

UBIQUITOUS COMPUTING

Summer 2004



ISNM
Willy-Brandt-Allee 31a
23554 Lübeck
Germany



Prof. Dr. Andreas Schrader
schrader@isnm.de

iNTELLiGENT BUiLDiNGS

Intelligent Buildings

- ☐ Creating new dynamic living environments
- ☐ Realizing Ubiquitous Computing in homes and working environments
- ☐ Goal: simplifying or enhancing daily life activities:
 - ☐ Refridgerator automatically orders food
 - ☐ Position in bed automatically switches light
 - ☐ Integrated control of television, Internet and all electric devices
 - ☐ Remote control from any place
 - ☐ Automatic heating control through timers and location tracking of inhabitants
 - ☐ Automatic emergency calls through observations
 - ☐ etc.



iNTELLiGENT BUiLDiNGS

▣ The Adaptive House

- ❑ University of Bolder, Colorado (<http://www.cs.colorado.edu/~mozer/nnh/>)
- ❑ Michael Mozer, 1992, First Intelligent Home



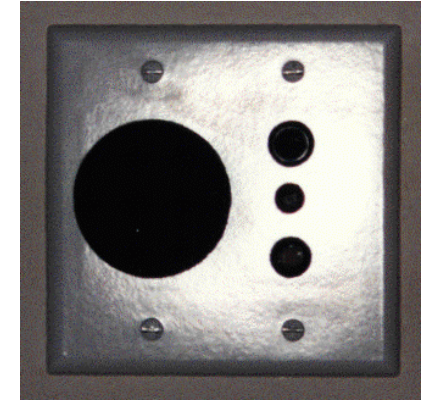
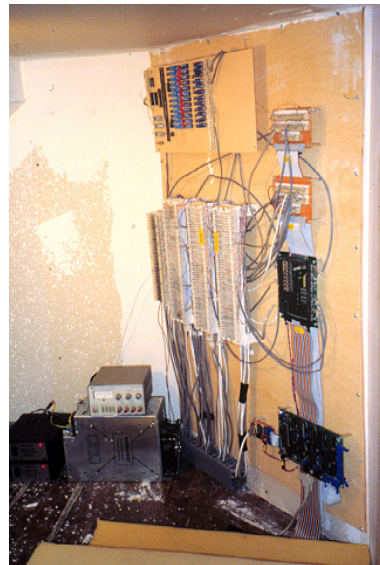
iNTELLiGENT BUiLDiNGS

The Adaptive House

- ❑ Goal: to maximize the satisfaction of the inhabitants and minimize energy consumption
- ❑ A number of embedded sensors and actors
- ❑ ,**Reactive Environment**' using AI self-learning technologies (neural networks)
- ❑ No administration necessary, no new interfaces or GUIs

The five miles of conductor around the house terminate at a telephone punch panel and are fed (via the ribbon cables) into data acquisition hardware on a PC.

Also shown are a speaker control board (upper left) and a microcontroller for the lights, electric outlets, and fans (lower right).



A sensor panel.

On the left are sensors for temperature, ambient light, and sound. On the right is a speaker that allows the house to talk to the inhabitant.



