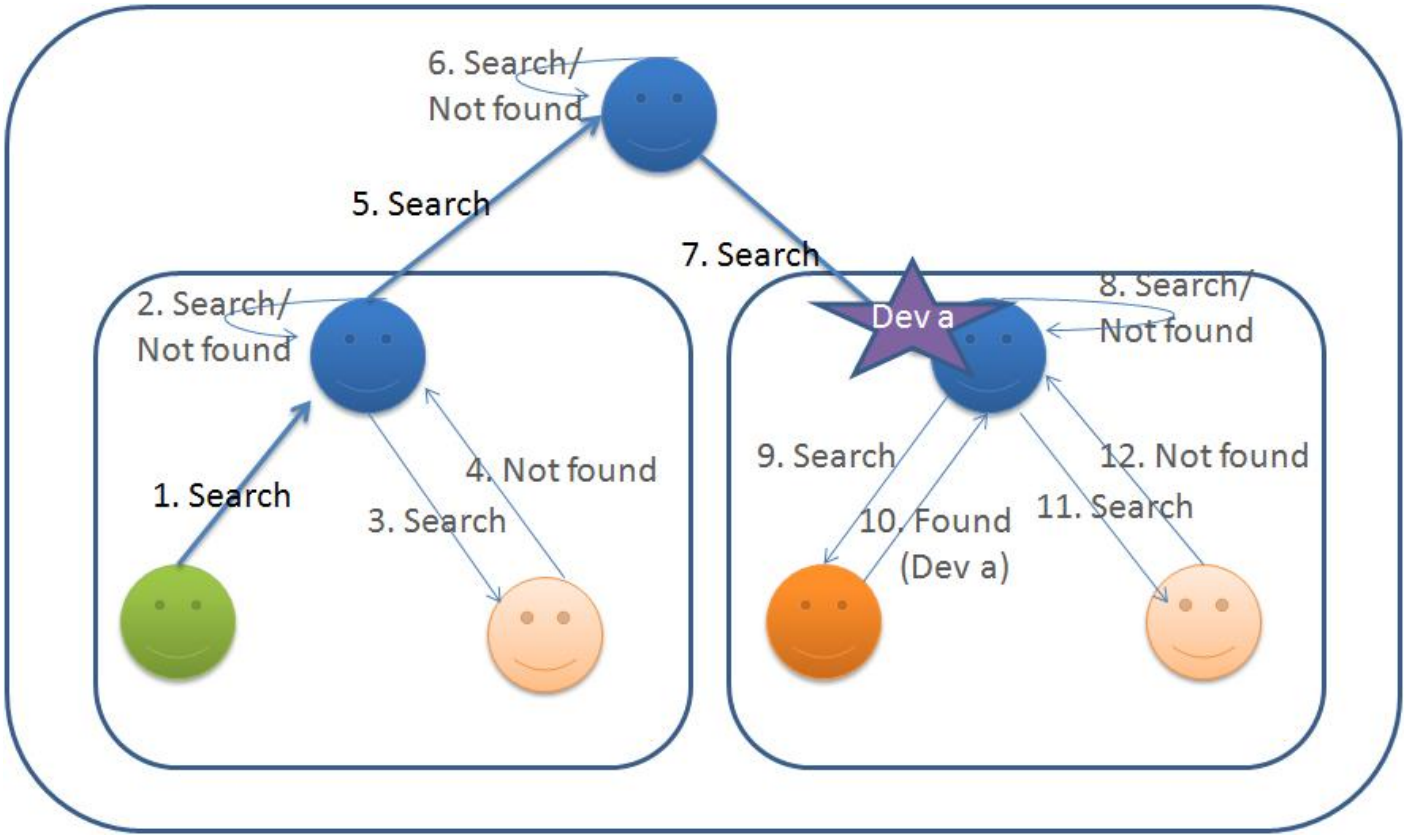

