Technologies for Natural Interaction with Intelligent Environments

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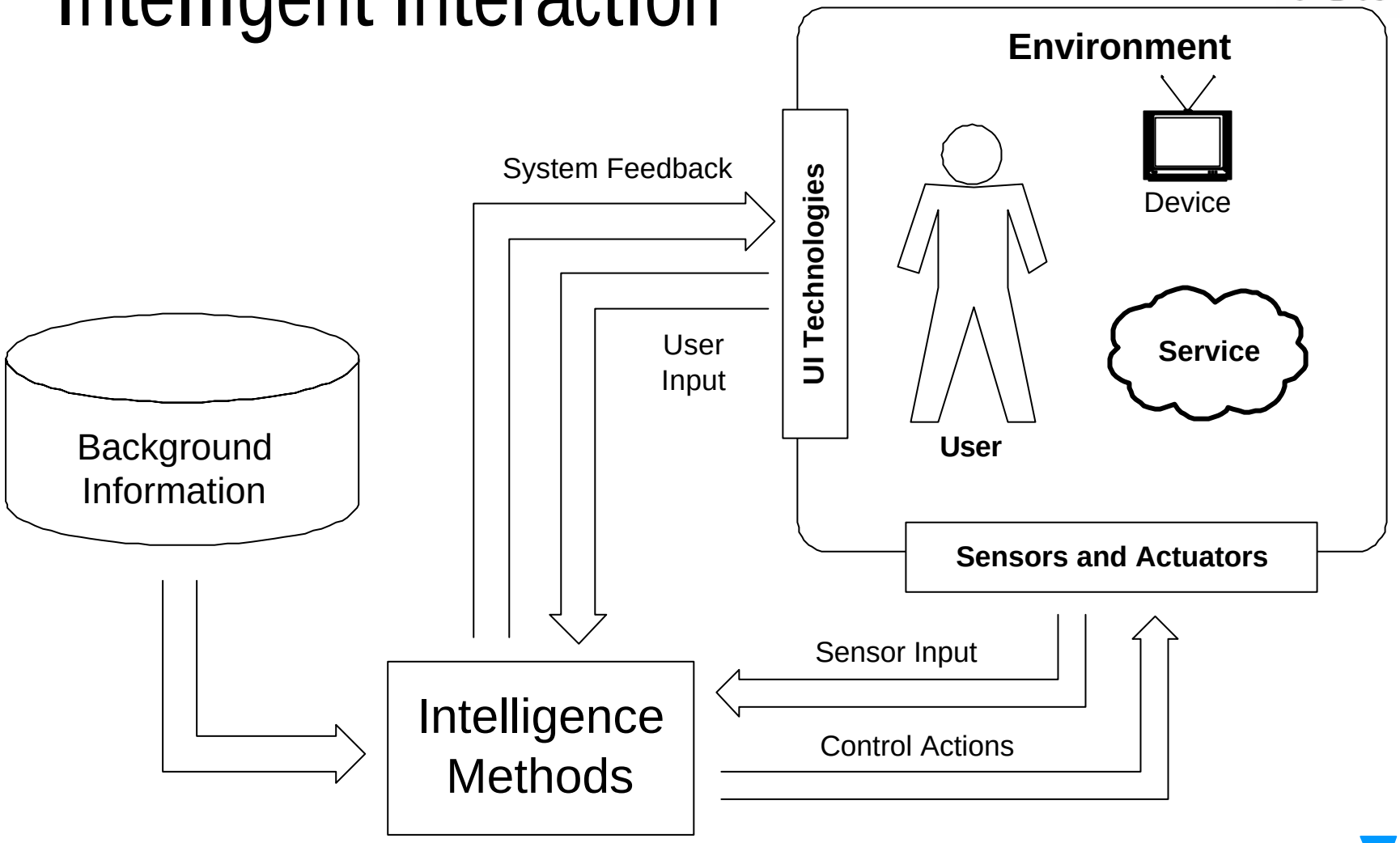
Vision

- Our future environment will actively support us in our activities where-ever and whenever
- We will perceive our environment as ***smart*** because of its *awareness* and *pro-active* behaviour, as well as its ability to *interact naturally* through *multiple modalities*
- The added *ambient* intelligence will not be immediately obvious, but it will be *embedded* and *distributed* in the environment and every day objects, be *ubiquitous*, and operate as *unobtrusively* as possible