Outside Light Sensor

INTELLIGENT BUILDINGS



The Adaptive House

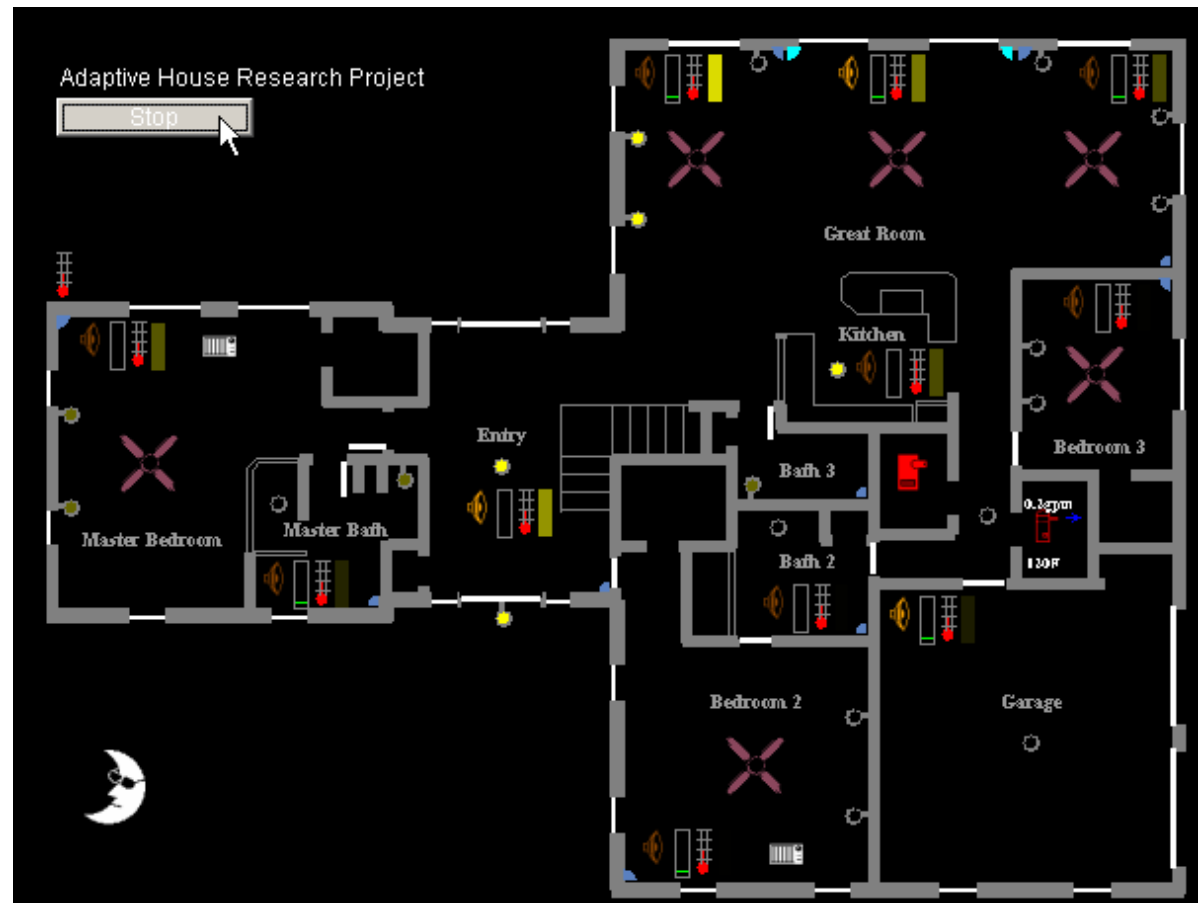
❑ Online tracking of Adaptive House status

❑ Sensors for

- Sounds
- Temperature
- Movements
- Light
- Switches

❑ Actors for

- Light
- Heating
- Ventilators
- Sound



📖 Reactive Environments (William „Bill“ Buxton, 1995)

- ❑ Chief Scientist of *Alias/Wavefront (Maya)* (1994-2002) and *SGI Inc.* (from 1995)
- ❑ Also at Xerox PARC and Associate Professor at the University of Toronto



<http://www.billbuxton.com>

- ❑ Main idea:
 - Extend Weiser's vision with media-related components: **Ubiquitous Media**
 - Environments should react to the user in an appropriate way
 - Context is used for the interaction between humans and computers
 - Try to preserve function and space relationships of real world
- ❑ Buxton, W. (1997).
Living in Augmented Reality: Ubiquitous Media and Reactive Environments.
In K. Finn, A. Sellen & S. Wilber (Eds.). *Video Mediated Communication*.
Hillsdale, N.J.: Erlbaum, 363-384. An earlier version of this chapter also
appeared in *Proceedings of Imagina '95*, 215-229.
- ❑ Buxton, W. (1995)
Space-Function Integration and Ubiquitous Media (Unpublished paper)
- ❑ Cooperstock, J.R., Tanikoshi, K., Beirne, G., Narine, T., Buxton, W. (1995).
Evolution of a Reactive Environment, *Proceedings of CHI'95*, 170-177.

Reactive Environments (William „Bill“ Buxton, 1995)

□ Defined **five design principles** for reactive environments:

- (1) Preserve function/location relations for both the tele and local activities
- (2) Treat electronic and physical „presences“ of visitors the same
- (3) Use same social protocols for electronic and physical social interactions
- (4) The box into which we are designing our solutions is the room in which you work/play/learn, not a bot that sits on your desk.
That is the difference between the ecological design of Ubiquitous Media and the design of appliances.
- (5) Every device used for human-human interaction (cameras, microphones, etc.) are legitimate candidates for human-computer interaction (and often simultaneously)

iNTELLiGENT BUiLDiNGS

📺 Reactive Environments (William „Bill“ Buxton, 1995)

❑ Example: Ubiquitous Video – UbiVid



Traditional Video-Conferencing:
A Video camera on top of a monitor on the user's desktop.

