

WP1 Activities

General state, details on the model, future plans

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- 1 WP1 Activities
- 2 Abstract Model of SAPERE



Outline

1 WP1 Activities

2 Abstract Model of SAPERE



Research Activities in WP1, at a Glance

Timing in M1-M12

- M1-M4. Exploration about model, methodology and technologies
- M5-M8. “Development” of agreed model (and related technology)
- M9-M12. Activities towards production of D1.1
 - ① First version of abstract computational model
 - ② First version of LSA framework
 - ③ Early demonstration of the operational model at work

Proposal of efforts for D1.1 (34 PMs overall)

- UNIBO (~16pm): leading, overall model
- STA (~7pm): LSA framework, semantics/matching in eco-laws
- GENEVE (~6pm): spatiality/self-org in the model and in eco-laws
- UNIMORE (~5pm): basic technology, demonstration



Research Activities in WP1 so far

UNIBO

- Positioning of SAPERE as a coordination framework [Omicini and Viroli, 2011, Nardini et al., 2011, Viroli et al., 2010]
- An abstract viewpoint over all the aspects of the model
- A prototype incarnation of LSA-space, and eco-laws in fuzzyDL

STA

- Preliminary study on formal models for chemical-like systems
- Representing LSAs by RDF
- Role of ontologies for pervasive computing

Others

- UNIGE: Review on self-organisation mechanisms
- UNIMORE: Use cases and their impact on LSAs/eco-laws

What WP1 Expects from M4 Meeting

Reach an agreement on answers to general questions:

- ① what in the end are eco-laws and LSAs?
- ② shall we need application-specific or general eco-laws?
- ③ what behaviour in eco-laws, what in agents?
- ④ how serious should we be with the chemical model of eco-laws?

Take decisions now on what to do by M12

- which case studies/features we want to support?
- we should not tackle the entire SAPERE model by M12...
- ... something can be left for 2nd year, but what?

Objectives of WP1 at M8

Tentative Goals

- Propose concrete “languages” for LSAs/eco-laws (UNIBO,STA)
- Develop a prototype matching engine (UNIBO,STA,UNIMORE)
- Develop an LSA-space simple prototype (UNIBO,UNIMORE)
- Develop a spatial mechanism into eco-laws (UNIBO,UNIGE,STA)

Towards M12

The above models and technologies:

- can be refined slightly
- should be the ground for D1.1

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A Proposal for the SAPERE “Abstract” Model

Our viewpoint

- is nurtured by several discussions/thoughts
- requires (hopefully constructive) feedback
- admittedly suffers from current lack of reference case studies
- indeed takes some design choice
- abstracts from incarnation technology

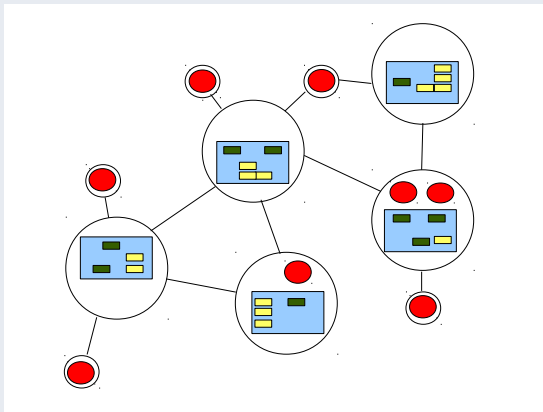
Outline

- abstracting from topology/spatiality
- LSA
- agent interaction
- eco-laws
- an abstract language for eco-laws



Which Topological Model?

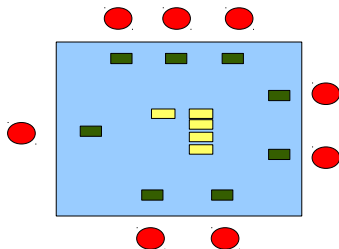
The Mobile Network of LSA-Spaces



- Featuring SAPERE nodes, device nodes, LSA spaces, Agents, LSAs
- Not really a P2P network

Temporarily Abstracting away from Spatial Issues

The Single LSA-Space Abstraction



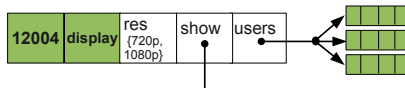
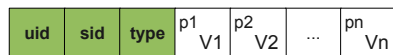
- Suppose agents perceive a single LSA-space
- Discuss spatiality in the boundary of WP1-WP2 (tomorrow)



Live Semantic Annotations

General features (mostly in line with technologies like RDF)

- A unique ID (uid), source ID (sid), a type (or concept)
- a list of [property → value(s)] associations (single value or sets)
- a property may expect primitive types, ids, channel ends (,functions?)



Issues with LSAs

Simple vs Complex matching (i.e. semantics)

- Simple tag-based semantics (more lightweight & open)
- OWL-based reasoning (more standard & expressive)

Ontologies can play a key role in SAPERE (see STA talk)

- they affect LSAs as well as eco-laws
- they can tackle general-concepts and application-oriented aspects
- not simple to understand how to manage their life-cycle in SAPERE

Do we find an agreement on these issues?

