

Institute of Science and Technology  
of Information “A Faedo” (ISTI)  
Domotics Lab

An adaptive and anticipatory Aml approach  
tailored to user needs

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# ***Domotics Lab***

Lab of the “Institute of Science and Technology of Information” (ISTI) of the National Research Council of Italy (CNR).

# *Mission*

Ambient  
Intelligence

Internet of  
Things

Ambient Intelligence e  
Internet of Things are upon  
Domotics

Domotics

Domotics Lab aims to improve the quality of everyday life realizing the *Ambient Intelligence* (Aml) e *Internet of Things* paradigms.

# *Domotics*

Is a multidisciplinary technology that aims to:

- improve the quality of life
- improve the security and safety
- energy saving
- integrate all electrical, gas and water equipment to create smart applications

But...

- lack of an unique standard and poor communication among different technologies (interoperability issue)

# *Ambient Intelligence*

- Thanks to:
  - Miniaturization of electronic components → higher integration of technology on our everyday life
  - Internet of Things → hidden distributed technology on everyday objects
- Goal to reach:
  - Users must ~~adapt~~ themselves to the environment and to the limits of technologies.
  - The technologies and the environment must be hidden and adapted to real user needs.

# *Aml as reality*

Our guidelines aim to realize an intelligent ambient where people can live surrounded by information and telematic technologies. The environment must be:

- **embedded**: integrated in the environment (user hidden technology);
- **interoperable**: all devices must be able to communicate each others indipendently by their communication and technology systems;
- **context aware**: able to recognize users and their ambient context;
- **personalized**: customized to user needs;
- **adaptive**: able to change in depending on new scenarios;
- **anticipatory**: able to anticipate the needs and the wishes of users in a unaware way for them.

# *Interoperability with DomoNet*

- Open source prototype developed by our laboratory
- Abstracts belonging technologies of the real domotic devices providing their characteristics and functionalities, using an XML sub-language (called DomoML)
- Use of W3C open source tools and standard (Web Services, XML)

# ***DomoPredict Aml goals***

Taking advantage of the semantic offered by the DomoNet framework:

Goals:

- Anticipate user actions
- Take customized user decisions
- Anticipate user needs
- Infer particular state of illness or discomfort

To reach these objectives the system must:

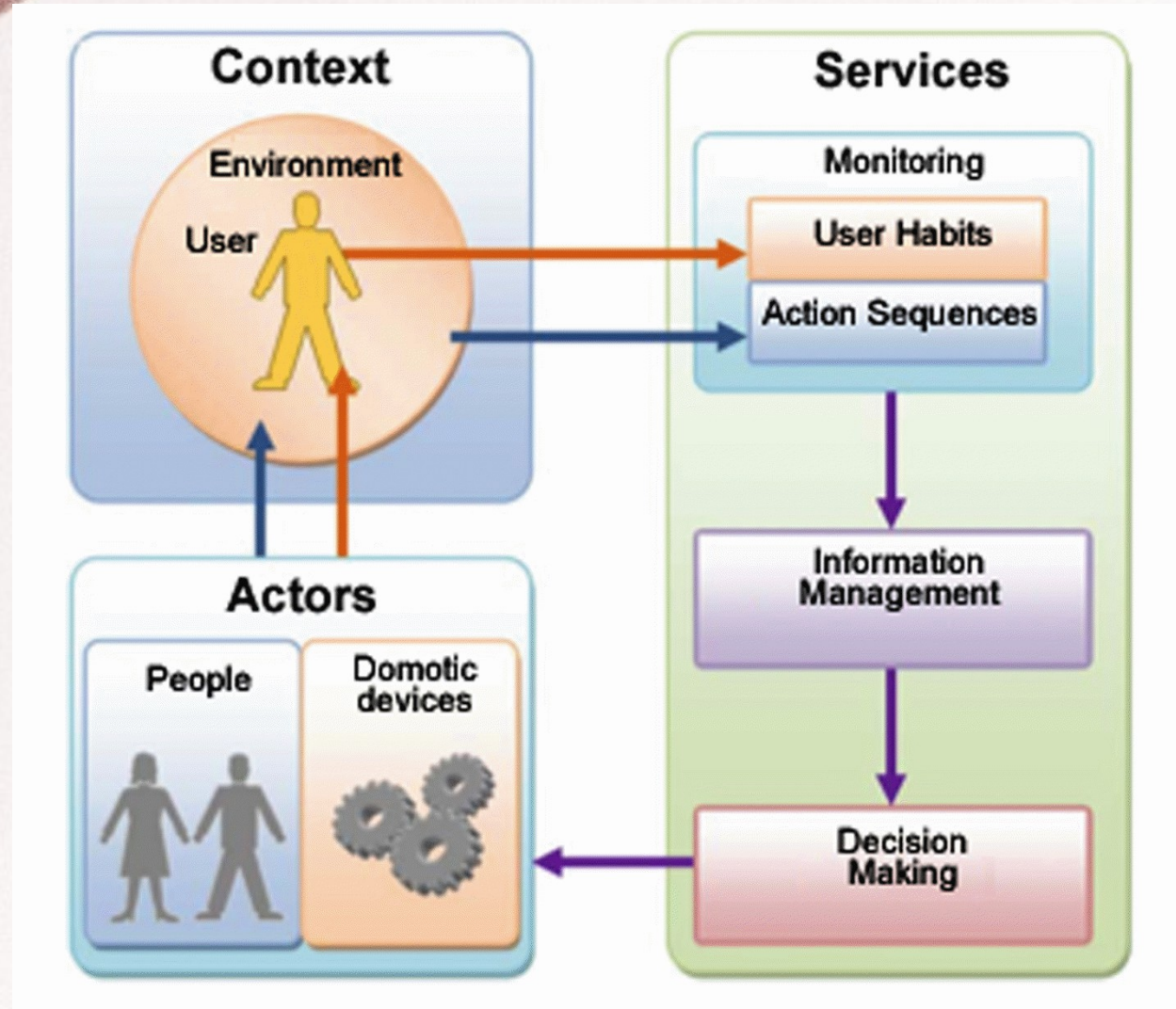
- Learn user habits obtained monitoring his actions
- Analyze data provided by domotic home environment
- Act in place of user