Problem:
Violates design goals 1&2:
typical location/function
relationships
are not preserved

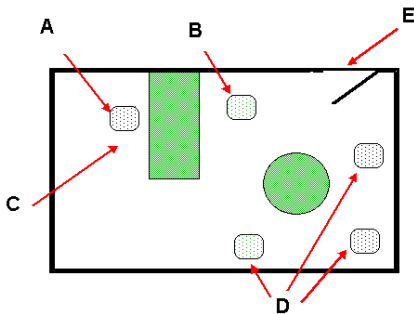
- ❑ **Approach:**
Several cameras and monitors are placed in the office to support different contexts and usage scenarios

iNTELLiGENT BUiLDiNGS

Reactive Environments (William „Bill“ Buxton, 1995)

❑ Example: **Ubiquitous Video – UbiVid – Informal Group Videoconferencing**

System at position (D):
A remote visitor could „sit“ and participate
in around-the-table conversations



Schema of Office Context:

- A – Buxton's chair behind the desk
- B – The chair across the desk
- C – Beside his chair
- D – Chairs around the table
- E – The doorway



Close
look-up



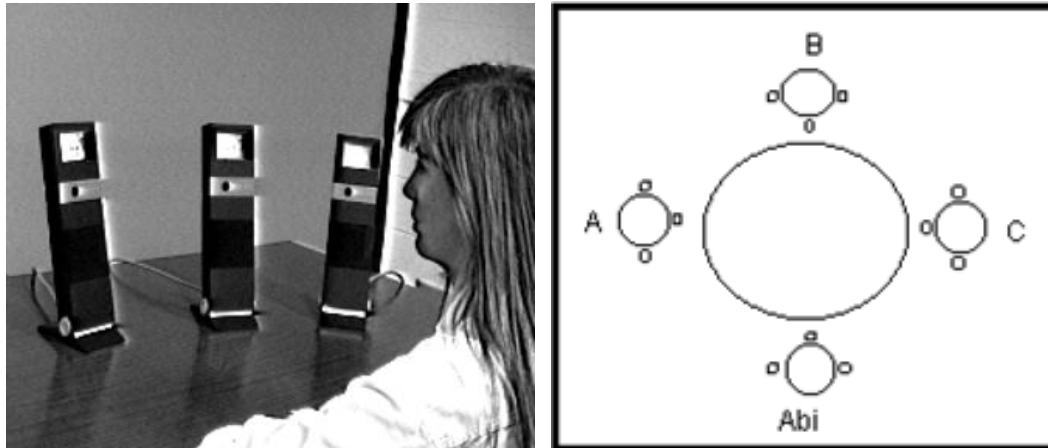
A conventional
system in (A) for
doing one-to-one
communication

Source: <http://www.billbuxton.com>

iNTELLiGENT BUiLDiNGS

Reactive Environments (William „Bill“ Buxton, 1995)

Example: Ubiquitous Video – UbiVid – 4-way Videoconferencing



- ❑ Each participant is in a different location and supported by an own unit.
- ❑ The system **preserves the spatial relationship „around the table“** by capturing many of the spatial cues of maze and head turning of face-to-face meetings.
- ❑ Each unit provides a unique view for one of the remote participants and a unique view of them.
- ❑ Therefore, parallel conversations (side comments) are supported in multiparty communication scenarios.

iNTELLiGENT BUiLDiNGS

📺 Reactive Environments (William „Bill“ Buxton, 1995)

❑ Example: **Ubiquitous Video – UbiVid – Face-to-Face Videoconferencing**



No need to
learn a user
interface or
technical setup!

