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Ambient Communication in Smart Environments

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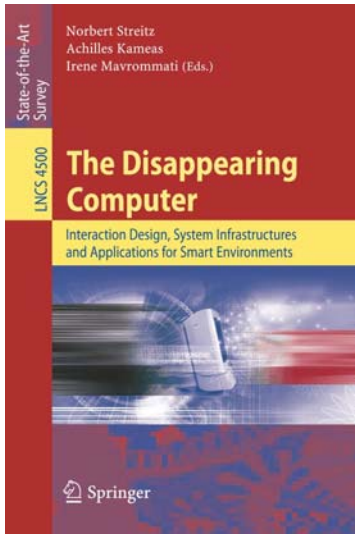
Overview

- Seven Claims and Issues
- The Disappearing Computer
- Ubiquitous and Ambient Computing
- Smart Environments and Privacy
- From Information Design to Experience Design

- Cooperative Buildings and Roomware®
- Ambient Agoras - Project
  - ambient display Hello.Wall, Personal Aura
- InterLink-Project: Hybrid City
- Summary: Claims Revisited



Seven Claims to start with

1) *The more the computer disappears and becomes invisible, the more it determines our lives*
2) *It's all there in the environment => no need to carry devices*
3) *People-friendly environments in which the "computer-as-we-know-it" has no role*
4) *From information design to experience design*
5) *New affordances for facilitating coherent experiences*
6) *Smart spaces make people smarter*
7) *Privacy might become a commodity and a privilege*

Variety of Approaches

This area of research is coming with many different names:

- Ubiquitous Computing
- Pervasive Computing
- Proactive Computing
- Ambient Computing
- Ambient Intelligence (AmI) <=> Artificial Intelligence (AI)
- *Disappearing Computer*

The Disappearing Computer

The most profound technologies are those that disappear.
They weave themselves into the fabric of everyday life
until they are indistinguishable from it
(*Weiser, Scientific American, 1991*)

It seems like a paradox but it will soon become reality:
The rate at which computers disappear will be matched
by the rate at which computer/information technology
will increasingly permeate our environments
and determine our lives.
(*Streitz & Nixon, Communications of the ACM, March 2005*).

Ambient Computing and Interaction

- computer functionality moves more into the background, in the periphery of our attention (=> *ambient*)

- ambient displays are unlike traditional displays

- *anything can be a "display"*
  => smart materials and multiple modalities
  often based on metaphors from the real world
  (e.g., sounds => network traffic)

