Graphs and Patterns for Context-Awareness

Andrei Olaru

Adina Magda Florea, Amal El Fallah Seghrouchni

04.04.2011

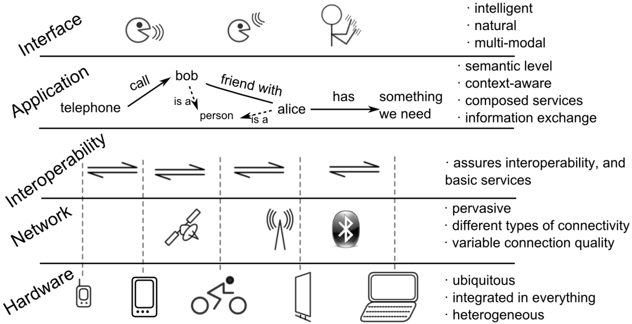
Graphs and Patterns for Context-Awareness

overview

AmI – is an 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]

Our Perspective on Ambient Intelligence



based on [El Fallah Seghrouchni, 2008]

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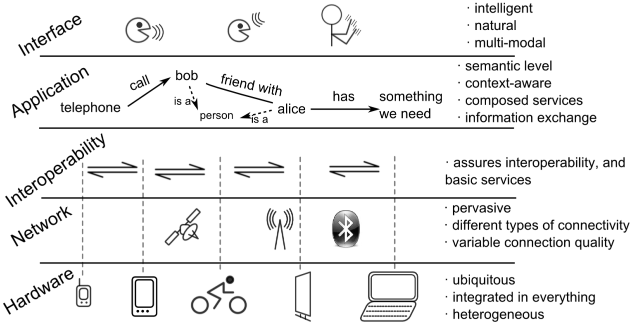

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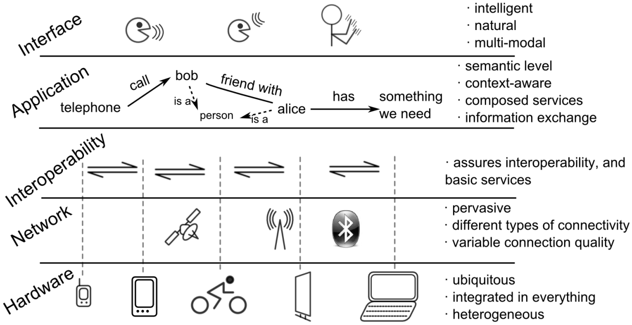

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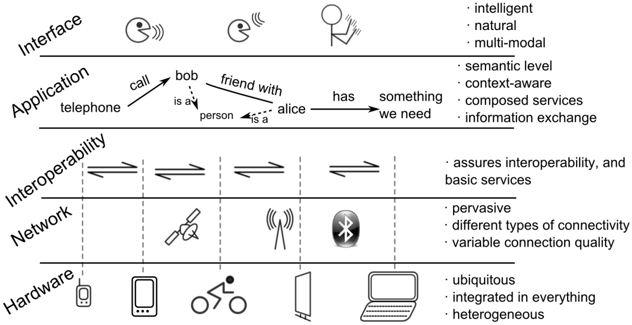

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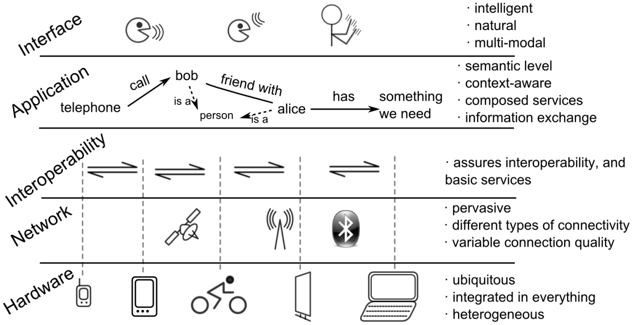

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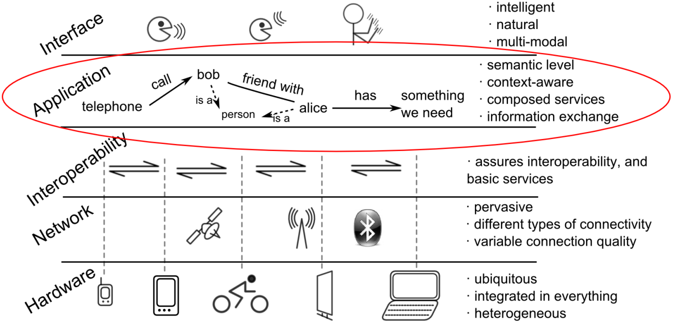