- ❑ Each participant has a computerized desk displaying the same information.
- ❑ The intention is to capture the essence of working on the same desk
- ❑ The display is very large,
creating the impression of a transparent wall between the remote locations
- ❑ The eye seems to project into the space of the other,
creating a more natural impression
- ❑ The remote participant is presented with actual size,
creating a balance of power by each participant

Source: <http://www.billbuxton.com>

iNTELLiGENT BUiLDiNGS

📺 Reactive Environments (William „Bill“ Buxton, 1995)

- ❑ Example: **Ubiquitous Video – UbiVid – Back-to-Front Videoconferencing**



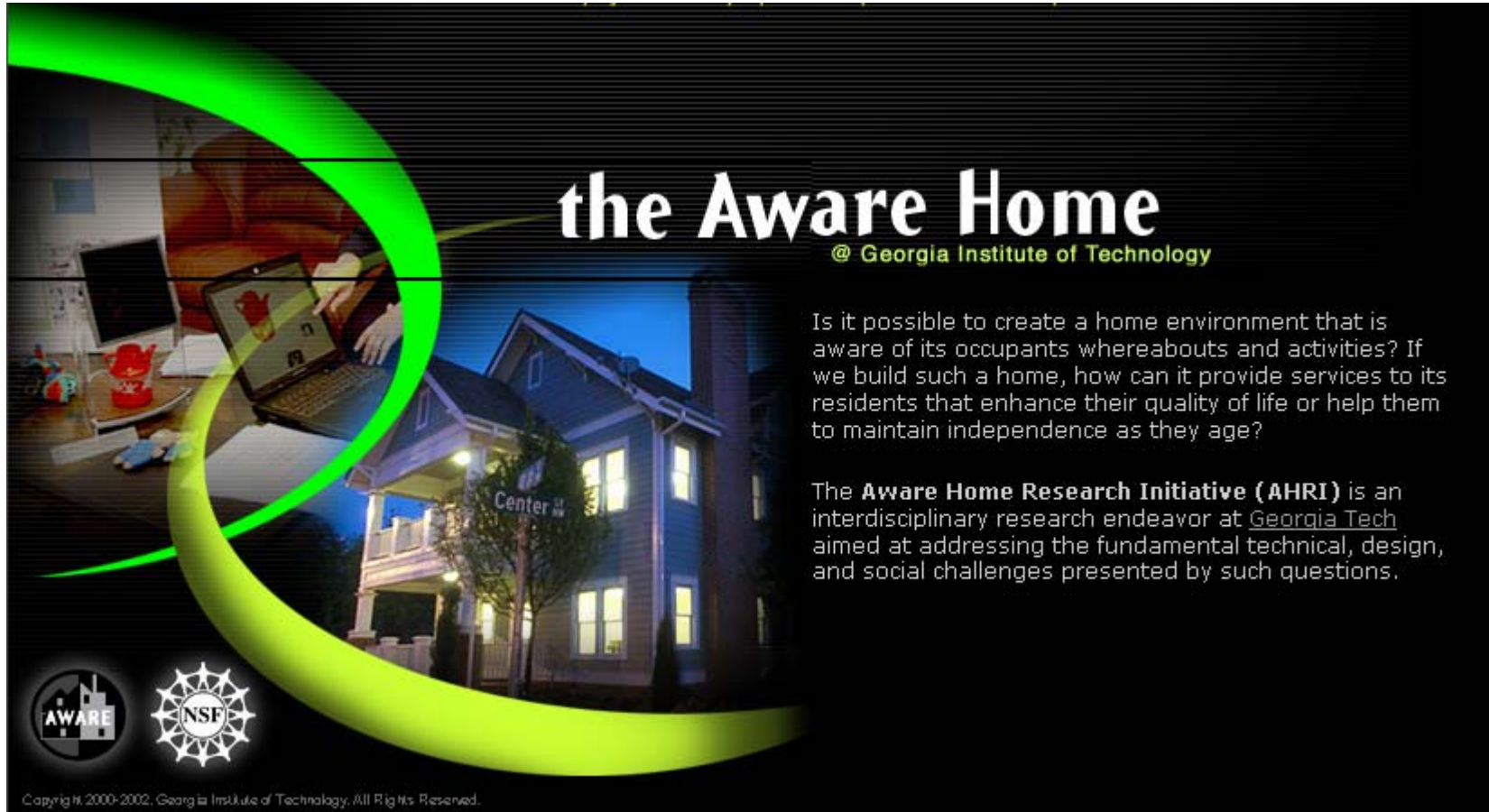
No need to
change social
interaction
patterns!

