



Butler-ising HomeManager: a Pervasive Multi-Agent System for Home Intelligence

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Outline

- ◆ Introduction and context
- ◆ Home Manager: new scenario
- ◆ Next steps and future work
- ◆ Conclusion

- ◆ Home appliances / devices becoming smarter and connected
- ◆ New pervasive scenario in many application fields
 - Remote appliance monitoring /control for
 - ◆ Energy saving
 - ◆ Air conditioners control
 - ◆ ...
 - Domotics
 - Ambient Intelligence (Aml)
 - Smart Environments
 - ...

Focus onto *people's needs*:

- User-friendliness
- User-empowerment
- Support for advanced human interaction



Context: State of the Art

Several tools, devices and apps offer

- ◆ Remote Control
- ◆ Real-time Online Monitoring (energy, alarm,...)
- ◆ Check your data anywhere, anytime..



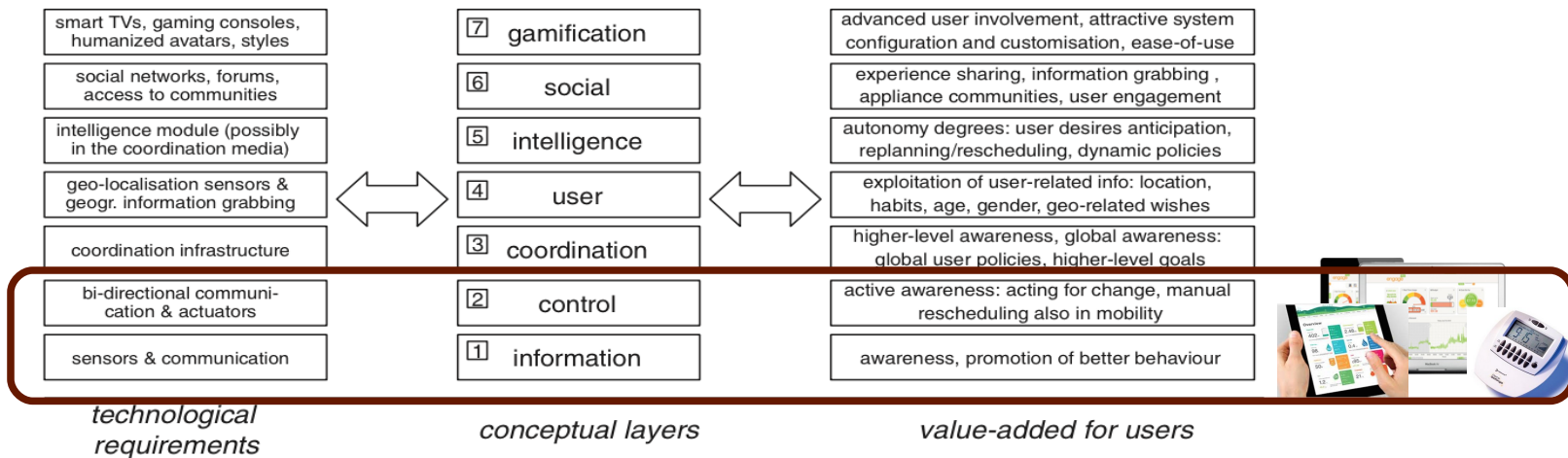
But..

- ◆ Still focused on *monitoring and controlling*
- ◆ No actual embedded intelligence
- ◆ No idea of exploiting the user habits & data in any way