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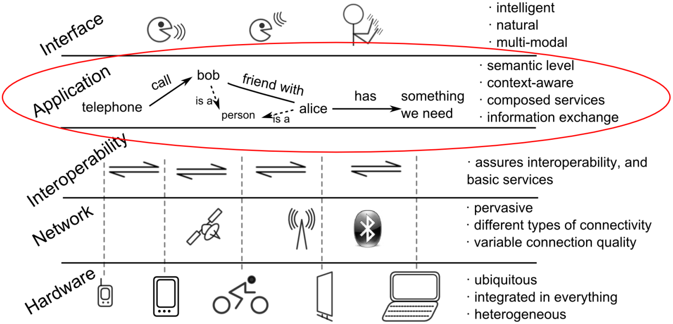

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People · Devices · Services · Communication
· focus on information ·

Our Perspective on Ambient Intelligence

Important AmI requirements:

- pro-active behaviour
- non-intrusiveness
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· Out approach: use a multi-agent system that relies on local communication and handles context information in a decentralized manner.

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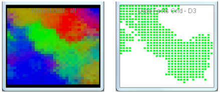
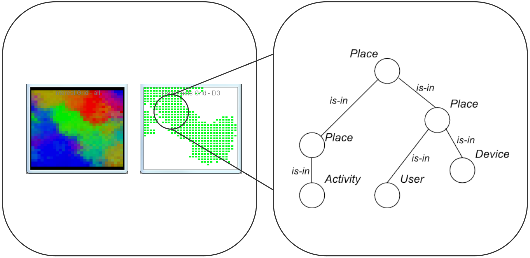
, 04.04.2011

- decentralized MAS for the directed exchange of information [Olaru and Gratie, 2010]

The Research Approach



- decentralized MAS for the directed exchange of information [Olaru and Gratie, 2010]
- simple topology
- generic context measures



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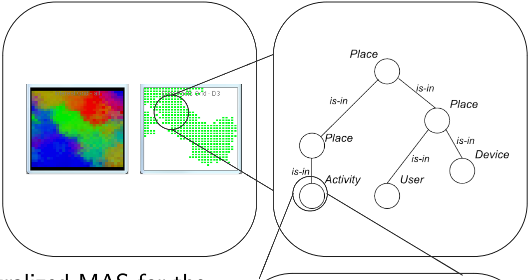
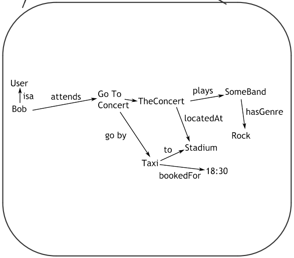
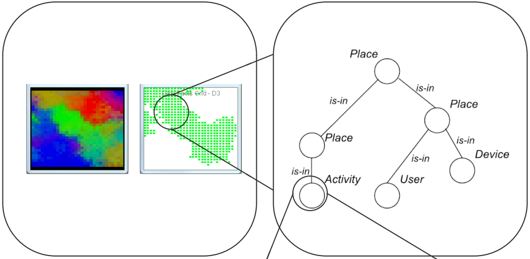


- decentralized MAS for the directed exchange of information [Olaru and Gratie, 2010]
- ~~simple topology~~
- ~~generic context measures~~
- context-related structure [El Fallah Seghrouchni et al., 2010]
- flexible representation that allows detection of compatible context





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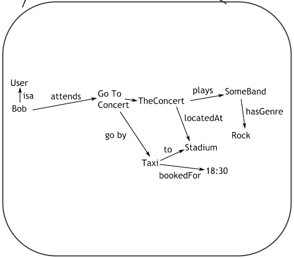

Context is any information that can be used to characterize the situation of entities (i.e. whether a person, place or object) that are considered relevant to the interaction between a user and an application, including the user and the application themselves. [Dey, 2001]

Related work presents two aspects:

· infrastructures for the processing of context information

[Hong and Landay, 2001, Harter et al., 2002, Lech and Wienhofen, 2005, Henricksen and Indulska, 2006, Baldauf et al., 2007, Feng et al., 2004]

· context modeling

[Perttunen et al., 2009, Strang and Linnhoff-Popien, 2004]

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Related work presents two aspects:

· infrastructures for the processing of context information ← layered, centralized, oriented towards physical context

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· context modeling ← based on tuples, case-based reasoning, ontological representations

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· context modeling

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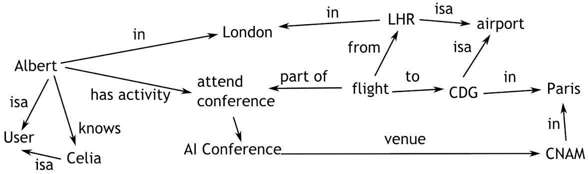
· context as associations [Henricksen and Indulska, 2006, Bettini et al., 2010].