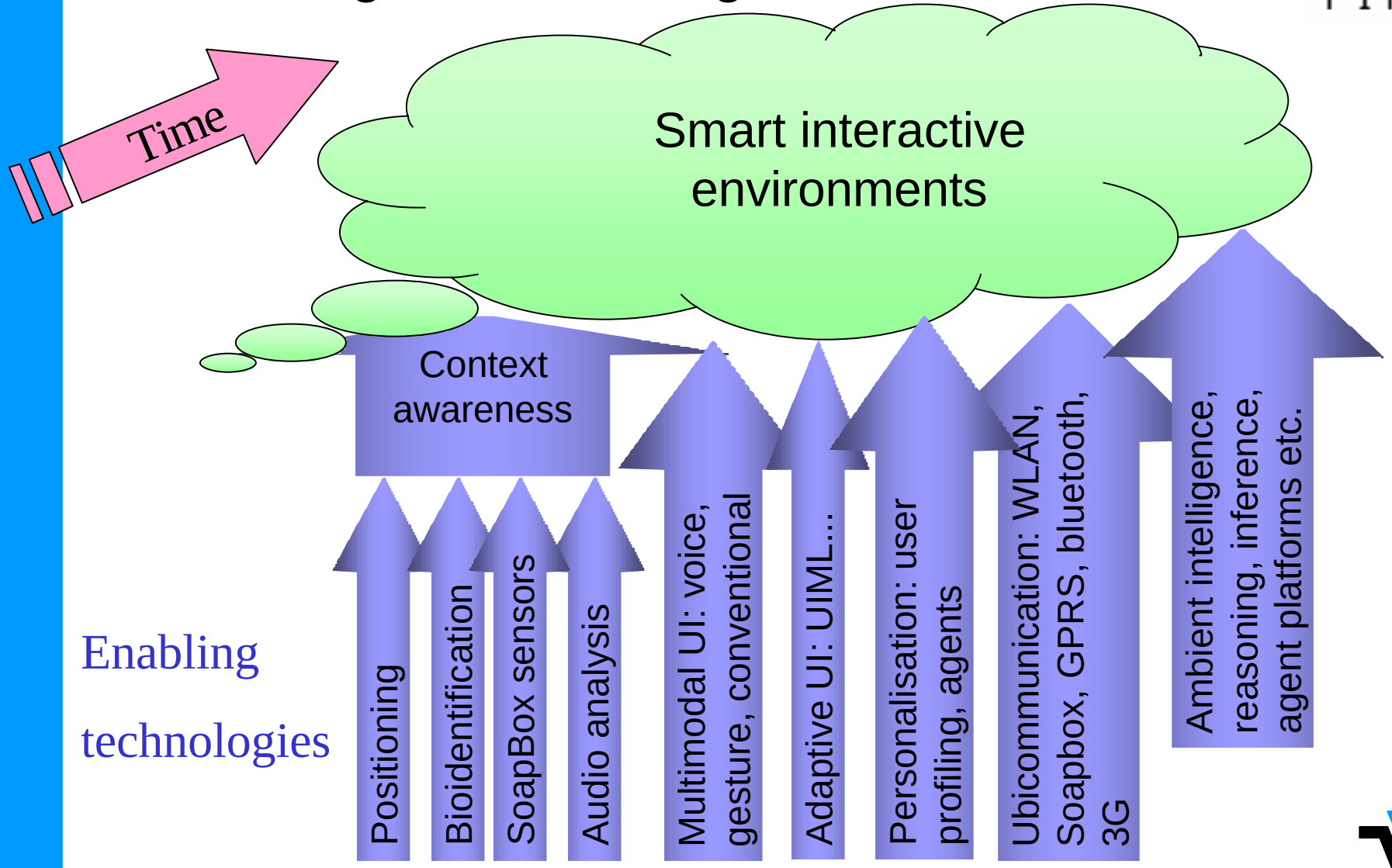
Trends: Towards Natural Interaction

- New modalities & multimodal interaction
  - At least gestures (including pointing) and voice have not been exploited fully
  - Combining modalities to work together (multimodality)
- Awareness
  - Of person - personalisation
  - Of task or objective of user
  - Of context
    - Location, Social (other users), Physical (room, devices)
  - Of UI rendering device features (adaptation)
- Services instead of control
  - Control of several appliances simultaneously to achieve a desired service
  - Pro-active services
- Ubiquity
  - Everywhere & always

Intelligent interaction



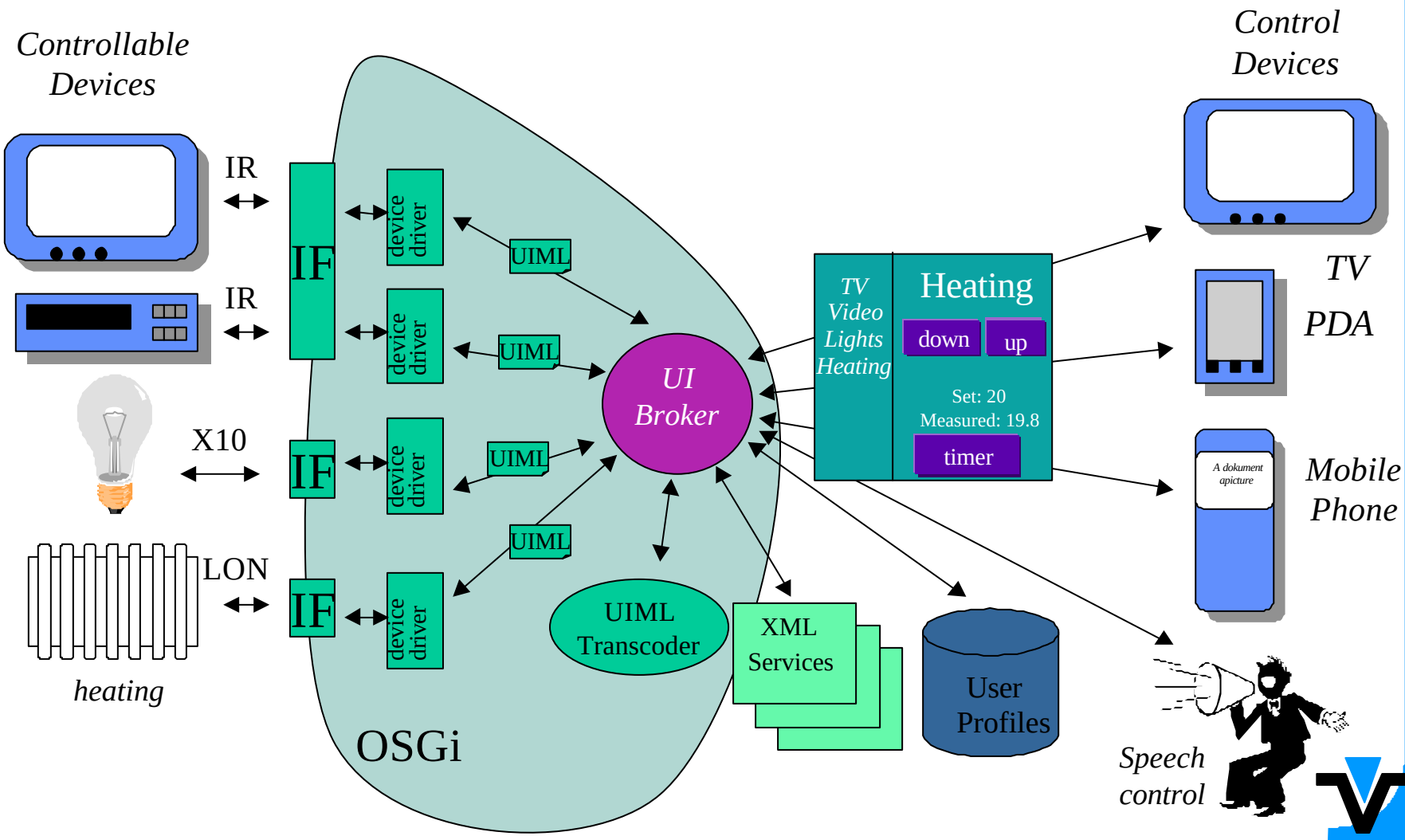
Technologies enabling the vision



HTI Research at VTT Electronics

- Interaction technologies
  - Multimodal interaction
    - Speech-driven user interfaces
    - Gesture based UI (new research)
  - Advanced pointing techniques
  - Generic UI definition & adaptation
- Context awareness
  - SoapBox
  - Sensor based context reasoning
  - Indoor positioning
- Personalisation
  - Bio-identification methods
  - User profiles
- Data visualisation (for industrial applications)

Home Control by means of generic UI



UIML Language Overview

- User Interface Markup Language
  - XML-based language for the definition of user interfaces
- Separation of the UI-presentation and content (interface and non-interface code)
  - structure - Each one of the interface parts
  - content - Allows to specify content (text, sounds, images)
  - behavior - What happens when the user interacts
  - events - The logic and actions associated to events
  - style - Denotes the device-specific presentation style
  - peers - Specifies widgets and methods to associate with the target platform
- Several widget vocabularies have been defined
  - HTML, WML, Java, VoiceXML, Palm OS
  - Need for more generic vocabulary