One step further: the Butlers Architecture

The Butlers Architecture (Denti, 2014) defines a multi-layer framework aimed at

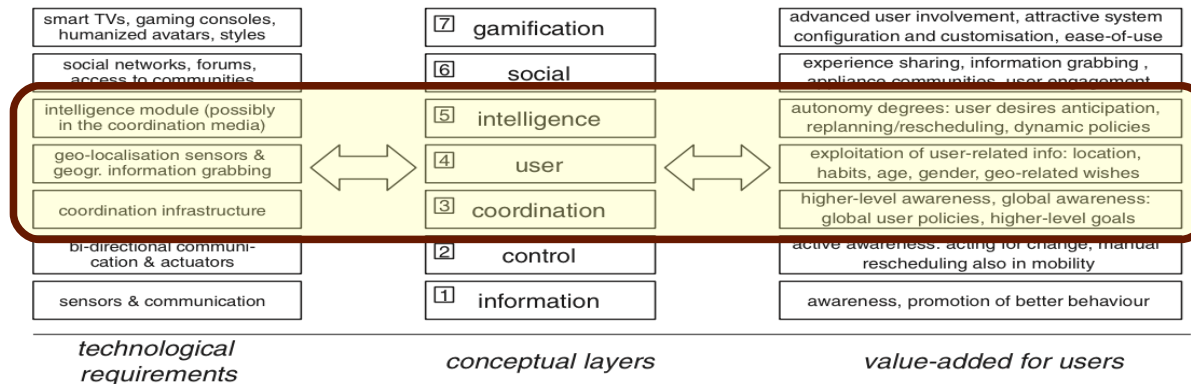
- ♦ Identifying different layers of existing/desirable features, going well beyond the simple monitoring and control
- ♦ Relating technologies with the expected value-added for users



New Objectives

In such a context, new application scenarios become possible

- ◆ Higher value-added for users
- ◆ New intriguing possibilities and features



Our aim

Extend a Home Intelligence Application prototype towards the layers 4-5 (Home Manager System - currently supporting levels 1-3)

Butler-ising Home Manager

Our aim

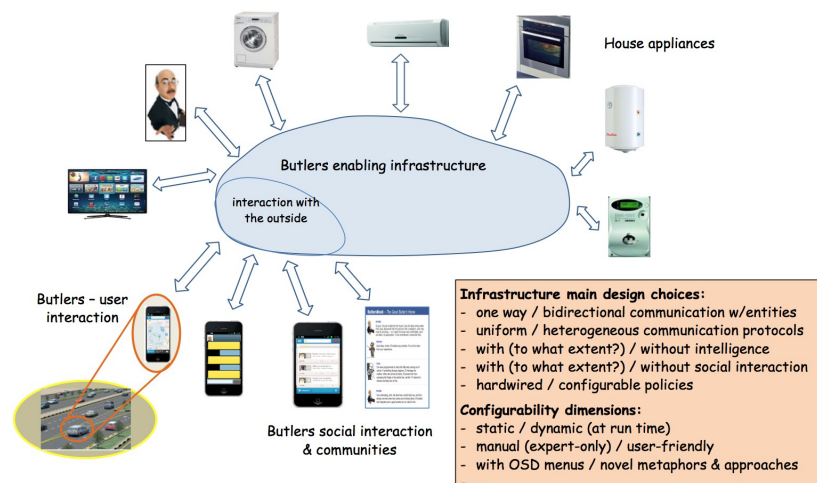
Extend a Home Intelligence Application prototype towards the layers 4-5
(Home Manager System - currently supporting levels 1-3)

- Add support for mobility, enabling users to operate on the home appliances remotely
- Geo-localise the user in real time, reifying this information into the system
- Exploit this information to detect relevant user patterns