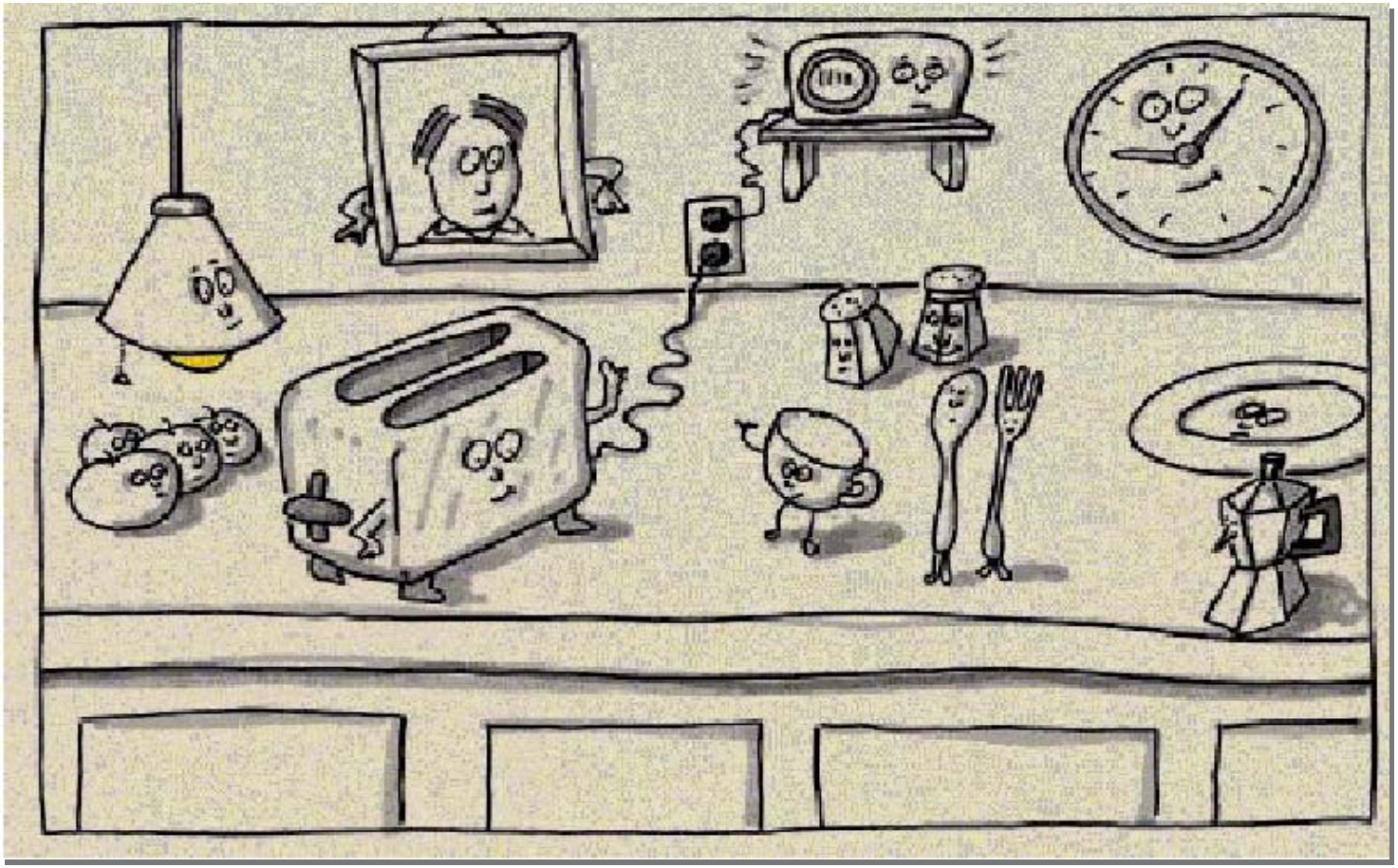
- *"The world around us"* is the ‚interface' to information

- **Claim**:
  No need to carry computing devices with us.
  It's all in the environment: *„everything is everywhere"*

… this is not Ambient Computing

The Computer Disappears …

Everyday objects (household, leisure, work, ...) with integrated and ubiquitously networked processors and sensors => Smart Artefacts



(drawing: Rich Gold)

Anything can be a „Display“

Multi-Person Ambient Environments

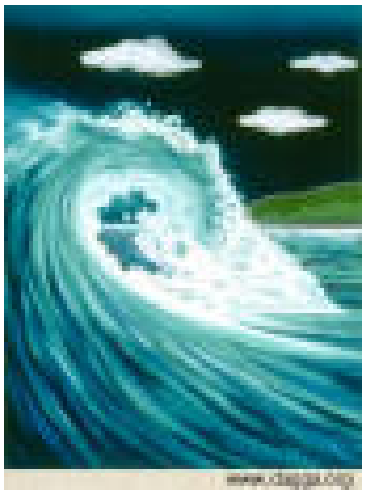
- Extensions of the “traditional” UbiComp approach:
- Not only many devices for one person,
  but many “devices”, resp. interaction opportunities
  for many people,
  => ambient environments are
  multiple-”devices”, multiple-users environments

- one person => groups and teams => communities => cities

- New challenges for the design of interaction, group interfaces,
- Relationship to CSCW (Computer-Supported Cooperative Work),
  Web 2.0 …. social web …. social (network) software
- going on-line not only to be informed and to inform others,
  but to live a social life, to have experiences, …

From Web 2.0 => *Web++ or Hybrid Web*

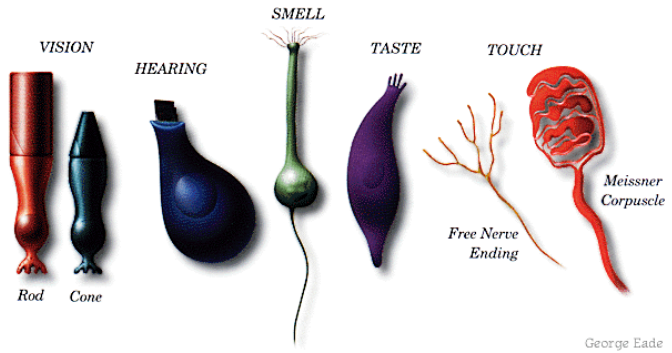
- Integration of virtual and real worlds