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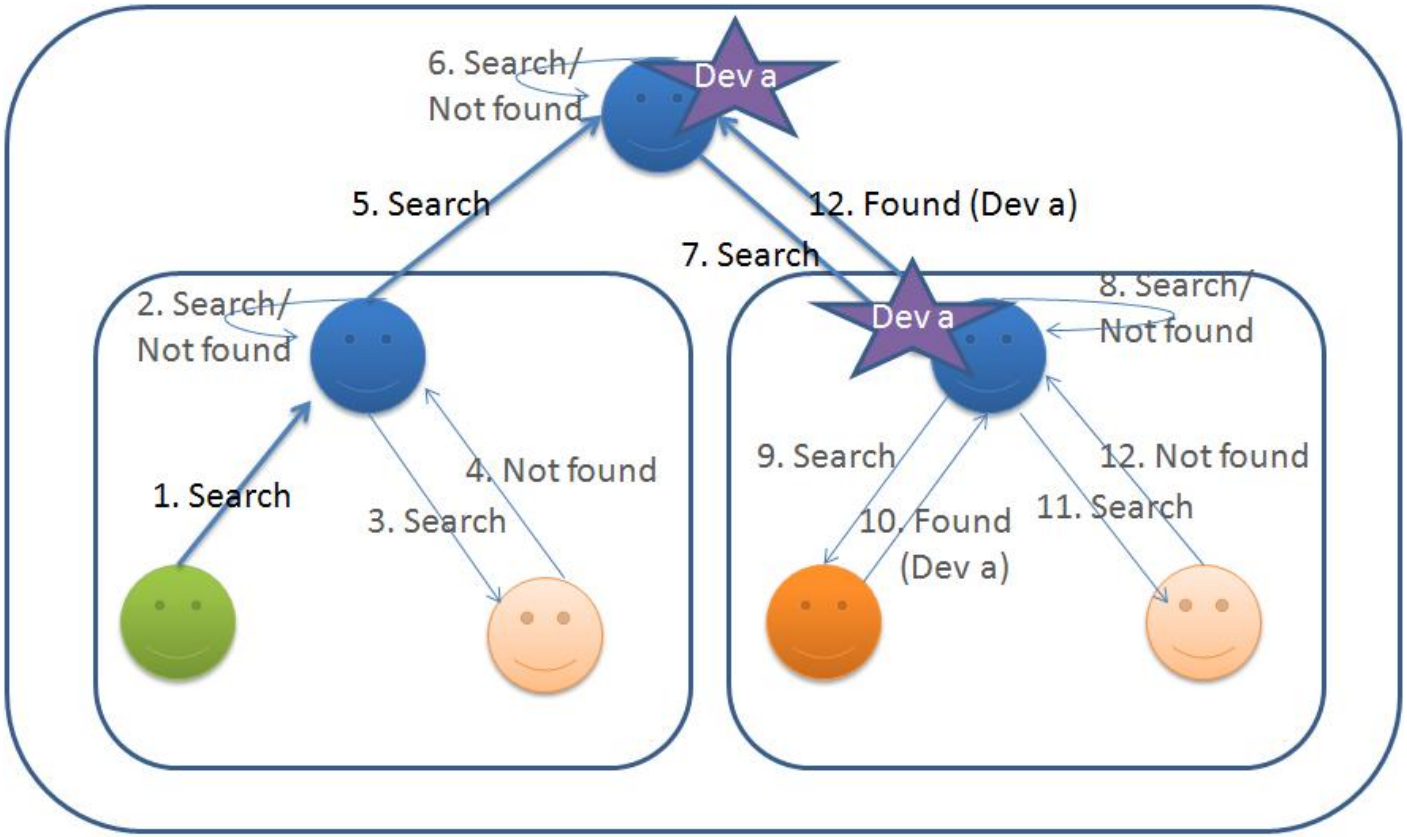