One more step towards the Butlers vision

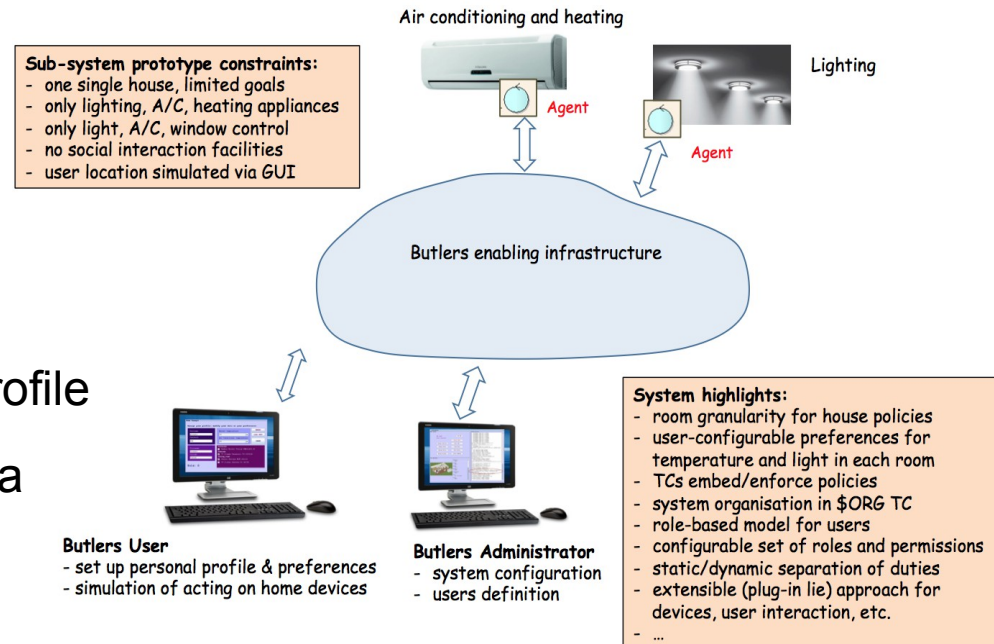
- ◆ The intelligent *butler* handles the appliances w.r.t. user goals and configurable policies
- ◆ *Anticipates the user's needs* by exploiting any kind of user information (position, habits, mood..)



Home Manager 1.5

Agent-based application for the control of an intelligent home

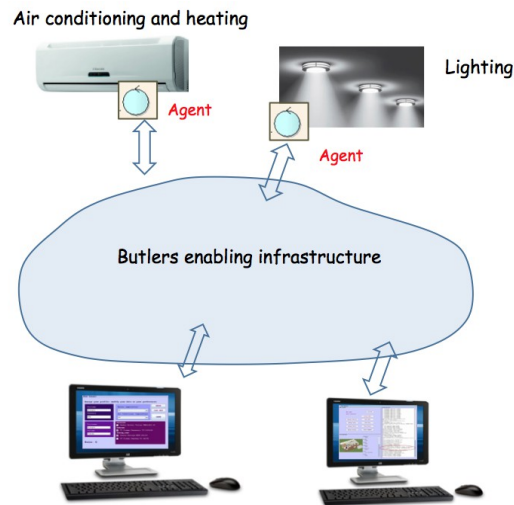
- 😊 Basic set of home appliances / devices
- 😊 Basic support to policies and user goals
- 😊 Users preferences
- 😊 RBAC model
- 😐 No mobility aspects
- 😐 No remote control capabilities
- 😞 No exploitation of the user's profile
- 😞 No exploitation of dynamic data



Extending Home Manager

Home Manager 1.5

- ☹ No mobility aspects
- ☹ No remote control capabilities
- ☹ No exploitation of user's profile
- ☹ No use of dynamic data



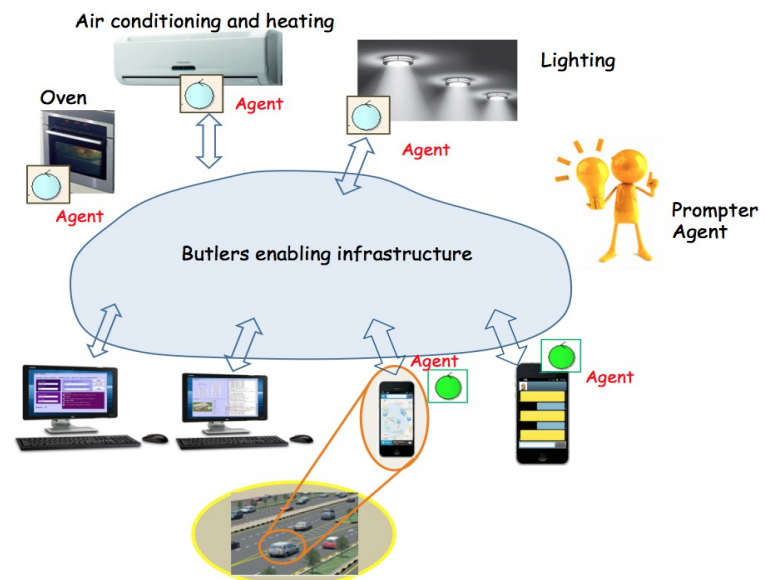
Butlers User
 - set up personal profile & preferences
 - simulation of acting on home devices