- ❑ Remote participants take a place at the table by means of a video monitor mounted on the back wall
- ❑ The **presenter does not need to change interacting paradigm** for the electronically present attendee

iNTELLiGENT BUiLDiNGS

The Aware Home

□ Georgia Institute of Technology (<http://www.awarehome.gatech.edu/>)





the Aware Home

@ Georgia Institute of Technology

Is it possible to create a home environment that is aware of its occupants whereabouts and activities? If we build such a home, how can it provide services to its residents that enhance their quality of life or help them to maintain independence as they age?

The **Aware Home Research Initiative (AHRI)** is an interdisciplinary research endeavor at Georgia Tech aimed at addressing the fundamental technical, design, and social challenges presented by such questions.

Copyright 2000-2002, Georgia Institute of Technology. All Rights Reserved.

iNTELLiGENT BUiLDiNGS

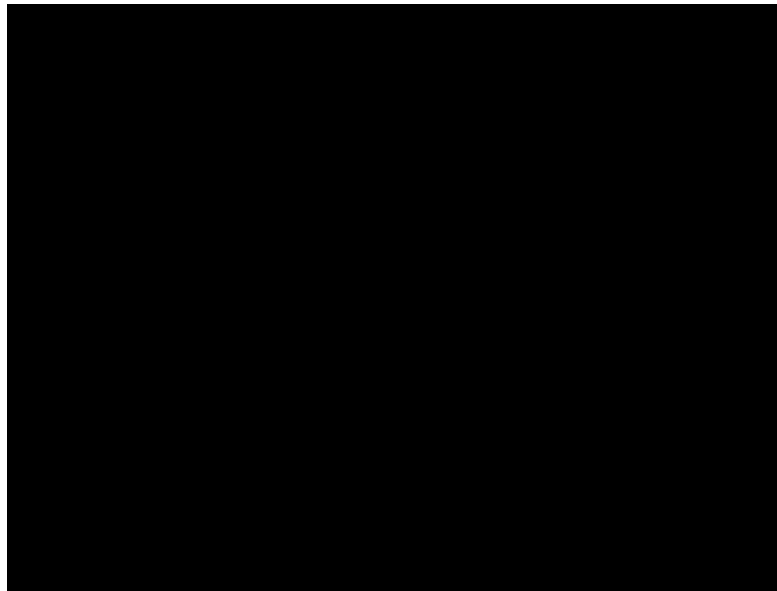


The Aware Home

- ❑ Exploring ways to use the latest in home technology to help senior adults remain in their homes and maintain their independence as long as possible.



Prof. Gregory Abowd



Overview Video

iNTELLiGENT BUiLDiNGS

The Aware Home

☐ Some Issues of the Aware Home



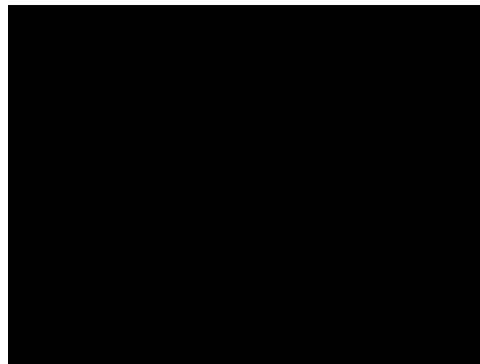
Aging in Place



Family Intercom



Family Portrait



Portrait Demo



Privacy Issue

iNTELLiGENT BUiLDiNGS

The Aware Home

Infrastructure

- Three floors with identical floor plans
- Basement: technology infrastructure.
- Main floor: central research for students working on new projects.
- Second floor: stabilized prototypes demonstrated to visitors.
- Invited seniors live on the second floor for short time periods to use the various applications on a daily basis and provide feedback.