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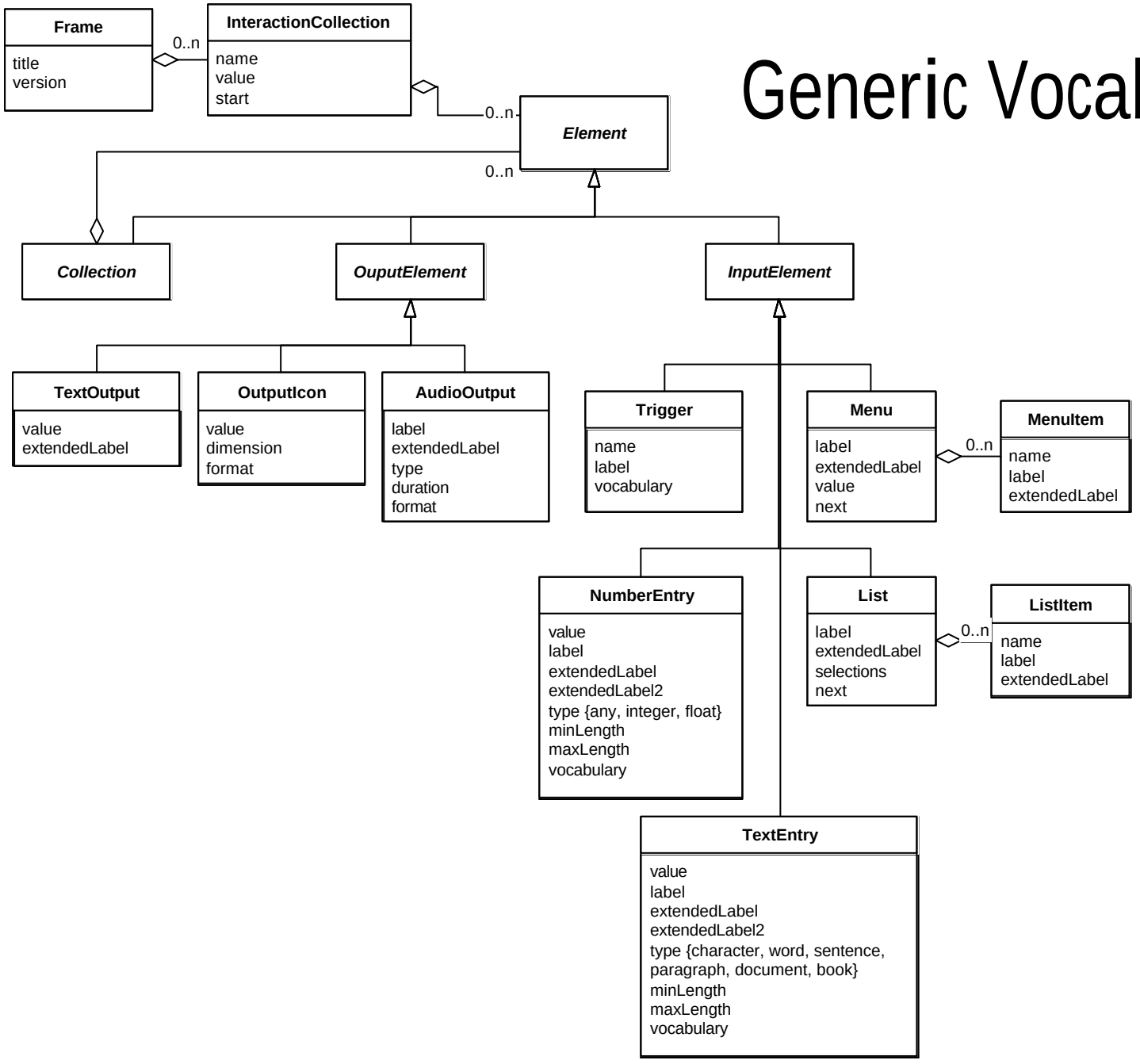
Generic Vocabulary



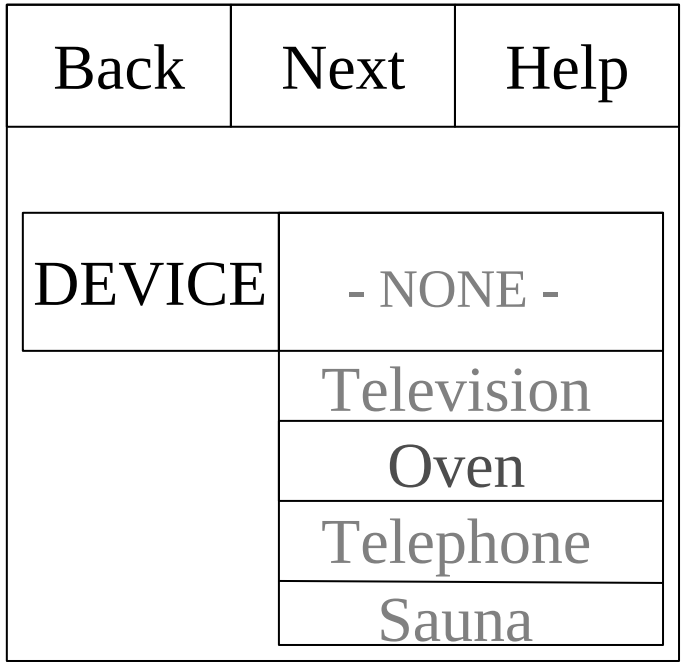
Examples

```
<Menu  label="DEVICE"    extended-label="The devices to control are:" value="NONE">

    <MenuItem  label="Television"    extended-label="One, Television"    />
    <MenuItem  label="Oven"          extended-label="Two, Oven"          />
    <MenuItem  label="Telephone"     extended-label="Three, Telephone"   />
    <MenuItem  label="Sauna"         extended-label="Four, Sauna"        />

</Menu>
```

GUI



SUI

Comp: " *The devices to control are:* "

Comp: " *One, Television.*"

Comp: " *Two, Oven.*"

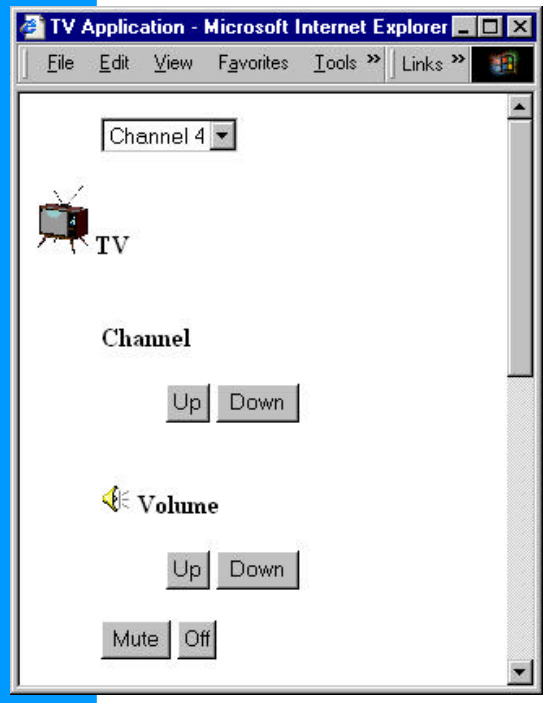
Comp: " *Three, Telephone.*"