Butlers Administrator
 - system configuration
 - users definition

Home Manager 2.0

Foundations for "pervasive" and "ubiquitous" extensions

- 😊 Android app
- 😊 Android app: remote control
- 😊 Prompter agent: reasoning
- 😊 Geo-localisation



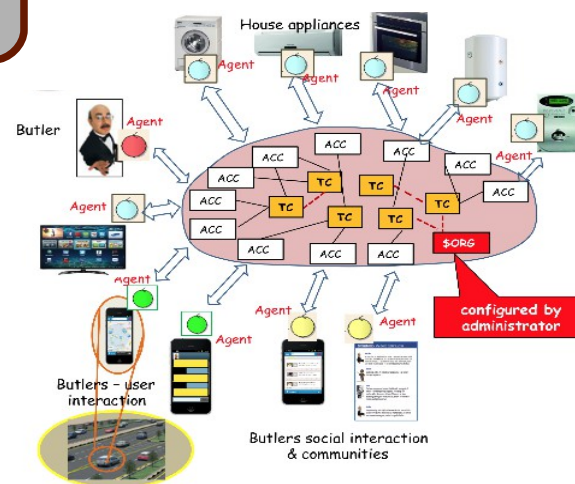
Design: following the Butlers architecture

- ◆ Technology-neutral (provided that some key requirements are met)
- ◆ But *naturally suited to an agent-based approach*
 - + Agent-based approach is adopted
 - + Suitable agent-based coordination infrastructure
 - + Supports for embedded intelligence

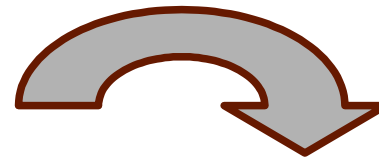
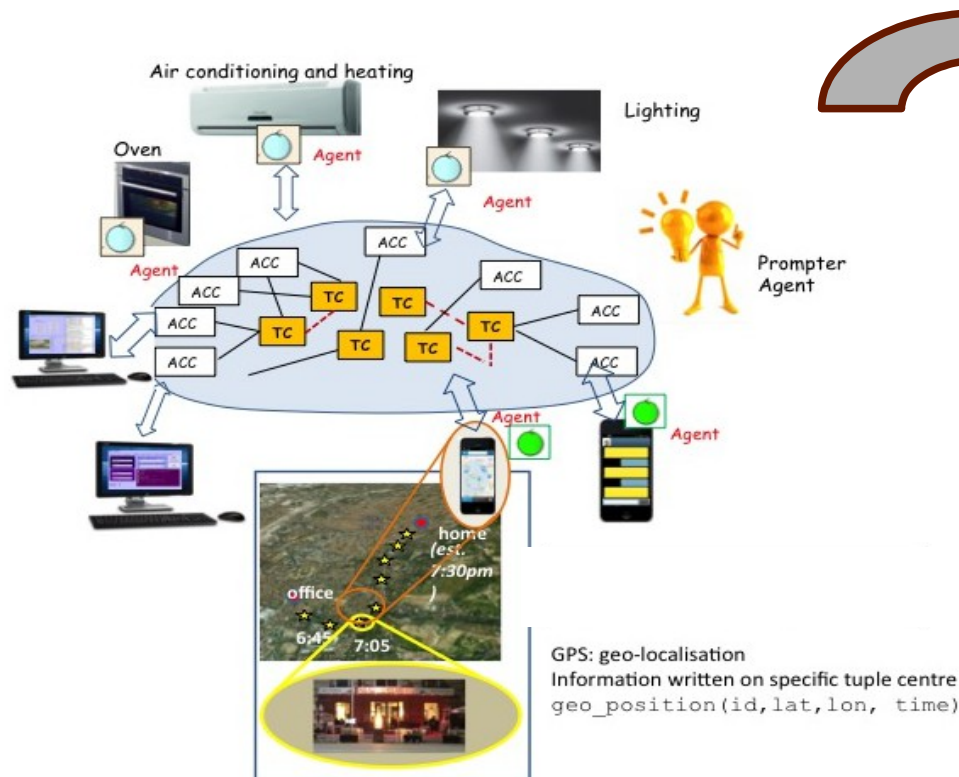
TuCSon (*Tuple Centres Spread over the Network*)

a model and infrastructure for the coordination of distributed processes, and autonomous, intelligent & mobile agents