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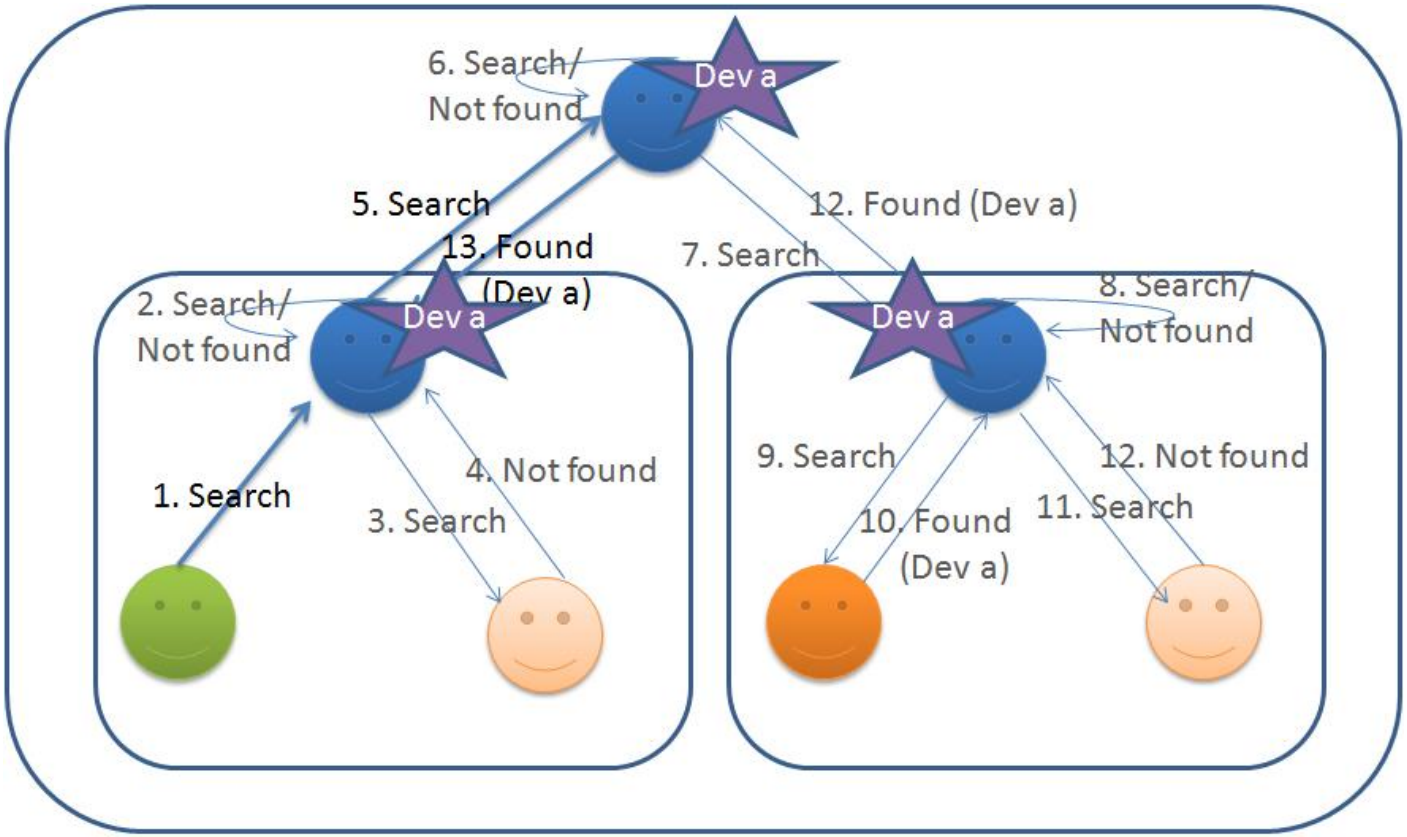