Infrastructure Video

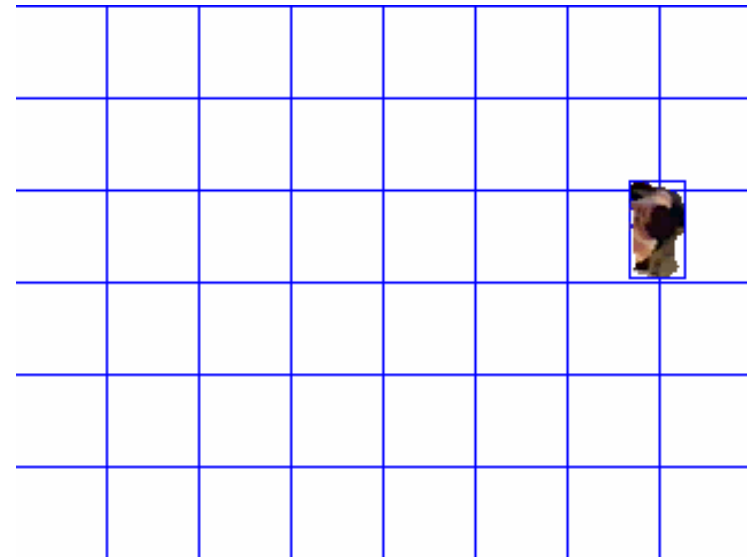
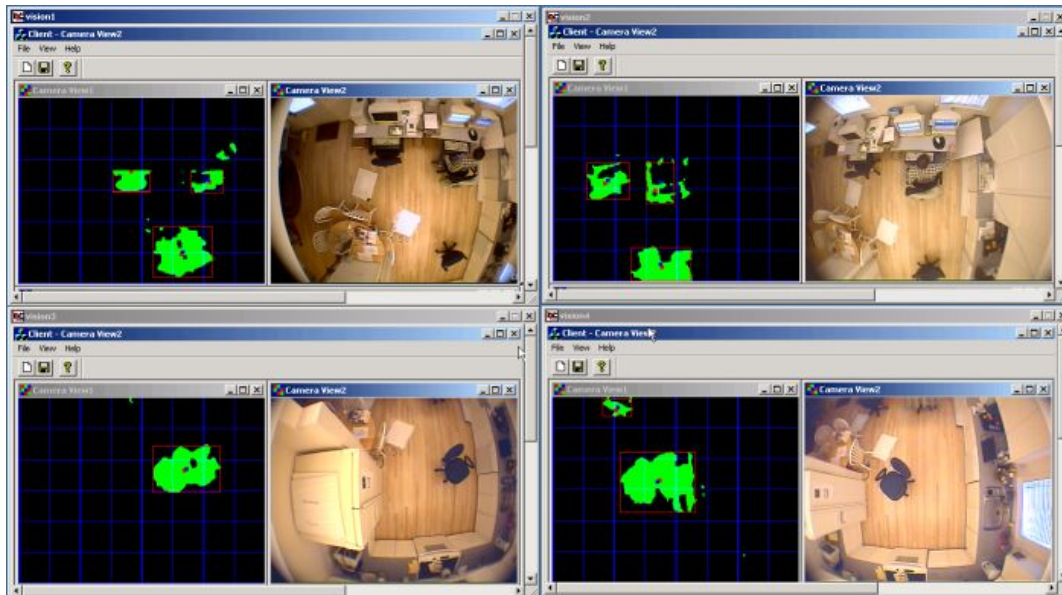
<http://www.gatech.edu/innovations/awarehome/>

iNTELLiGENT BUiLDiNGS

The Aware Home

Indoor Location Tracking

- Location is important to guess what a person is doing or willing to do
- RFIDs and antennas only provide information on room level
- Cameras in the ceiling providing an overhead view of the home can reach more fine-granular resolutions inside a room



iNTELLiGENT BUiLDiNGS



InHaus Duisburg

- Consortium of ~65 partner institutes (<http://www.inhaus-duisburg.de/>)