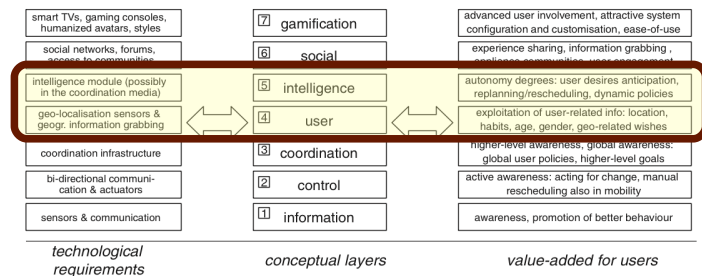
- ◆ **Agents:** *coordinables* (embed local intelligence)
- ◆ **Tuple centres (TC):** **programmable** coordination media (embed social intelligence)
- ◆ **Nodes:** basic *topological abstraction* (host the TCs)
- ◆ **Agent coordination contexts (ACCs):** filter access /grant use rights to agents



From architecture to Home Manager Scenario



User geo-localisation (lev. 4)
Prompter Agent intelligence (lev. 5)



Prompter Agent:

- Exploits information to take autonomous decisions
- Anticipates users' needs
- Handles the appliances

Scenario in detail

Ann is stopping at Henry's Take Away Pizza on her way home.



GPS

Home Manager
Android App



IN on the
tuple centre

Location tc

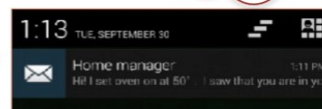
`geo_position(Ann, 61, 88, '7:30 pm')`



Hey, Ann is taking
a pizza tonight.



Switch the
oven on



Send her a
notification

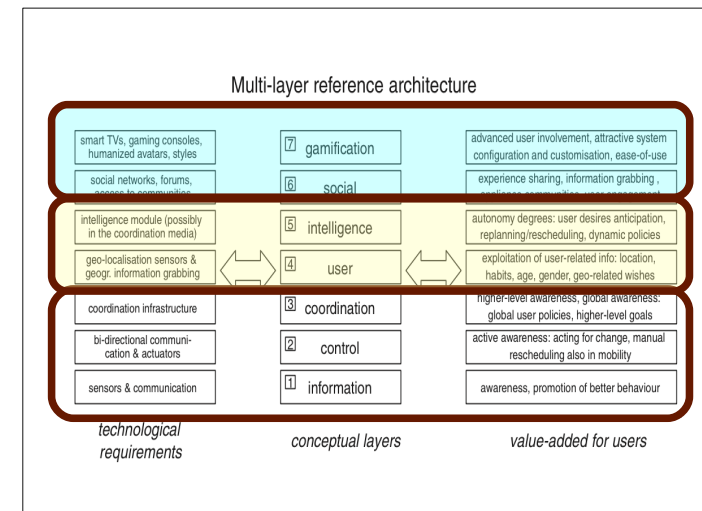
Next steps

Extension towards pervasive and ubiquitous contexts

- ◆ Adding the notion of user's favorites (possibly importing from social networks Facebook, Google+, ..)
- ◆ Integrating the system with Google Maps to grab the user's check-in location
- ◆ Testing the connection to real devices
- ◆ Improving reasoning of the prompter agent

In the perspective:

- ◆ Exploiting of situatedness, intended as the strict coupling with the environment
- ◆ Exploiting of social and gamification aspects