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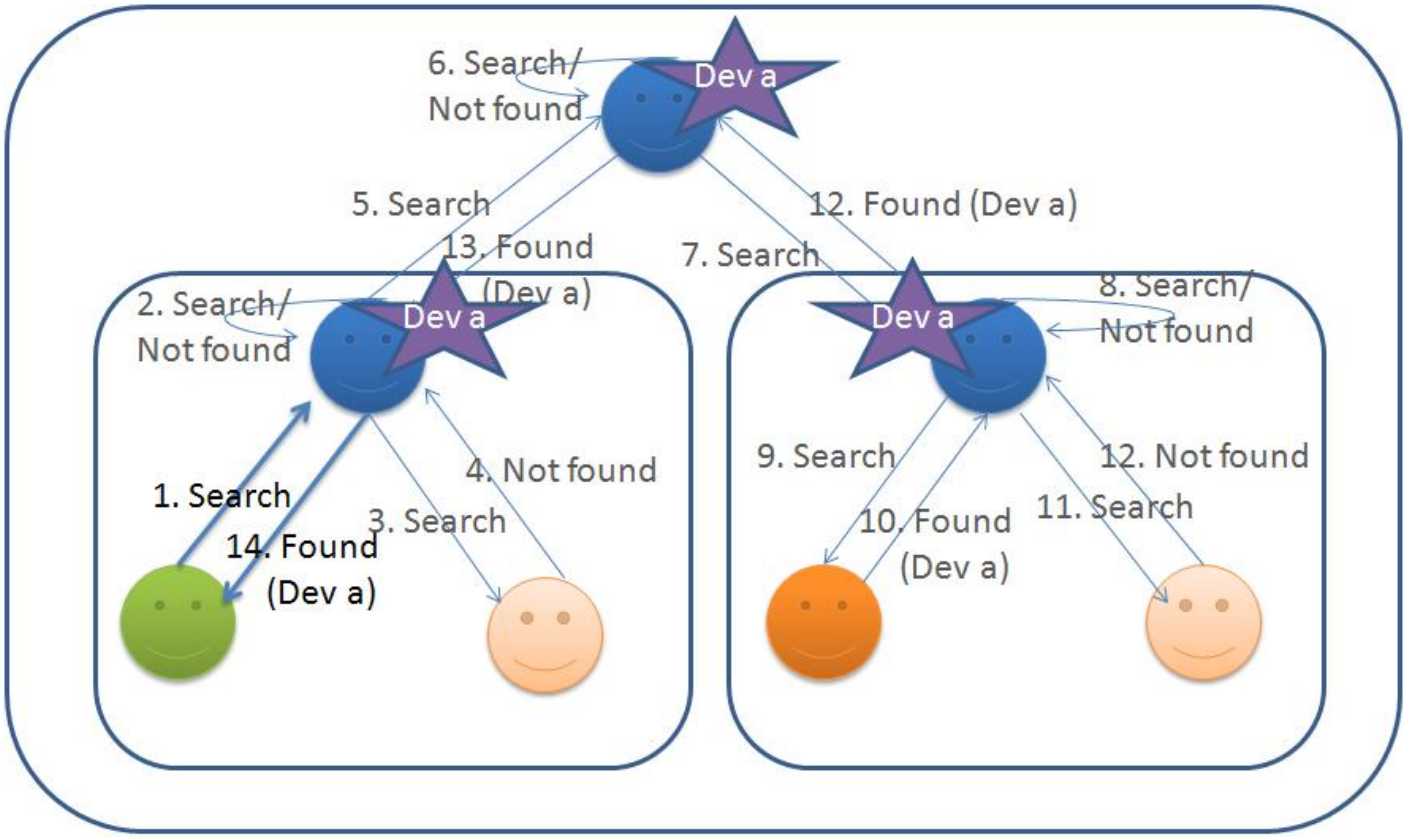