Comp: " *Four, Sauna.*"

Human:_ _ _ _

UI examples

HTML



VoiceXML

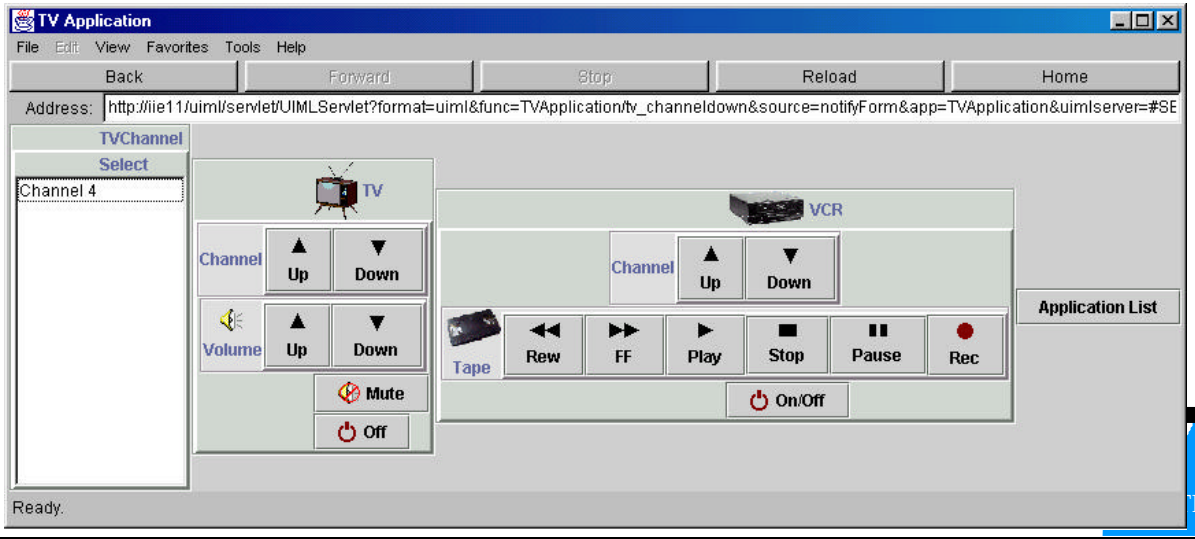
C: Please select your application.

H: TV Control Application

H: TV Power On

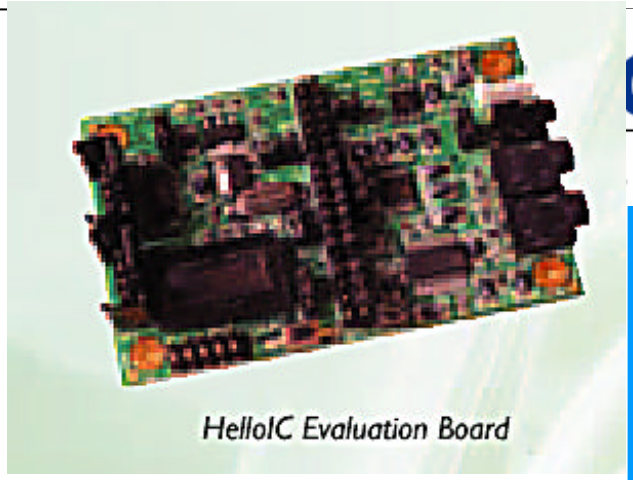
H: TV Channel Up

Java



HW-based voice recognition with

HelloIC

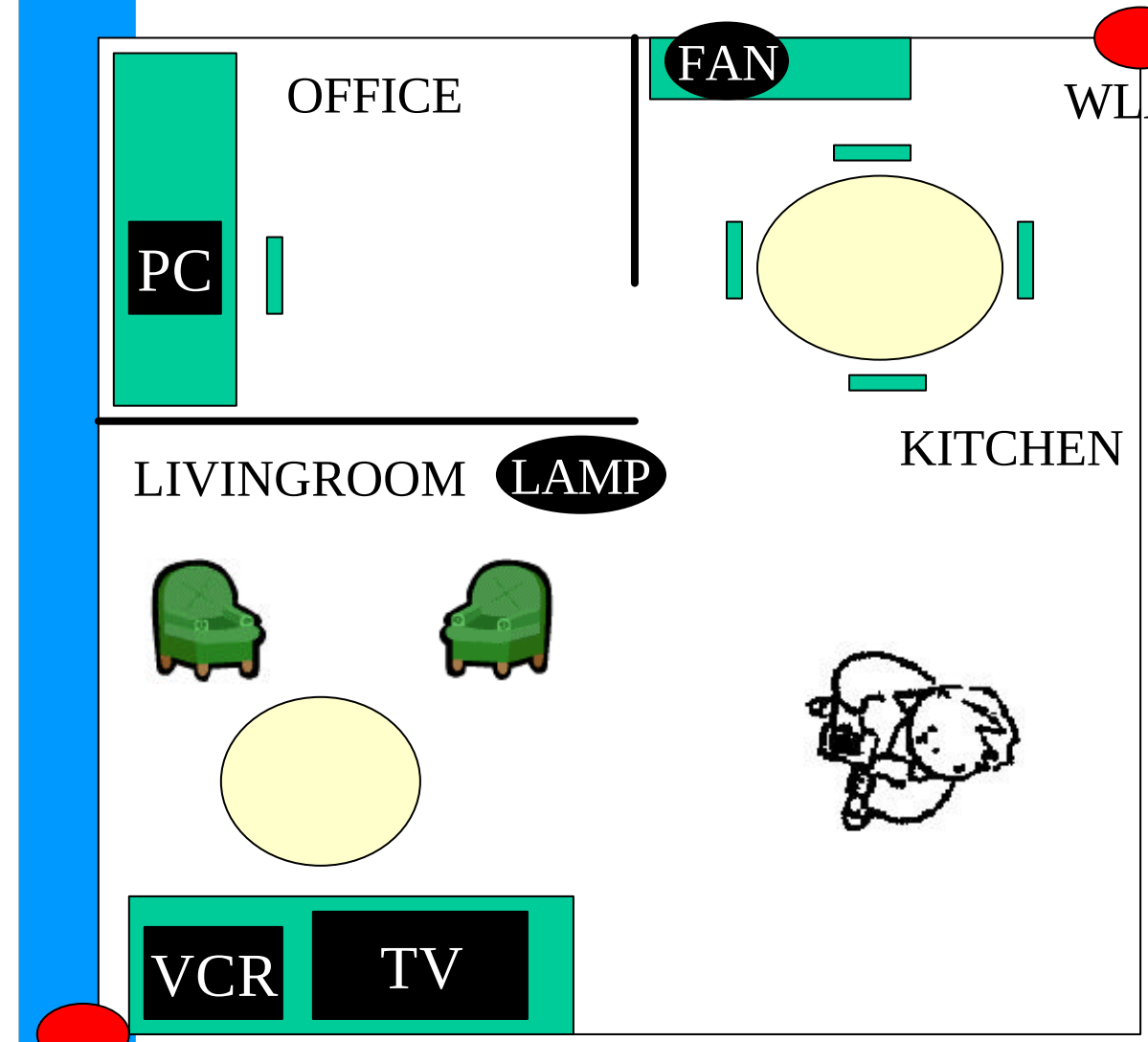

HelloIC Evaluation Board

Key benefits

- Up to 100 words storable on chip
- Up to 50 words active simultaneously
- Dedicated algorithms and language databases for the specific environments
- All memories on chip
- Speaker dependent and independent recognition
- Word spotting and key word activation
- Continuous connected word recognition
- Noise robustness
- Confidence measures
- Optional Acoustic Echo Cancellation (AEC)
- Automotive temperature range (-40 °C to +85 °C)