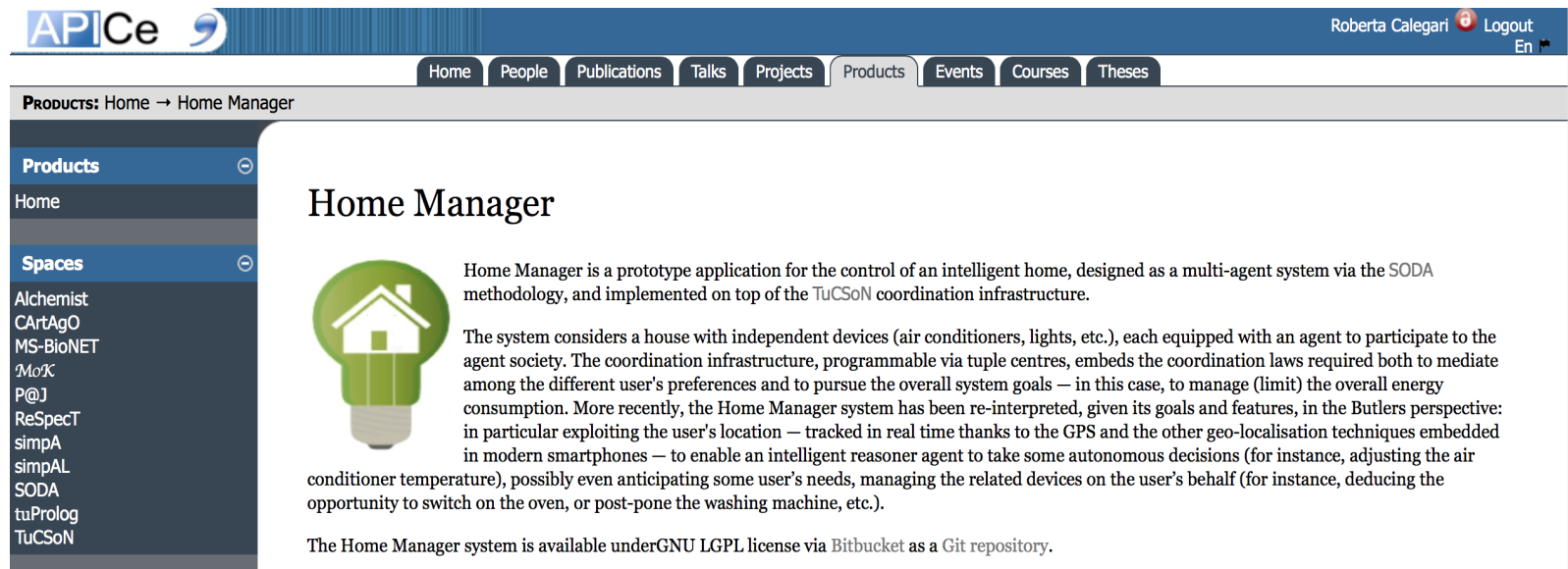


Conclusions

- ♦ The potential and feasibility of **innovative pervasive scenarios** has been shown - one first, yet fundamental, step towards the Butlers upper layers
 - Reifying the user position via geo-localisation
 - Adding the ability to reason over such information
 - Enabling the anticipation of the user's needs
 - Highlights the potential of the innovative pervasive scenarios

Home Manager: home sites

- ◆ <http://apice.unibo.it/xwiki/bin/view/Products/HomeManager>
- ◆ <https://bitbucket.org/tuprologteam/homemanager>



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simpAL
SODA
tuProlog
TuCSoN

Home Manager



Home Manager is a prototype application for the control of an intelligent home, designed as a multi-agent system via the SODA methodology, and implemented on top of the TuCSoN coordination infrastructure.

The system considers a house with independent devices (air conditioners, lights, etc.), each equipped with an agent to participate to the agent society. The coordination infrastructure, programmable via tuple centres, embeds the coordination laws required both to mediate among the different user's preferences and to pursue the overall system goals — in this case, to manage (limit) the overall energy consumption. More recently, the Home Manager system has been re-interpreted, given its goals and features, in the Butlers perspective: in particular exploiting the user's location — tracked in real time thanks to the GPS and the other geo-localisation techniques embedded in modern smartphones — to enable an intelligent reasoner agent to take some autonomous decisions (for instance, adjusting the air conditioner temperature), possibly even anticipating some user's needs, managing the related devices on the user's behalf (for instance, deducing the opportunity to switch on the oven, or post-pone the washing machine, etc.).

The Home Manager system is available under GNU LGPL license via Bitbucket as a Git repository.



Thank you.

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