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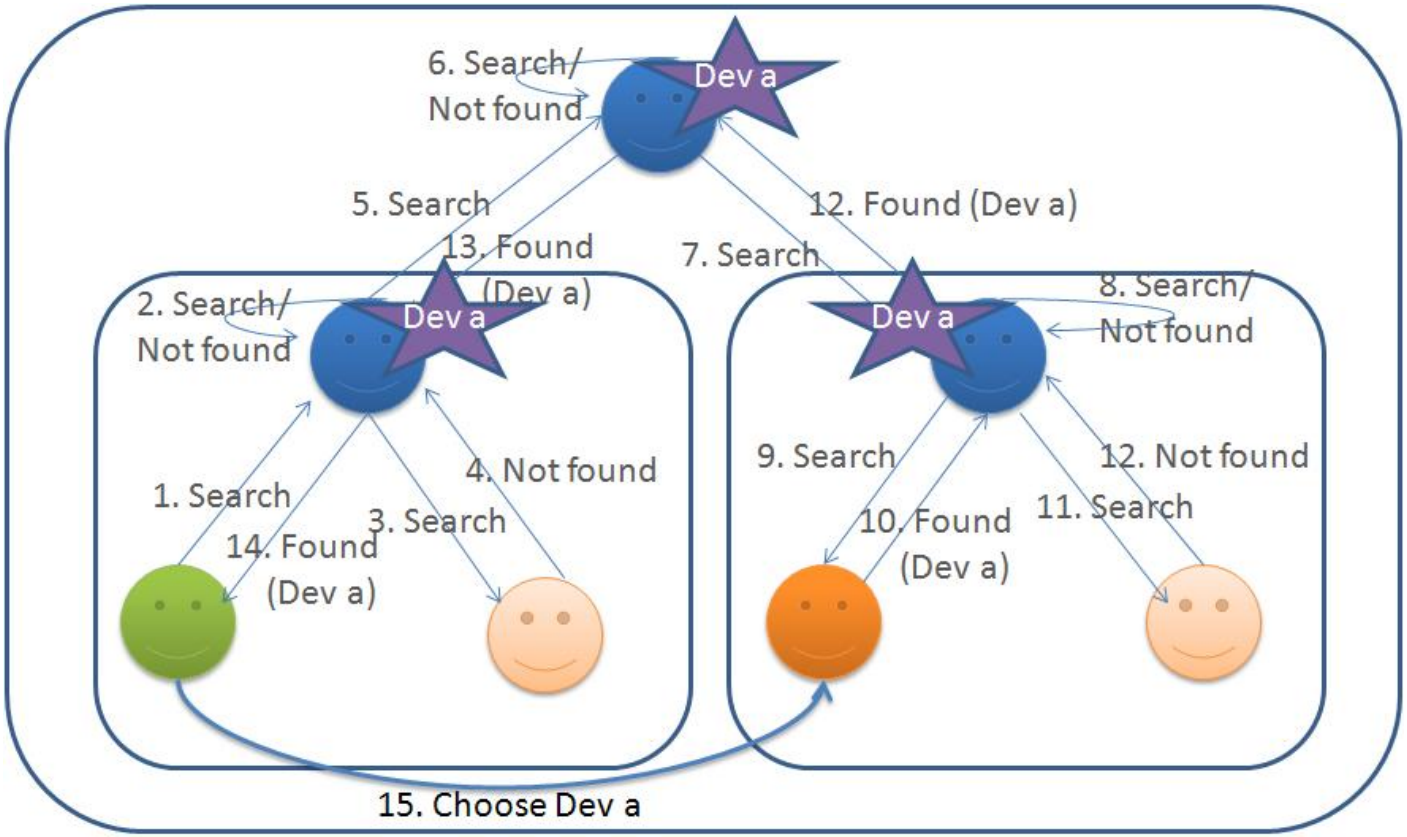

Future Work:

- Search:
  - Multi-criteria
  - Flexible criteria: based in preferences of user and in context
- Anticipation
  - Anticipatory system: *[...] a system containing a predictive model of itself and/or its environment, which allows it to change state at an instant in accord with the model's predictions pertaining to a latter instant*

    [Rosen, 1985]
  - Anticipation is a future-oriented action, decision, or behavior based on a (implicit or explicit) prediction

    [Pezzulo, 2008]

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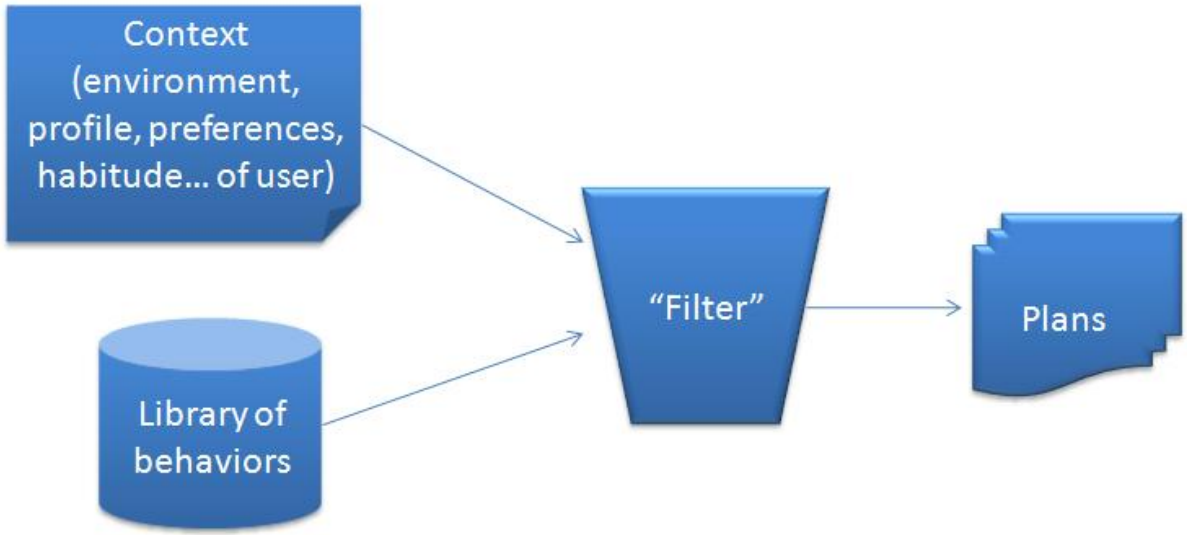