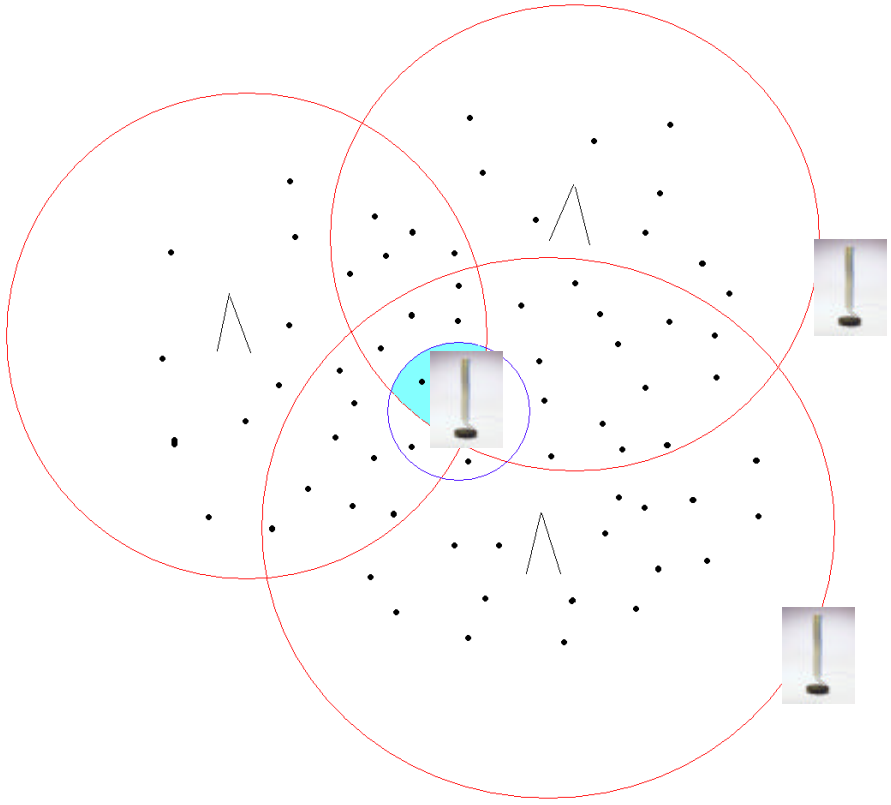
http://www.speech.be.philips.com/vc/media/HelloIC_brochure.pdf