· semantic networks, concept maps [Novak and Cañas, 2006] and conceptual graphs [Sowa, 2000].

· graph matching (e.g. for image processing [Bengoetxea et al., 2002], ontology matching [Laera et al., 2007]).

Our goal: A simple, generic formalism that allows agents in a multi-agent system, that have only local knowledge, to share and process context-related information and to solve problems.



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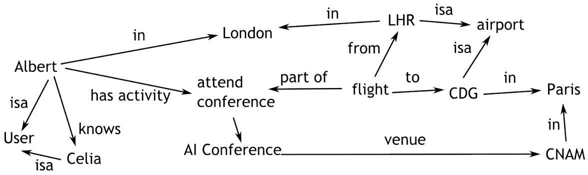
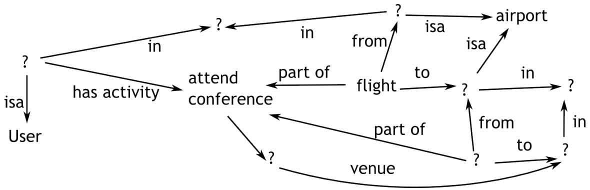


The agent of a user holds a context graph G:
$G = (V, E)$
$V = \{v_i\}, E = \{e_k\}, e_k = (v_i, v_j, value)$
where $v_i, v_j \in V, i, j = \overline{1, n}, k = \overline{1, m}$
values are strings or URI identifiers. Edges may have no value.

Problem: Albert should also think about some means of transportation to the concert.



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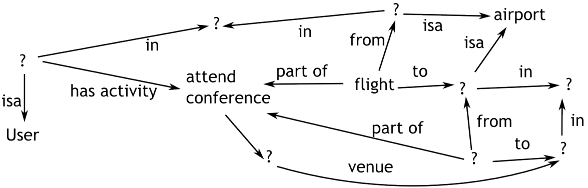


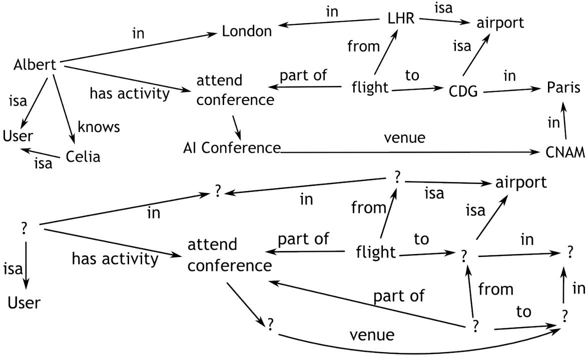
· patterns are also graphs. The graph for pattern s is

$G_s^P = (V_s^P, E_s^P)$

$V_s^P = \{v_i\}, v_i = string \mid URI \mid ?, i = \overline{1, n}$

$E_s^P = \{e_k\}, e_k = (v_i, v_j, E\_RegExp), v_i, v_j \in V_s^P, k = \overline{1, m}$

where E_RegExp is a regular expression formed of strings or URIs.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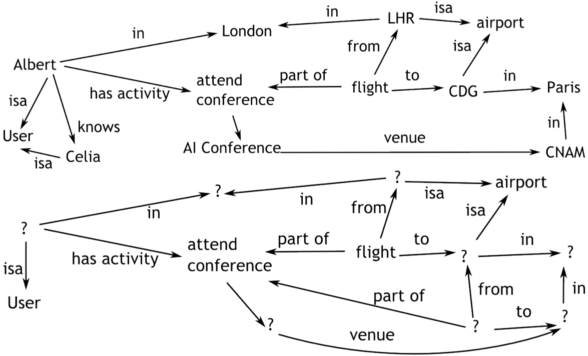
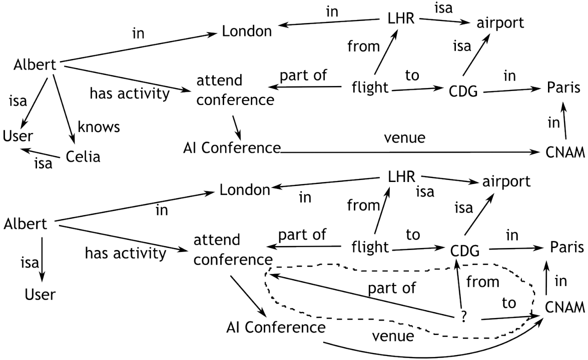


The pattern *matches* subgraph G' of the context graph G if every non-? vertex from the pattern must match a different vertex from G'; every non-regular-expression edge from the pattern must match an edge from G'; and every regular expression edge from the pattern must match a series of edges from G'.