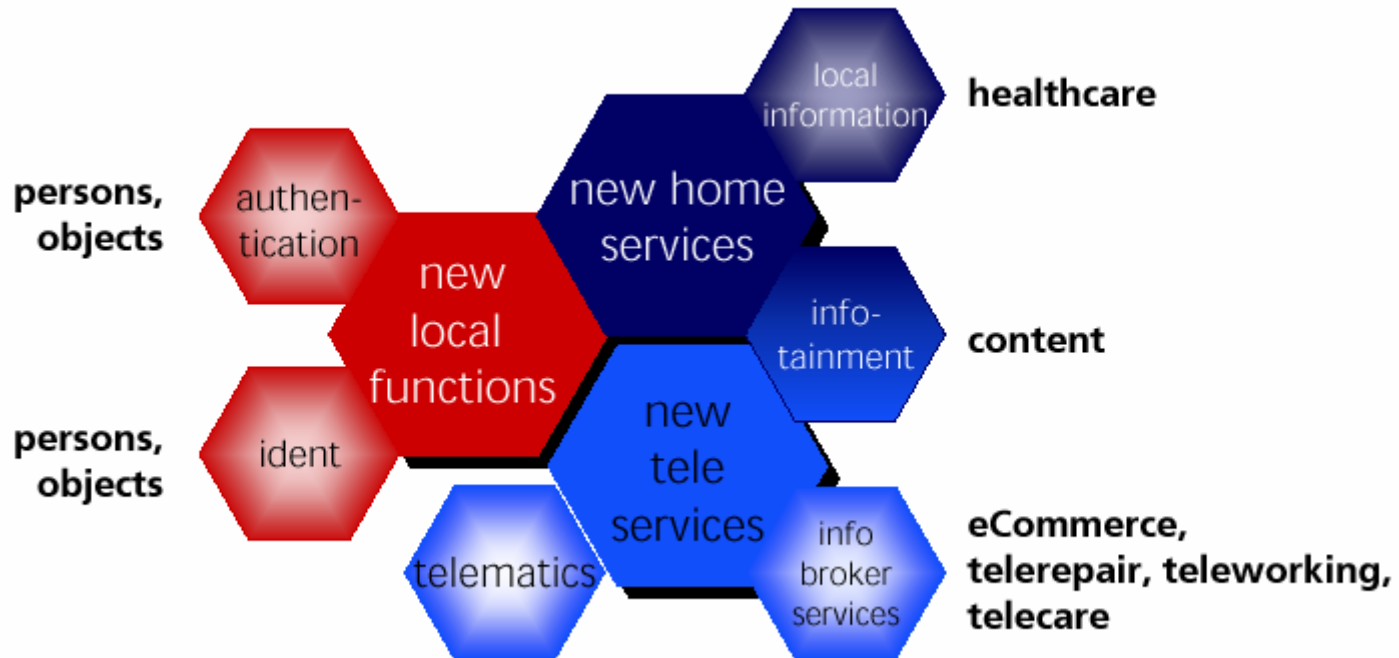


iNTELLiGENT BUiLDiNGS

InHaus Duisburg

□ Goals:

- Test and Demonstration Platform
- Combining products of partner companies
- Development of innovative products and services
- Cooperative distribution



Source: <http://www.inhaus-duisburg.de/>

iNTELLiGENT BUiLDiNGS

InHaus Duisburg

□ Scenarios:

- PDA-based remote control of all smart-label enhanced devices
- Intelligent monitoring of house functions using sensor technology
- eDelivery, automatic home supply
- Smart bath, window, kitchen, light control
- Health care functions
- Safety and Security ...



Door Camera on Videophone



Door Camera on TV-Set

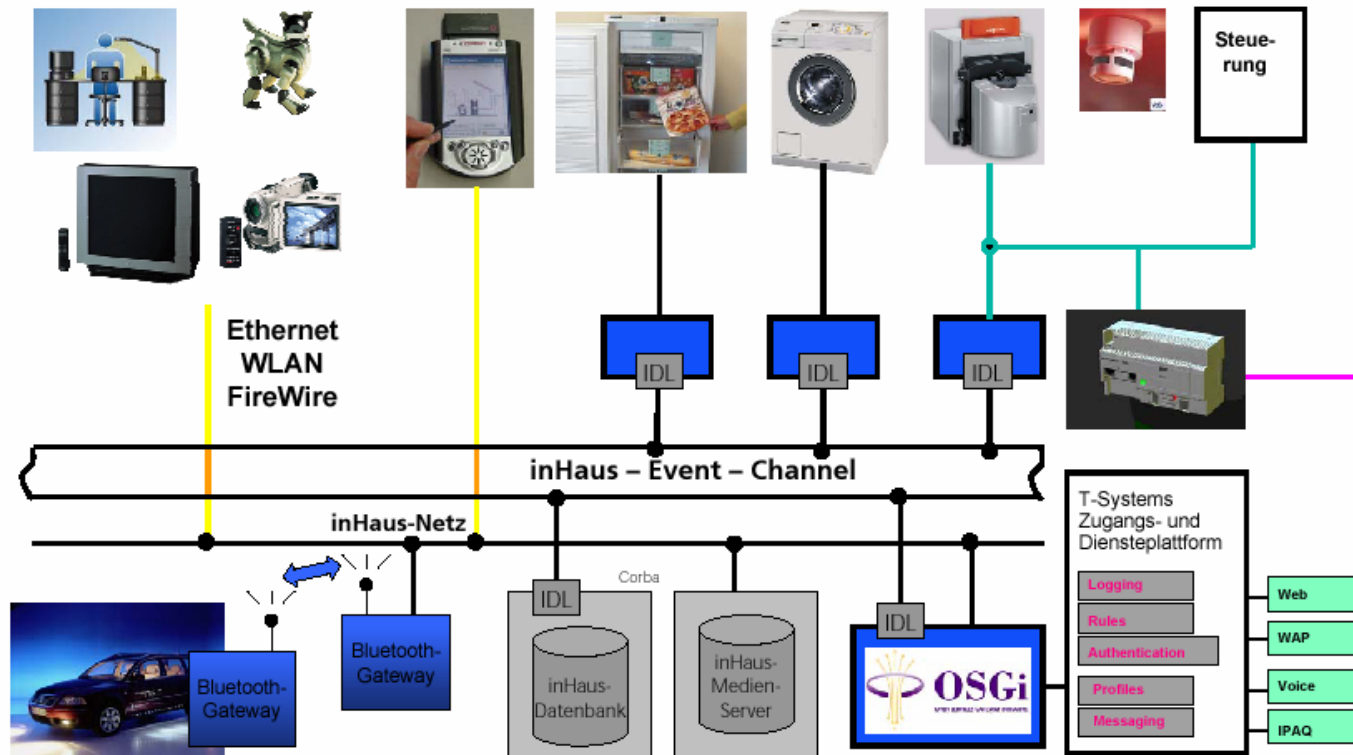
Source: <http://www.inhaus-duisburg.de/>