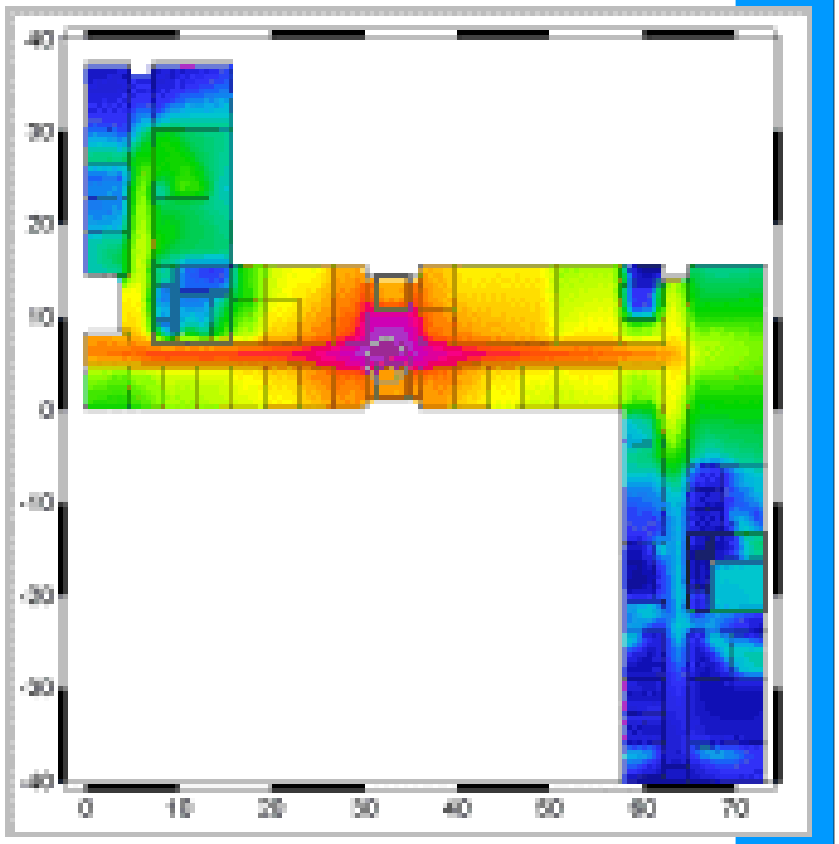
Home environment



Control devices

Positioning with WLAN



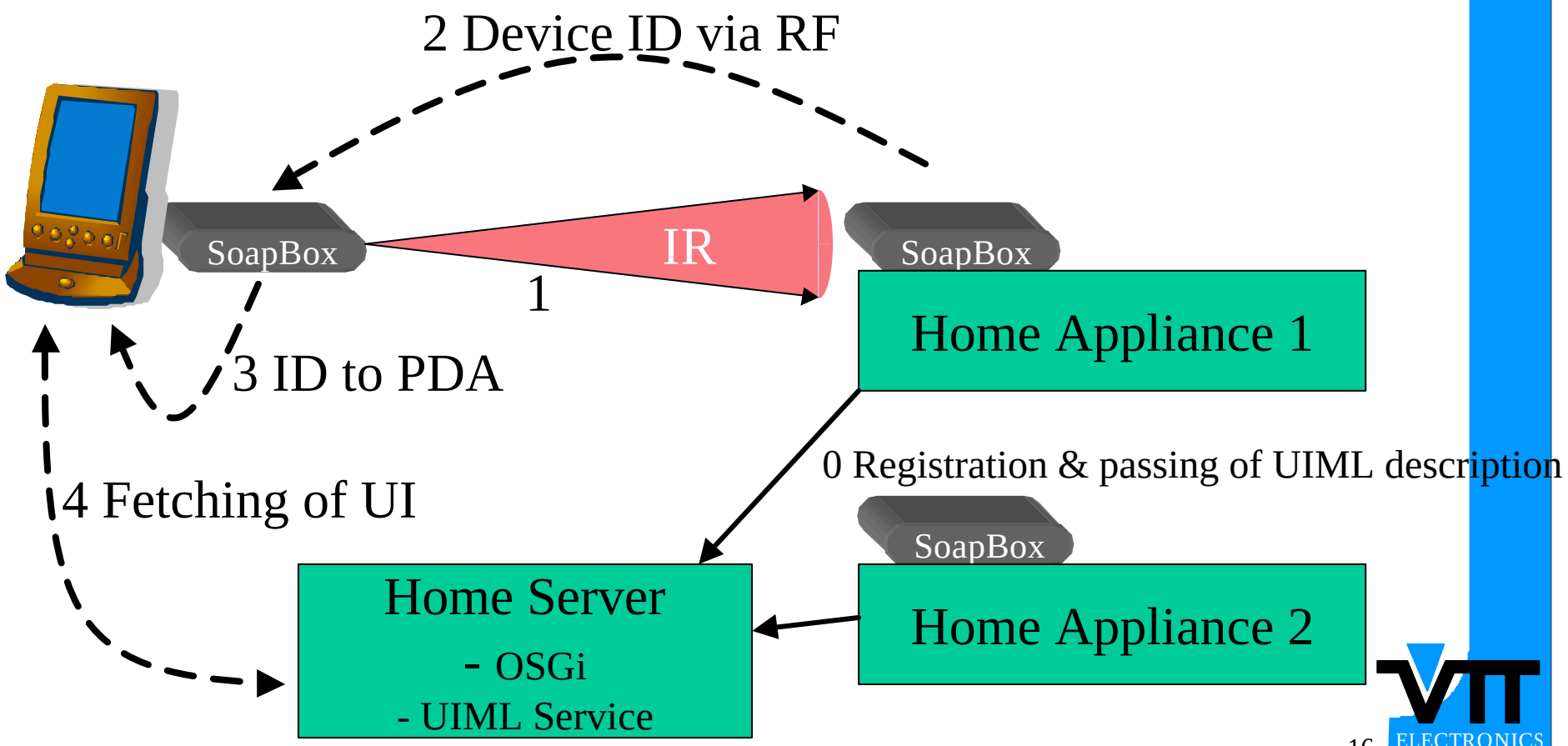


SoapBox Applications

- SoapBox - Sensing, Operating and Activating Peripheral Box
  - Sensors, wireless connection, processing power
- SoapBox opportunities in the home environment
  - Positioning
  - Pointing
  - Gesture UI
  - Control
  - ...
- Pointing aid in home environment
- Gesture UI with SoapBox
  - Example: tilting through the maze
  - Continued in the Ambience project

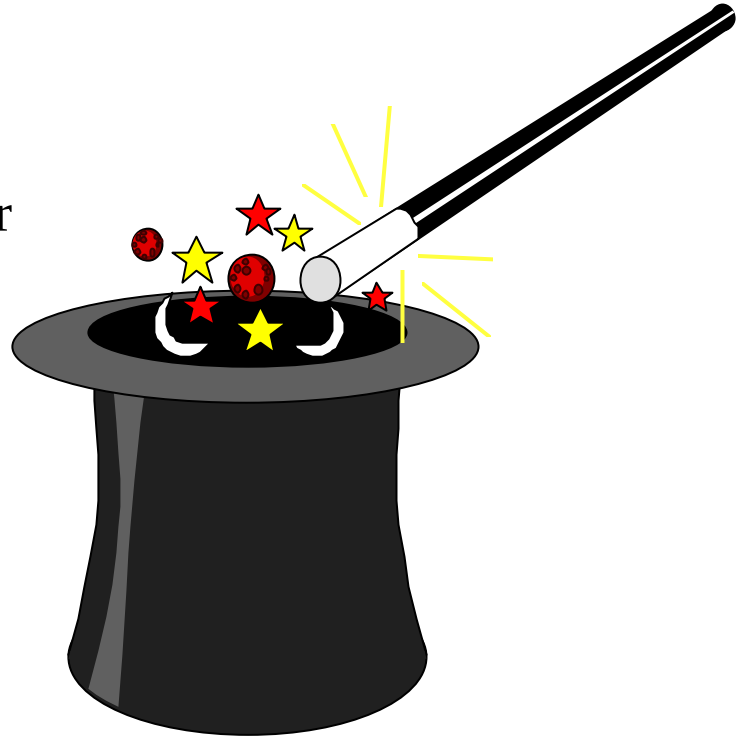
Pointing with SoapBox in the Home environment