# ***DomoPredict Aml approach***

- Open source prototype developed by our laboratory
- Use of W3C open source tools and standard (Web Services, XML)
- It belongs and exploits the DomoNet architecture features

# *DomoPredict LifeCycle*

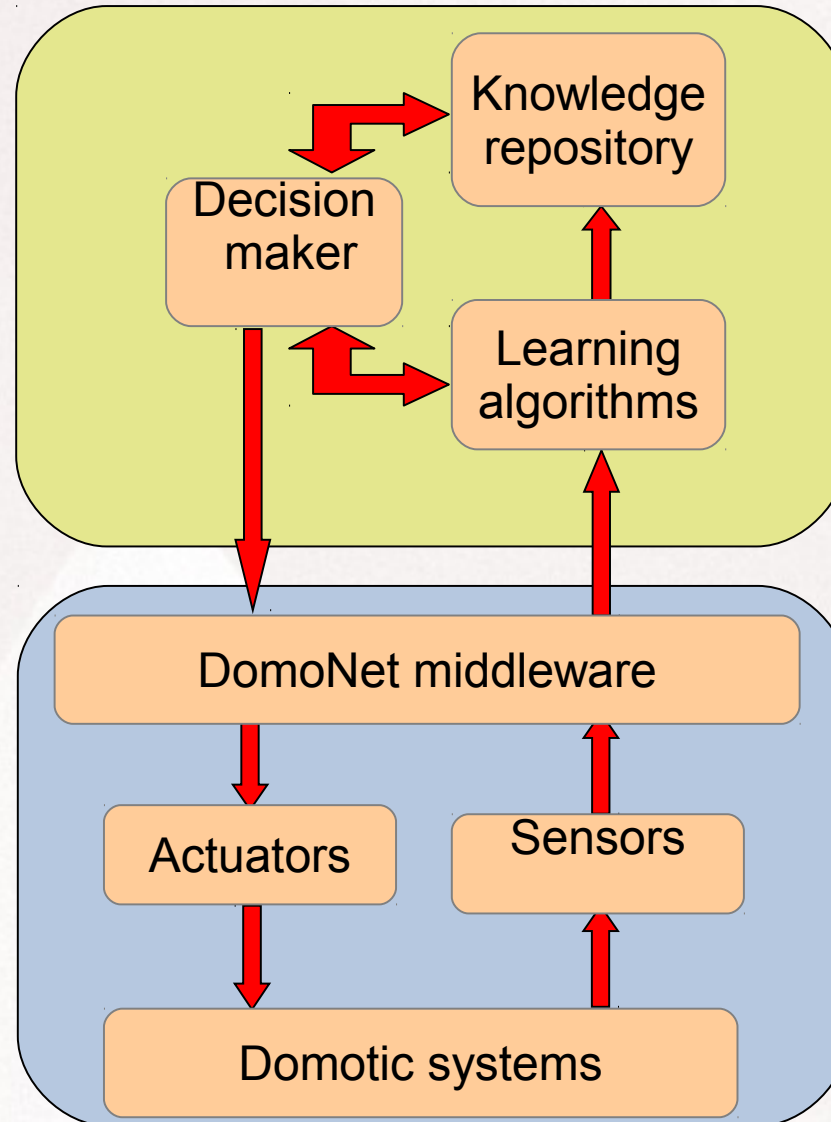


# *DomoPredict*

## *Innovative approaches*

- Agent programmed rules approach (against pre-programmed and user-programmed rules)
- Innovative hybrid approach:
  - Data Mining paradigm: association rules with Apriori algorithm). When inferred rules are still few, a low confidence parameter is used. Two or more actions are considered correlated if they are executed within a prefixed time window
  - Statistical paradigm: to learn user specific profiles not covered by the data mining approach (like temperature and music preferences)
- Temporal and not temporal related scenarios
- Reinforcement function: when user unconsciously correct undesired or incorrect system actions

# *DomoPredict Architecture*



# ***Validation and Tests***

- Monitoring activity of real situations for 1 month with 4 different people
- System validation according to K-Fold Cross Validation method
- Data divided into 4 sets, each corresponding to one week of data collection
- Best result were obtained setting the size of the time window to 15 minutes (89%) of accuracy

# **DAGON**

- DomoNet and DomoPredict framework are part of the DAGON project.
- DAGON = Domotics, Automation and Orchestration Government Network
- The project aims to develop an integrate platform for advanced domotic services for home environment and in particular for yachting
- The project is created by the European Regional Development Fund (ERDF) Competitiveness and Employment CREO POR 2007-2013 and region of Tuscany offers its financial contribution to companies and public administration organizations

# *Conclusions*

DomoPredict framework learns from the experience to execute automatically habitual actions. All framework potentials could be used to identify unusual and dangerous users behaviours because it is able to recognize user habits and to anticipate user needs.

Through DomoNet framework, DomoPredict is able to interact with heterogeneous domotic systems (send commands and receive status) and so, to interact with varied environment.

## ***Future works***

Adding to DomoNet framework semantic functionalities to improve inference algorithms and the introduction of a natural language capabilities to interact with the system.

Specialize the DomoPredict framework for anticipate ealth problems (hart attach and so on) quicker than traditional tele-care systems.



# *Contacts*

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