





A Web Based Approach to Virtual Appliance Creation, Programming and Management

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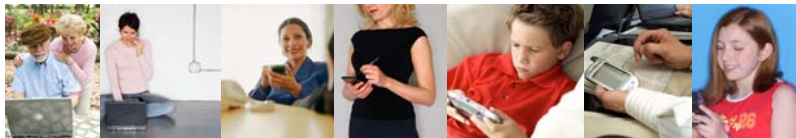
Digital-age Era

- The Internet and Web technology is advancing at a frantic pace, expanding into almost every aspect of our everyday life.
- People use it to shop, learn, share, play, read, research, send messages and even for social networking.
- One of the latest scientific uses for the Internet and the Web is the so-called pervasive or ubiquitous computing where networking plays a vital role in its core computational framework.
- In this, people are able to use the Internet and Web to manage the operation of embedded network devices, services and to coordinate their services in ways that create applications such as smart-homes, smart-offices, smart-cars etc, collectively referred to as intelligent environments.

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End users in digital-age era

- How would ordinary people, non-technologists, interact with the technology in the environment they are in? Would technology understand people's commands? Would people understand the technology response?
- Research in the area employs different approaches – from application-specific intuitive user-interfaces, via voice-command, through gesture recognition or touch interfaces, to generic web interfaces, all of which seek to enable users to control their environment.
- A recent approach to empowering users to customise the functionality of their environments is end-user programming.

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Pervasive Interactive Programming (PiP)

- Pervasive Interactive Programming (PiP) is a method that allows end users to customise their electronic environment by simply demonstrating examples of the behaviour they require.
- It involves a computational framework and can be viewed as a variant of the Programming-by-Example paradigm (show me by example).
- The main objective is to allow non-technical people to construct novel collections of multiple networked devices to coordinate a series of actions (with/without conditions). These collections are called 'virtual-appliances'.
- A basic example of a virtual appliance could be the interaction that a ringing telephone can make with other devices to carry out other functions, such as pausing the TV.

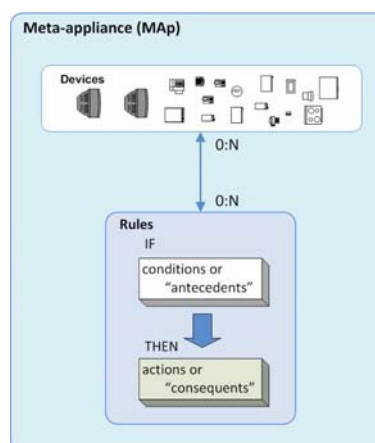
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PiP Concept

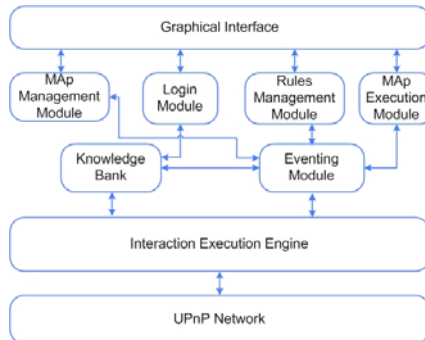
- Event-based architecture
- Works in real-time
- 'Listens' to the network

In PiP a 'virtual-appliance' is represented as a Meta-appliance (MAp) which define the membership set of 0-n device corresponding to 0-n rules which are created by an end user.

Rules in PiP contain sets of conditions or "antecedents" and actions or "consequents". Actions are only executed if all the conditions within the rule are satisfied.

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PiP Architecture



- Graphical Interface
- Map Management Module
- Login Module
- Rules Management Module
- Map Execution Module
- Knowledge Bank
- Eventing Module
- Interaction Execution Engine
- UPnP Network



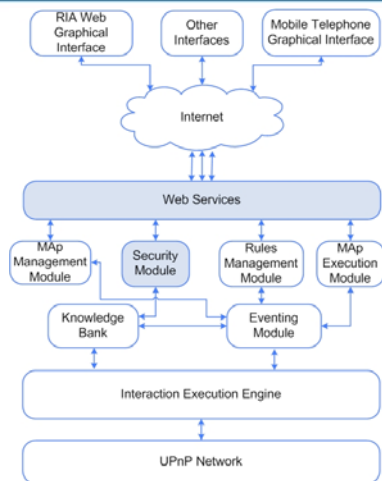
Web GUI Motivation

Although PiP encourages environment personalization (via end users physically demonstrating their desired behaviour by interacting with the environment), there is a need to have a secondary WEB interface because:

- (1) Pervasive devices have become more diversified and can include entities that have no physical form eg. software applications such as iTunes, Word, Calendar etc or abstract quantities such as time, heat etc.
- (2) The need to accommodate multi-level occupancy (people are complex!), different levels of permissions and authority (e.g. large companies) or simple with just one level (e.g. nuclear families).