SoapBox includes sensors & wireless communication

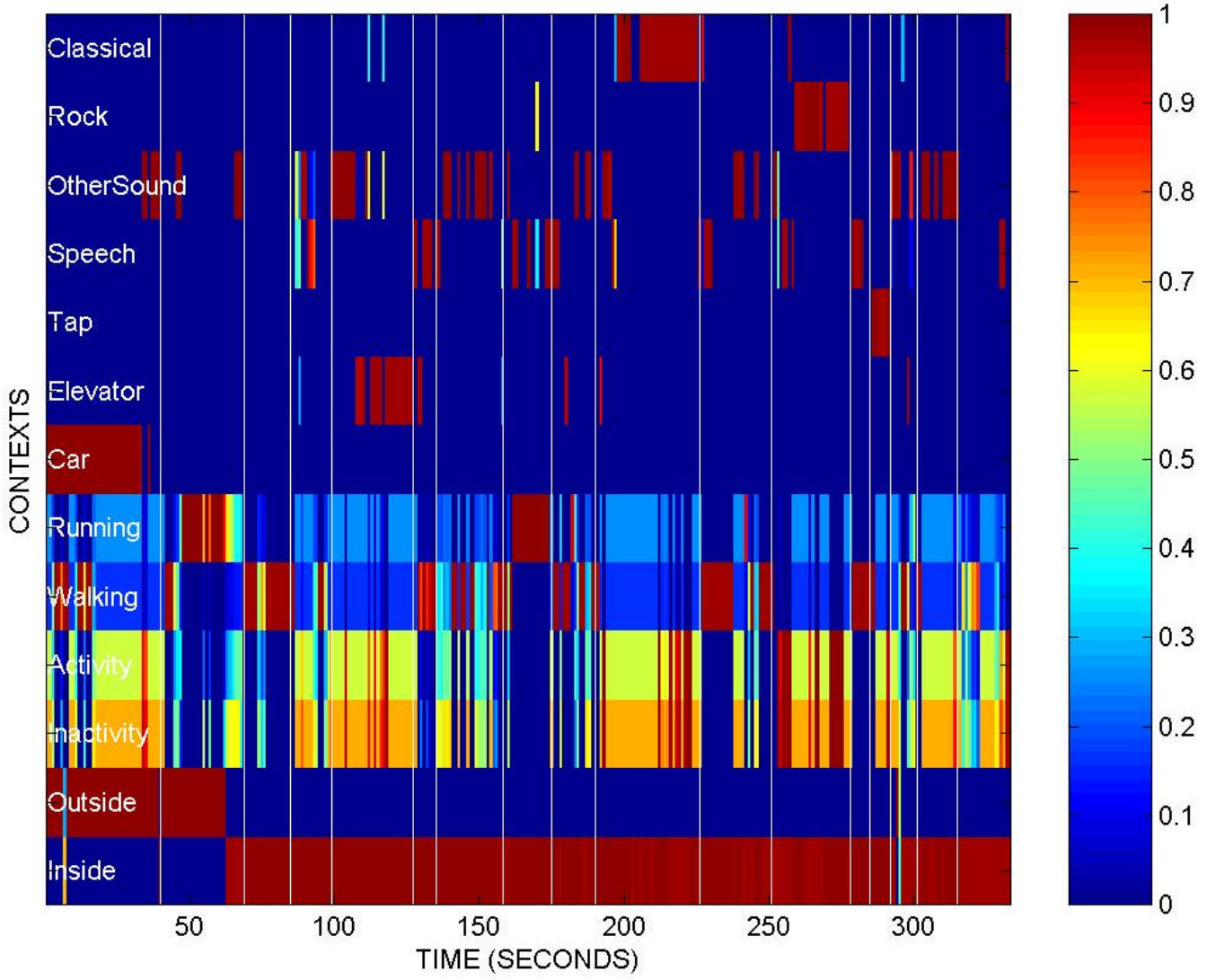


Magic Wand - Action by swaying a stick

- Use a hand-held stick-shaped object as control
  - Movement of the stick is registered
  - A vocabulary of gestures is established
  - Semantics are added to the gestures
  - The gestures are classified and used for control purposes
- Initial prototype
  - SoapBox taped to the end of a stick
  - Measuring accelerometer value wirelessly

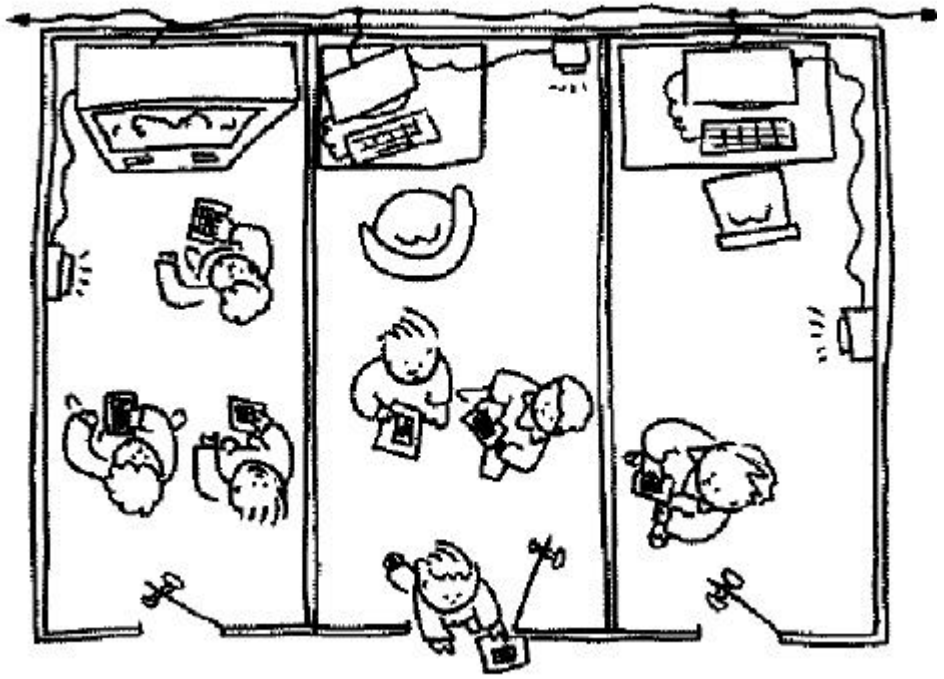


Context from audio analysis



Context aware user profiling

- Traditional - Modelling user interest
  - Monitoring user's behaviour, e.g. visited web pages or services
  - Updating model based on observations
  - Recommending based on model
- Next step - Modelling user behaviour
  - Enhance user model with context information and observed actions
  - Search for patterns
  - Update model
  - Trigger actions and recommendations based on context and user actions
- Enables proactive behaviour of ubiquitous applications
- Co-operation and continuation in the ITEA-Ambience project