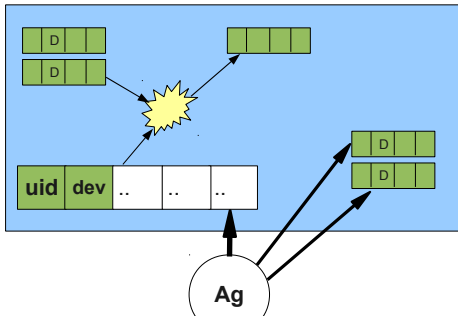
If we don't, we may try to make them fully orthogonal..



Injection of LSAs

How are LSAs created and inserted (implicitly or explicitly)?

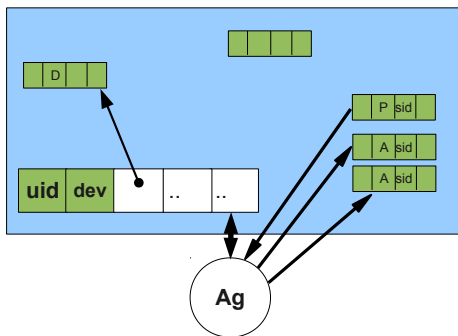
- Each agent has one individual LSA (iLSA), which identifies her existence
- An agent might also inject other LSAs (data, events, actions)
- (Some LSAs are also created by eco-laws)



Action/Perception through the LSA

Agent interaction is “constrained” by her LSAs

- Actions by updating an LSA, injecting new LSAs
- Perception by observing her LSAs (e.g. where iLSA links to)
- (Querying for any LSA should be very limited, or even prevented)



Why not simply Getting rid of Eco-laws?

Imagine we have no eco-laws

- Say the only way of affecting the LSA-space is by agents injecting/removing/updating LSAs
- Namely, to implement a given eco-law E , an agent A_E can be built who observes E -preconditions and produces E -effects over the LSA-space..
- This “permissive” situation is nothing but (semantic) Linda – not very tractable, not clear what is the contribution

A scientific goal of SAPERE

- Design an expressive, simple, tractable language of eco-laws
- Understand where drawing the boundary between what should come in eco-laws and what in agents – and prove this choice is good!

Some Hints about Trade-off between Agents and Eco-laws

Eco-laws

- They enact and constraint the “ecological” behaviour of the system
- Namely, basic forms of matching, composition, diffusion, ...
- They are “sufficient” to make things happening

Coordination Services, or “infrastructural services”

- They can empower eco-laws, by refining what they do:
 - they are services injected to change the ecosystem equilibrium
 - e.g. recommender agents, planners, situation recognisers
 - their behaviour is still subject to the eco-laws

Suggested stance for the SAPERE project

- Let's experiment with an expressive eco-law language till M12
- We will still have time for changing/refining the direction

An Abstract Eco-law Framework

Features of an Eco-law

It is basically a tranformation pattern for a (small) set of LSAs

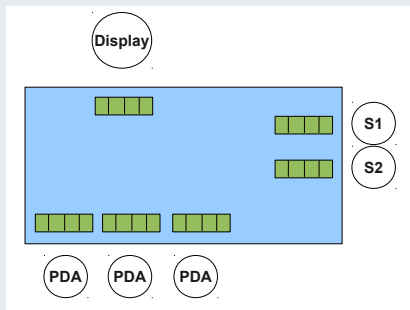
- it applies to a set R of reactant LSAs
- R is selected based on LSAs structure and mutual matching
- the choice of R has a “rate” (useful for ranking)
- possible effects of an eco-law:
 - it change values of properties in some LSAs of R
 - it removes some LSA of R
 - it creates new LSAs
 - it links some LSA of R
- (intentionally avoiding spatial issues)



A Small Case I

A display, users, visualisation services scenario

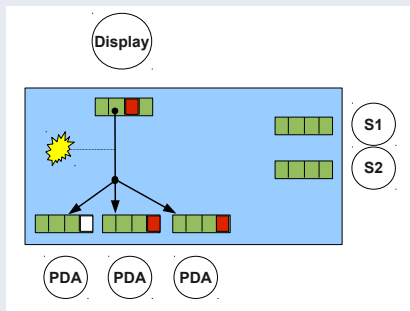
- Display agent is a S/W either on the display or in the SAPERE node
- PDA agents represent users nearby the display (i.e. profiles)
- Visualisation services are e.g. ads



A Small Case II

“Gathering” eco-law

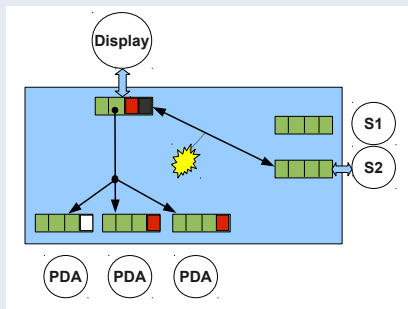
- An eco-law (either in one shot or by repeated application) links display's LSA with LSAs of users around
- A property of the display (red) reflects majority of preferences



A Small Case III

“Activation” eco-law

- An eco-law matches the display (the cumulative preference stored there) with a visualisation service
- A channel is created, by which the ad will be transmitted
- A property of the display (black) reflects activation of display



Application-dependent Eco-laws?