To work with context, we must have a representation:

- First order logic
- ontology
- graphical models
- ...

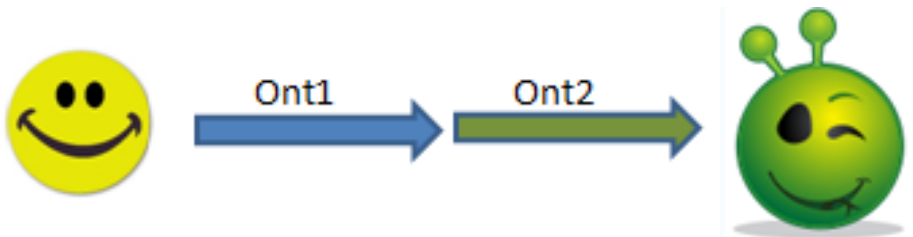
Ontology based models are flexible and robust

· Semantics representation (concepts, facts)

· Combine the assets of logic-based models and object-oriented technology [Krummenacher et al., 2007]

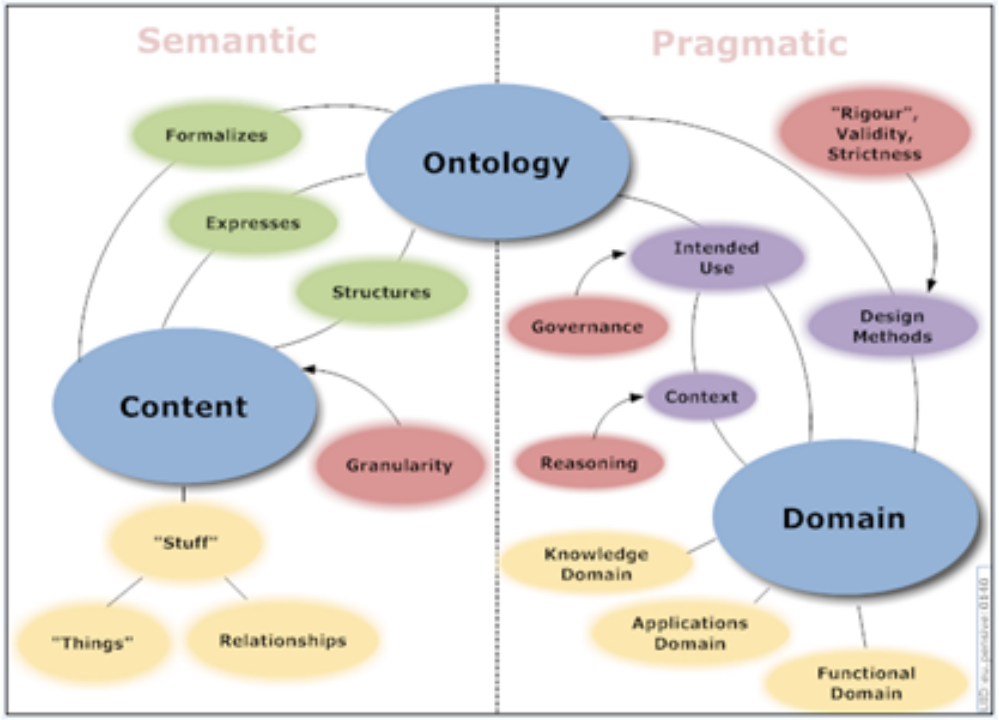
Open System Requirement:

· The agents heterogeneity imposes the possibility to work with different ontologies