iNTELLiGENT BUiLDiNGS

InHaus Duisburg

□ Infrastructure:

- Common bus system based on Fraunhofer technology (OSGi)
- Also CORBA, Java, Jini
- Operating Systems on VxWorks and eLinux



Source: <http://www.inhaus-duisburg.de/>

Andreas Schrader

UBIQUITOUS COMPUTING

iNTELLiGENT BUiLDiNGS

Easy Living Project

- Alexander Hegius Gymnasium Ahaus (AHG) (<http://www.easy-living.thn.net/>)



iNTELLiGENT BUiLDiNGS

Easy Living Project

□ TV-Report 3sat Nano



Source: <http://www.easy-living.thn.net/>

iNTELLiGENT BUiLDiNGS

Philips – The Mirror Display

- ☐ Personal care in the bathroom
- ☐ Interactive mirror display
- ☐ The LCD part of the mirror has been coated with a special film which allows all light through (for the mirror) or none at all (for the display)
- ☐ Shows video media and interacts with bathroom devices
- ☐ Shaver can show usage manual and signals battery recharging time
- ☐ Kids can be presented with teeth-brushing instruction videos
- ☐ Persons are recognized by weight, height, speech control, gestures, etc.
- ☐ Health information, like heartbeat and pressure functions can be displayed

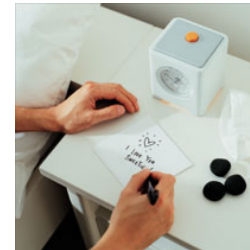


Source: http://www.research.philips.com/Assets/Downloadablefile/intelligent_personal_care-2454.pdf

iNTELLiGENT BUiLDiNGS

Example: **Nebula** (Philips)

- ❑ Nebula is an interactive projection system designed to enrich the experience of going to bed, sleeping and waking up.
- ❑ It provides intuitive and natural ways of physically participating in a virtual experience, through simple body movements and gestures.
- ❑ A ceiling projector linked via the Internet can be used to display information
- ❑ Body positions and movements are translated into moving imagery and text.



Pepples



Source: <http://www.design.philips.com/smartconnections/nebula/>

iNTELLiGENT BUiLDiNGS

Example: **Q4 Plugged** (Philips)

- ☐ Q4 is a couch designed for the connected home
- ☐ Wide variety of polyfunctional ‚zones‘ for relaxation and socialising by modular design
- ☐ Fully ‚wired‘, all elements are linked together physically and electrically
- ☐ Various elements can be plugged into the mattress ‚buttons‘ which provides electrical connections.
- ☐ Hollow arm-rests contain music player, loudspeakers and controls.
- ☐ Also available: a projector (for ceiling or wall projection), a web pad (screening and charging base), a table lamp using light-emitting polymers



Source: <http://www.design.philips.com/smartconnections/q4/index.html>

iNTELLiGENT BUiLDiNGS

Philips - HomeLab

- ❑ <http://www.research.philips.com/InformationCenter/Global>
- ❑ A large variety of ambient and ubiquitous computing scenarios