A pattern G_s^P *k-matches* a subgraph G' of G, if the condition for edges above is fulfilled for $m - k$ edges in E_s^P, $k \in [1, m-1]$, $m = ||E_s^P||$ and G' remains connected.



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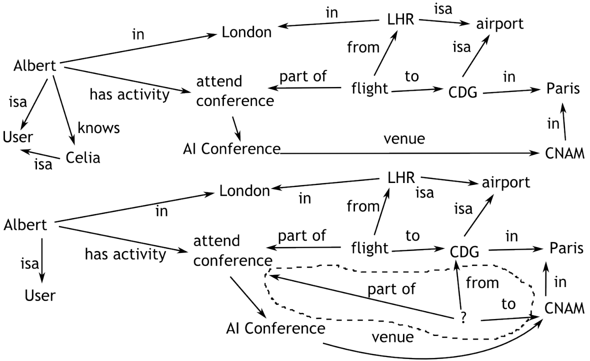

If a pattern $G_s^P = (V_s^P, E_s^P)$ k-matches the subgraph $G' = (V', E')$ of G, we can define a problem p as a tuple (G_s^P, G_p^P), where G_p^P is the problem's graph:

$G_p^P = G' \cup G_x^P$

$G_x^P = (V_x^P, E_x^P)$

$V_x^P = \{v \in V_s^P, v \notin dom(f)\}$

$E_x^P = \{e \in E_s^P \textit{ for which condition } (2) \textit{ is not fulfilled}\}$

Note that G_x^P (the unsolved part of the problem) is a subgraph of G_s^P.

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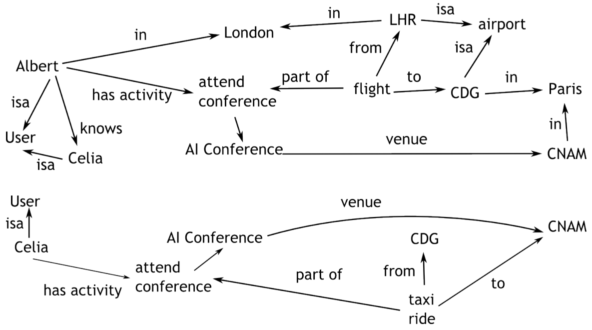

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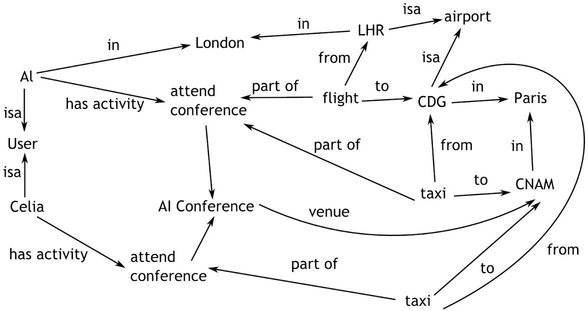

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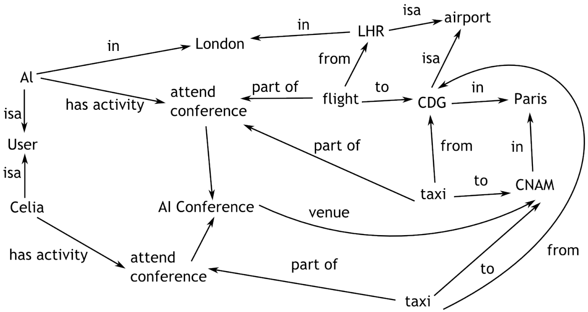

· Solution to the problem: suggest to Albert that a taxi may be a good idea to go from the airport to the conference's venue.

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Future work:

- we are in the process of implementing based on our approach toward the application layer of AmI.
- we must identify – or implement – an efficient algorithm for context matching – graph matching, but considering the particular features of context patterns.
- consider temporality, history of context.
- develop the idea of incompatible contexts.

Thank You!

Questions.

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