Enhancing PiP with a Web Based GUI



Web Services

- Allows any device to connect to the environment.
- Creates a standard interface which can be used by any developer to create GUIs.

RIA Web, Mobile Telephone & Other GUIs

- Allows the users to interact with the environment through different devices according to their preferences.

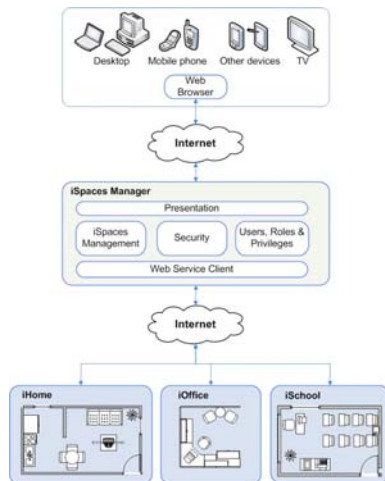
Security Module

- Authenticates and authorizes the users to connect to the environments.
- Verifies the user-privileges schema which manages a user's ability to perform actions based on permissions pre-assigned to them.

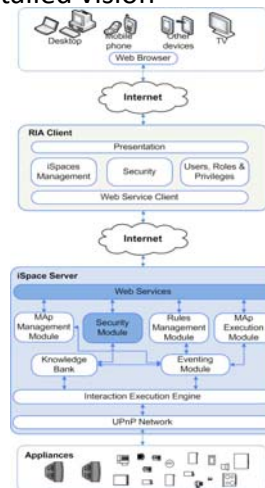


Enhancing PiP with a Web Based GUI (2)

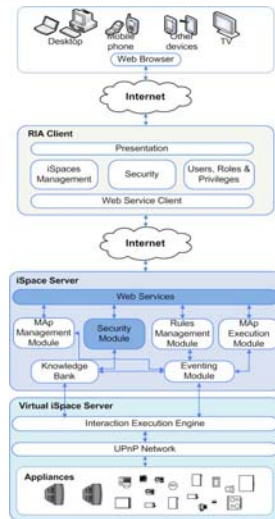
• General vision



• Detailed vision



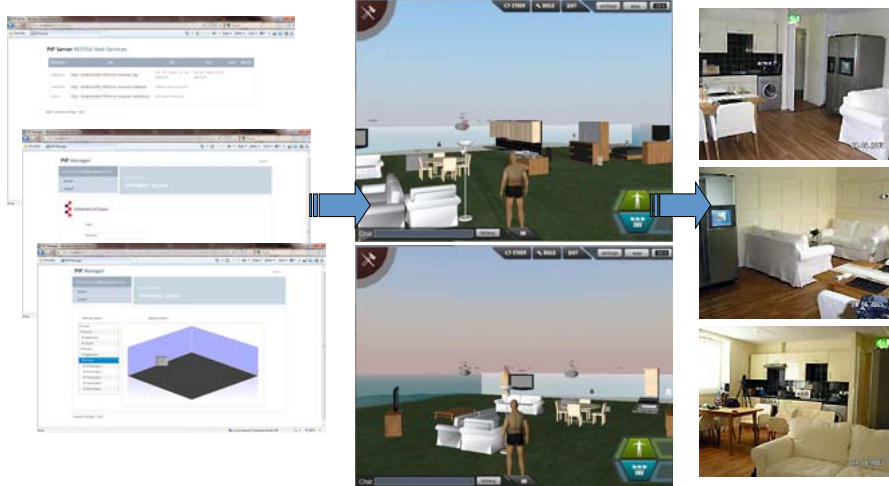
Development testbeds



- Currently tests are being carried out in a new tool; the iWorld developed by Marc Davies at the University of Essex.
- The iWorld is a virtual representation of the University of Essex iSpace, a research facility which provides a flexible testbed for future digital-home technology.
- Everything that what works in the virtual iWorld will work in the real iSpace!

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Development testbeds (2)




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Fictional Scenario

- *“It is a new day at the elementary school...”*




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Conclusions and Future Work

Towards these ends, this work-in-progress paper describes a marriage of a well established and proven architecture, the Pervasive interactive Programming, with a more conceptual distributed web service layer and a Rich Internet Application Interface. Some of the benefits of this are:

- To increase the flexibility of PIP by giving access to multiple and hierarchical web based users.
- To make the use of intelligent environments more versatile (across different platforms), easier and more user-friendly.

While this approach will bring many advantages we acknowledge that there are challenging issues as well, such as ensuring the security and privacy of users on the Internet. Clearly, there will be many lessons to be learnt from this work as it progresses, which we hope to report in subsequent conferences.



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