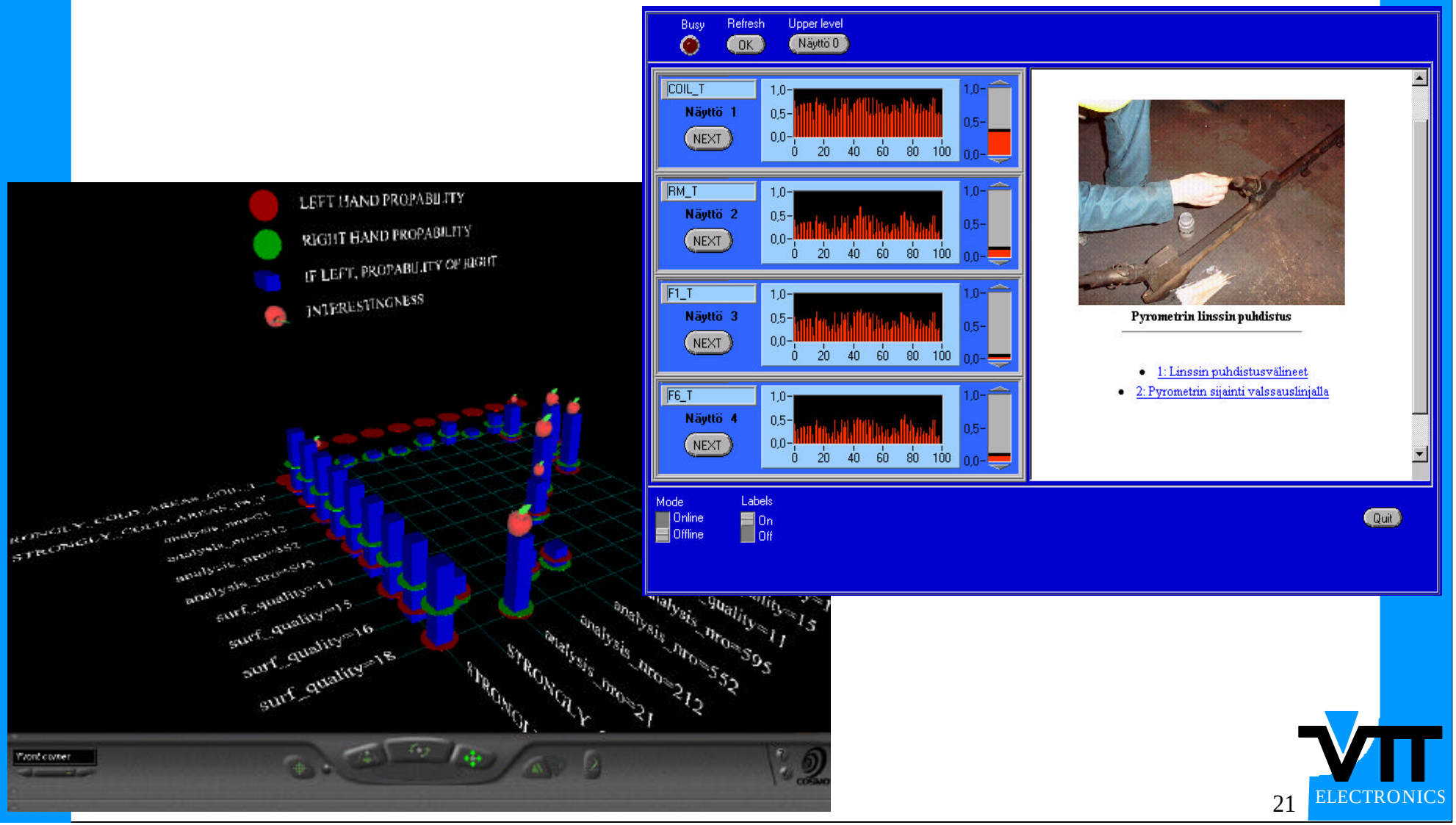


Bioidentification Methods

Menetelmä	Yleispätevyys	Ainutlaatuisuus	Pysyvyys	Helppous	Suorituskyky	Hyväksyt-tävyys	Mahdollisuus kiertää tai väärentää
Kasvot	***	*	**	***	*	***	*
Sormenjälki	**	***	***	**	***	**	***
Kämmenen muoto	**	**	**	***	**	**	**
Näppäily	*	*	*	**	*	**	**
Käden verisuonet	**	**	**	**	**	**	***
Iris	***	***	***	**	***	*	***
Retina	***	***	**	*	***	*	***
Allekirjoitus	*	*	*	***	*	***	*
Ääni	**	*	*	**	*	***	*
Kasvojen lämpökuvaus	***	***	*	***	**	***	***
Tuoksu	***	***	***	*	*	**	*
DNA	***	***	***	*	***	*	*
Kävely tyyli	**	*	*	***	*	***	**
Korvalehti	**	**	***	**	**	***	**

[Lähde, Anil K. Jain, Introduction to Biometrics, Biometrics Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.]

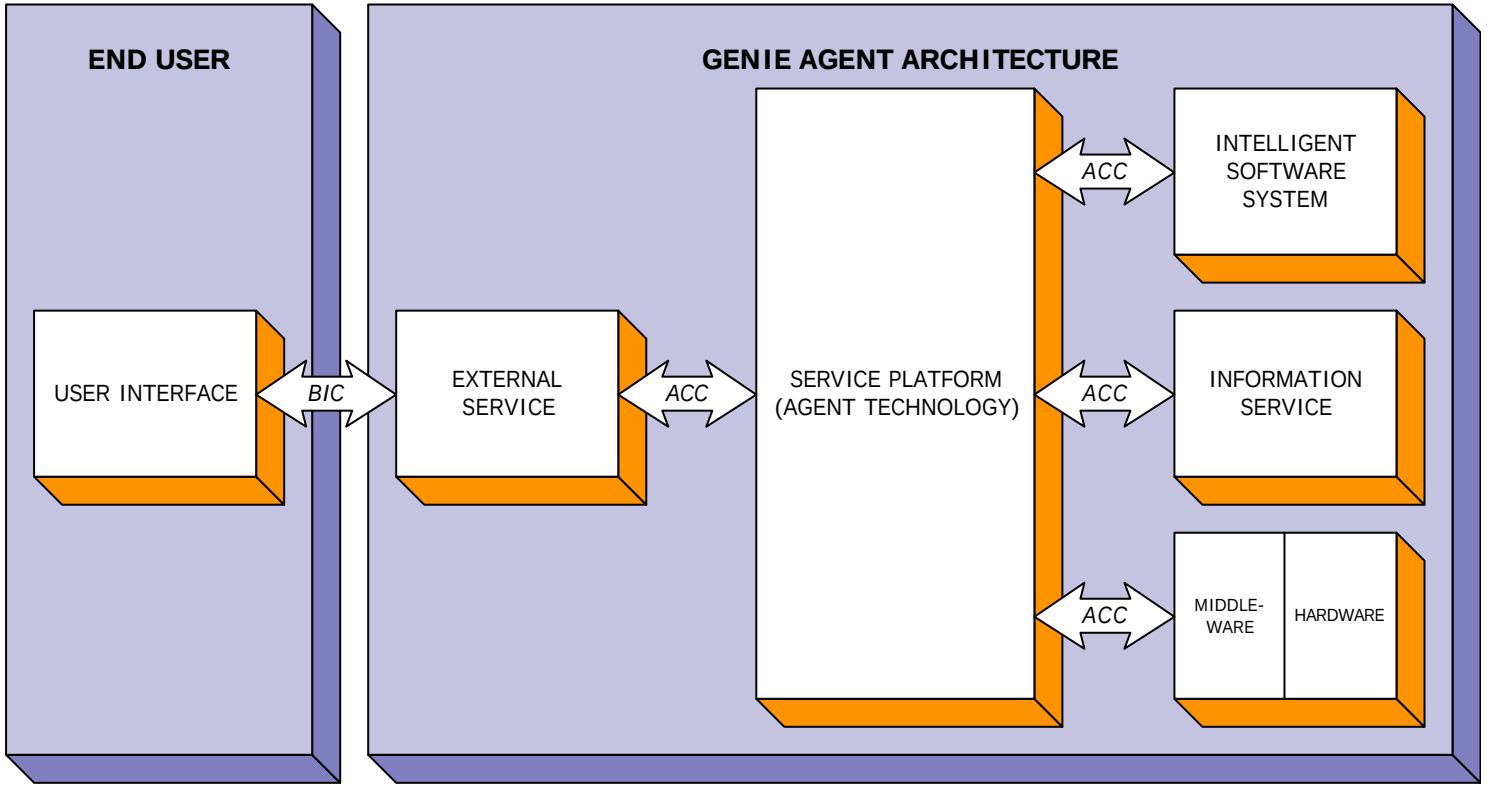
Visualisation of complex data



Platform for interaction

- Need a platform for integration
  - Distributed
  - Ubiquitous
  - Ad-hoc
  - Wireless
- Agent-based solution
  - Genie project
  - FIPA agents
- Home server (gateway)
  - Not as general, but supports in-home standards
  - One server controls it all
  - OSGi

Agent-platform



ACC = Agent CommunicationChannel
BIC = Bidirectional Communication Channel

Contact information

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