How can eco-laws be general?

- in the case above, they assume we know we have “displays”, “PDAs”, “services”, “preferences”, “cumulative preferences”, “display activation”, “display-service channel”, and so on
- are these concepts typical of any pervasive ecosystem?
- are eco-laws and LSAs relative to an ontology describing these concepts?

Proposed stance

- forget about this issue by M12
- study many case studies, and for each, design the required eco-laws
- in second year try to find a general ontology and eco-laws



An Example Language of Eco-laws

Features

- Eco-laws structured as chemical reactions
- On left- and right- hand side we have patterns of LSAs
- Proper annotations are added to enhance expressiveness

Generality

- Chemical concentration might be added rather orthogonally (we won't speak about it here)
- We are assuming LSAs are as described before
- We also assume we have a fuzzy semantic matcher between primitive values (e.g. strings, types, number intervals)



Example 1

"User Gathering" eco-law

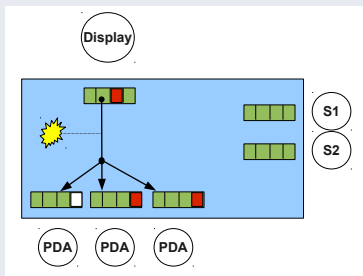
{d}:Display +

{u}:User[preference = {p}]

-->

{d}[preferences += {p}, users += {u}] +

{u}



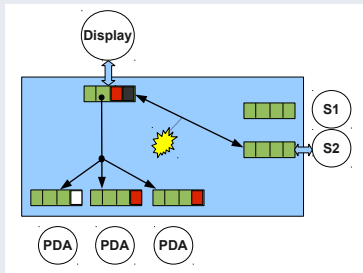
Example 2

“Display activation” eco-law

```
{d}:Display[preferences = {P}, showing = no] +  
{s}:Service[content = {c: c matches P}]
```

-->

```
{d}[showing = {s}, instream = #chan(0).in] +  
{s}[target = {d}, outstream = #chan(0).out]
```



Example 3

“Display activation + service session” eco-law

```
{d}:Display[preferences = {P}, showing = no] +
```

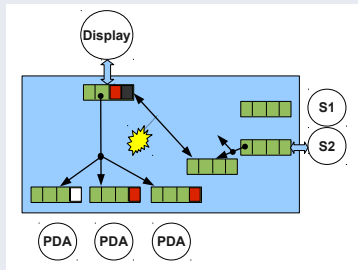
```
{s}:Service[content = {c: c matches P}]
```

```
-->
```

```
{d}[showing = {s'}, instream = #chan(0).in] +
```

```
{s}[sessions += {s'}] +
```

```
{s':s' clones s}:[target = {d}, outstream = #chan(0).out]
```



A Candidate Set of Eco-laws for the Display Ecosystem

An open list (spatiality again neglected)

- A display gathering user information
- A display connecting with a service provider
- Action/perception laws to user-display interaction
- Composition/orchestration of services and displays
- Decay/dispose of some service

Remarking that..

It is only by case studies that we can address:

- Completeness: can we express all that we want?
- Expressiveness: is writing specification simple/natural enough?
- Coherency: are we considering the right abstractions?
- Generality: can we define application-indepent eco-laws?

Dealing with WP2 and WP3

WP2: Where will we tackle self-organisation and space?

- Add some “spatial notion” to eco-laws language
- Low-level spatial mechanisms should become eco-laws
- Possibly high-level patterns (“space algorithms”) in agents
- Evaluate micro/macro eco-laws (e.g. implicit LSA-diffusion)

WP3: Where will we tackle situation recognition?

- Can we design eco-laws for situation recognition??
- Perhaps, agents will have the recognition task..
- ..they gather info about existing matching LSAs
- ..they reify the situation by injecting some LSAs
- “time algorithms” mostly embedded in agents

Current Developments in UNIBO

An LSA-space prototype

- Allowing injection/observation of “tuples”
- Embedding a highly-configurable Reaction Manager
- Supporting a limited form of space-space interaction
- Status: an early prototype is ready

An Eco-law interpreter based on fuzzyDL

- An LSA seen as an individual in fuzzyDL
- Matching reactants is performed by querying the reasoner
- Products obtained by adding assertion in ABox
- Status: only a design, need be implemented in the LSA-space above



Sum Up and Opening discussion

Agreement checklist

- 1 Proposed features in LSAs (properties, values, pointers,...)
- 2 Choosing an LSA framework (RDF?) or remaining orthogonal to it?
- 3 Expressive, lightweight, or orthogonal matching?
- 4 Which eco-laws vs. agents tradeoff?
- 5 Limiting agent interaction?
- 6 Eco-laws assumptions
- 7 Eco-laws proposed abstract language
- 8 Case studies



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