Future work in Ao Dai: Add ontology processing capacity to CLAIM:

- Choose a representation (OWL, XWL, ...)
- Implement alignment, construction, comparison



· Study the benefits of each topology

· Proceed with concrete tests to determine the best (or most appropriated) to each situation: Centralized (server), decentralized, hybrid

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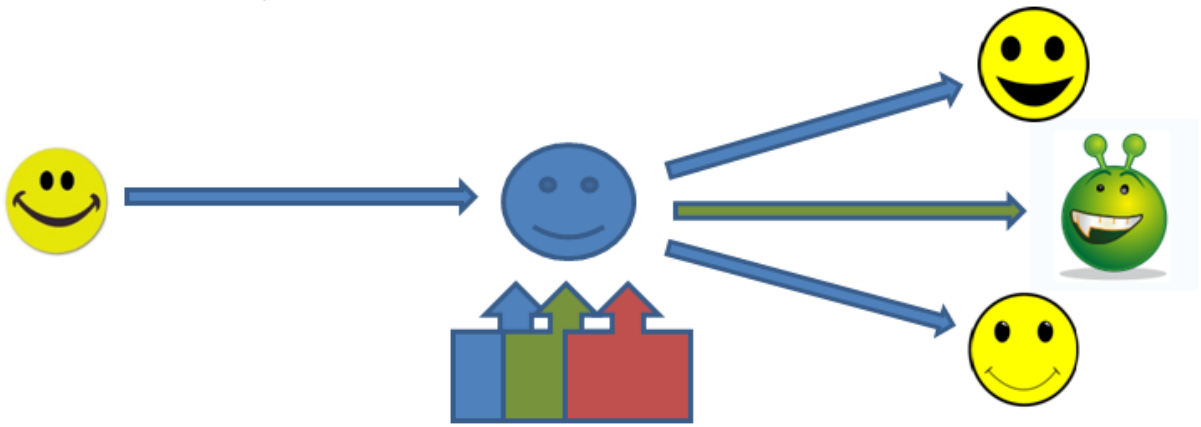

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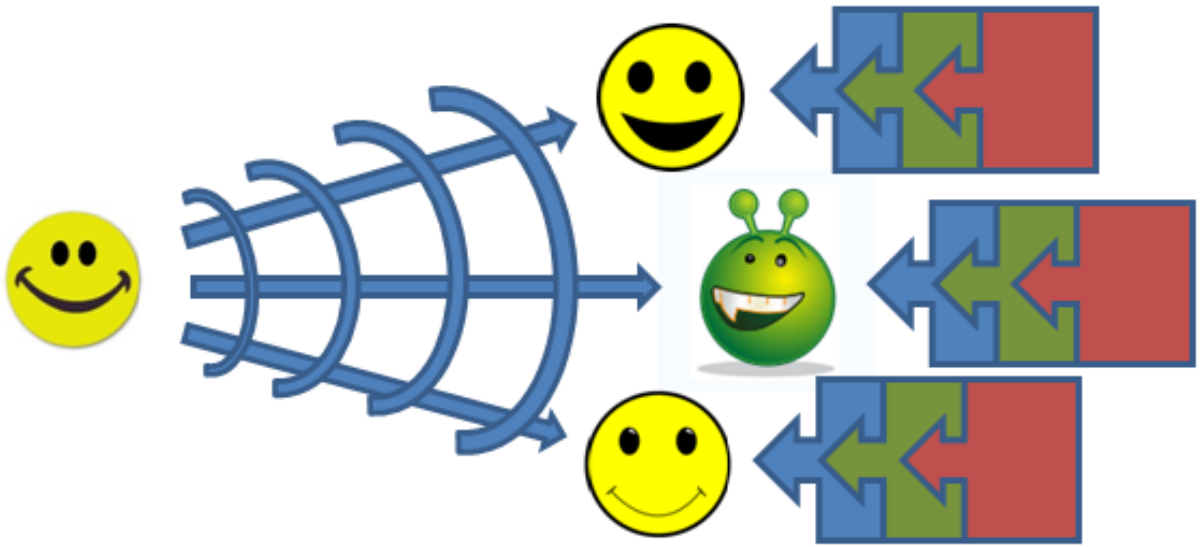

Our goal: Build an agent-based infrastructure, implemented in CLAIM, for an Ambient Intelligence system.

What was done: a first version, implemented in CLAIM, that offers context-awareness in terms of location and available resources.

Future work: implementation of ontologies for knowledge representation, consideration of other types of context (like social context) and anticipation of user's intentions. Also, integration of actual personal devices in the system.

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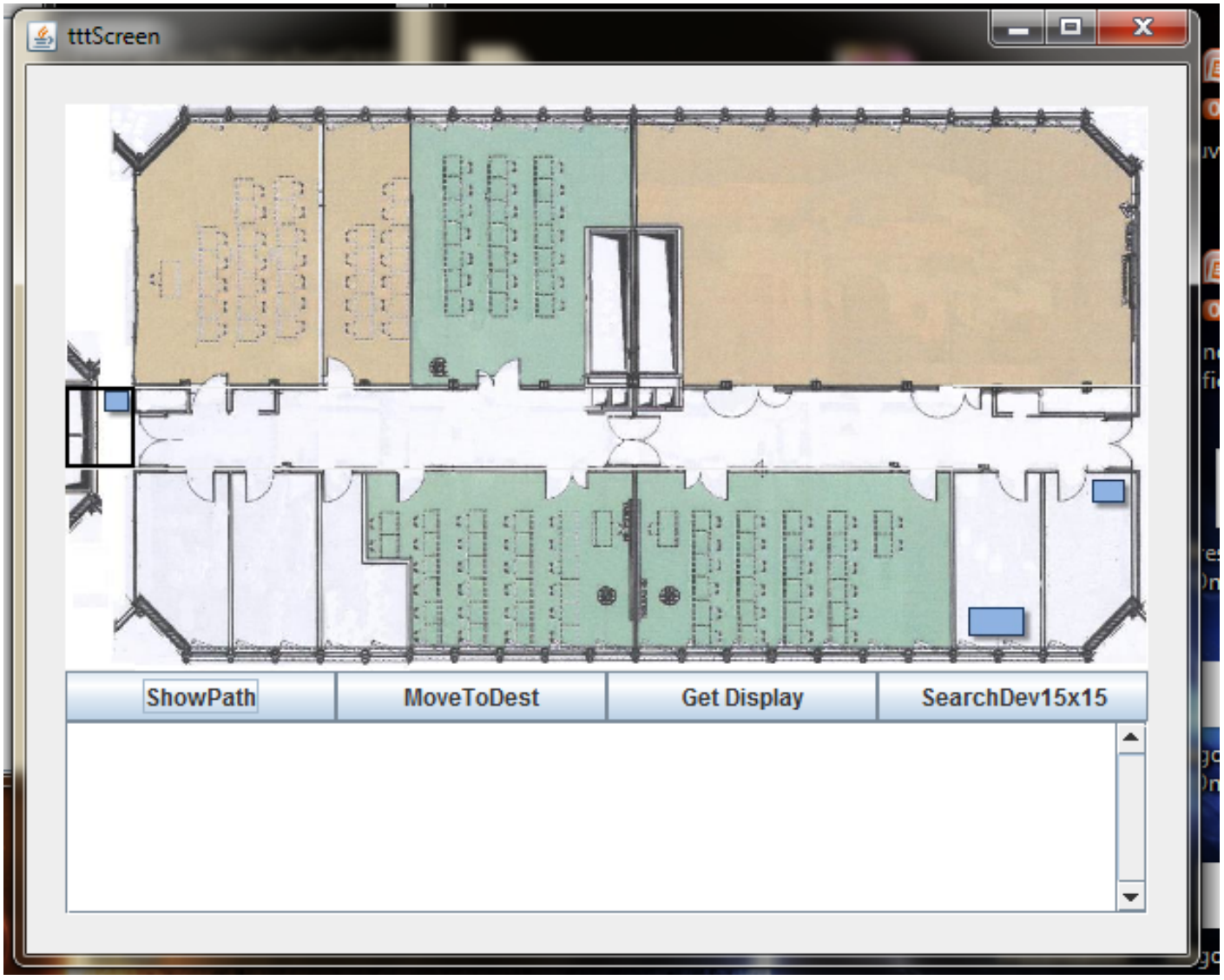

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Thank you!

Any Questions?