- Integration of real, virtual and social domains
- Going beyond an “internet of things” --- taking “reality tagging” to the extreme
- Hybrid worlds consisting of multiple, joint communities of people and artefacts with symmetric actions and effects in both (all) worlds
- From information design to experience design

From Information Design to Experience Design

- Towards an Experience Economy
- Facilitating experience-oriented activities and processes
  - social processes, leisure activities, games, ….
  - in public spaces, in the home, but also in office environments, …
- Designing Experiences (and then controlling them)
  - Direct experience/perception using our human senses
  - Indirect and mediated experiences
    - making invisible things „visible“ (e.g., radioactivity, network traffic, …)
    - aggregating parameters to convey higher level concepts (activities of a person, atmosphere/ambience of a room/building, …)
    - social experiences (awareness, connectedness, …)



Smart Environments

System-oriented, importunate smartness

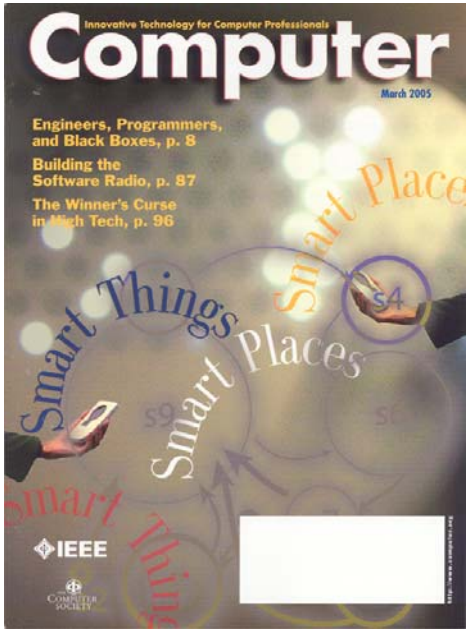
- More or less automatic behavior based on collected data, …
  - Intelligent Home (domotica, …)
  - BUT: refrigerator ordering items although we can't consume it due to circumstances beyond the refrigerator's knowledge such as unanticipated absence, illness, …

People-oriented, empowering smartness

- implies that the ***human is in the loop*** and can take mature, informed actions based on suggestions, recommendations

⇒ ***"smart spaces make people smarter"***

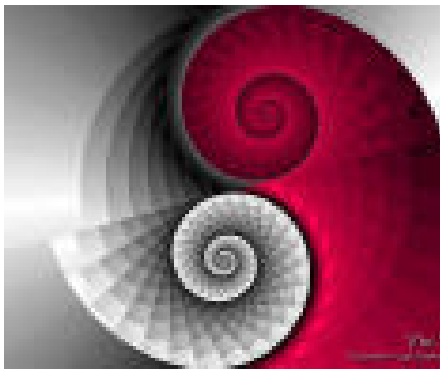
BUT: how much feedback do we want/ can we process?



(Streitz et al, IEEE Computer, March 2005)

Tricky Trade-off for Creating “Smartness”

There is an interaction and balance/ trade-off between



- able to provide support based on collecting and using sensor data and using them for selecting, tailoring functionality to make the system “smart”

and

- the right of people to be in control over which data are collected, by whom, how they are used => privacy

  (Note: People are willing to provide their data for certain benefits, e.g., loyalty/ payback cards, …)

Design issues and implications for privacy:

- How can people know what is going on, when they are not aware of it, when they don’t “see” the sensors, the devices?
- Privacy Enhancing Technologies (PETs)

Perspectives on Privacy

- Privacy as a legal and moral right
- Privacy as a socially negotiated feature
- Privacy as a commodity you pay for and trade
- Privacy as a privilege (implication of above)
- Two aspects:
  - Outgoing data (logging, tracking, surveillance, …)
  - Incoming data (intrusion, unsolicited communication, …)

Remember? -- Private calls in a public space

Reinventing Privacy …

Talk in Private 25¢

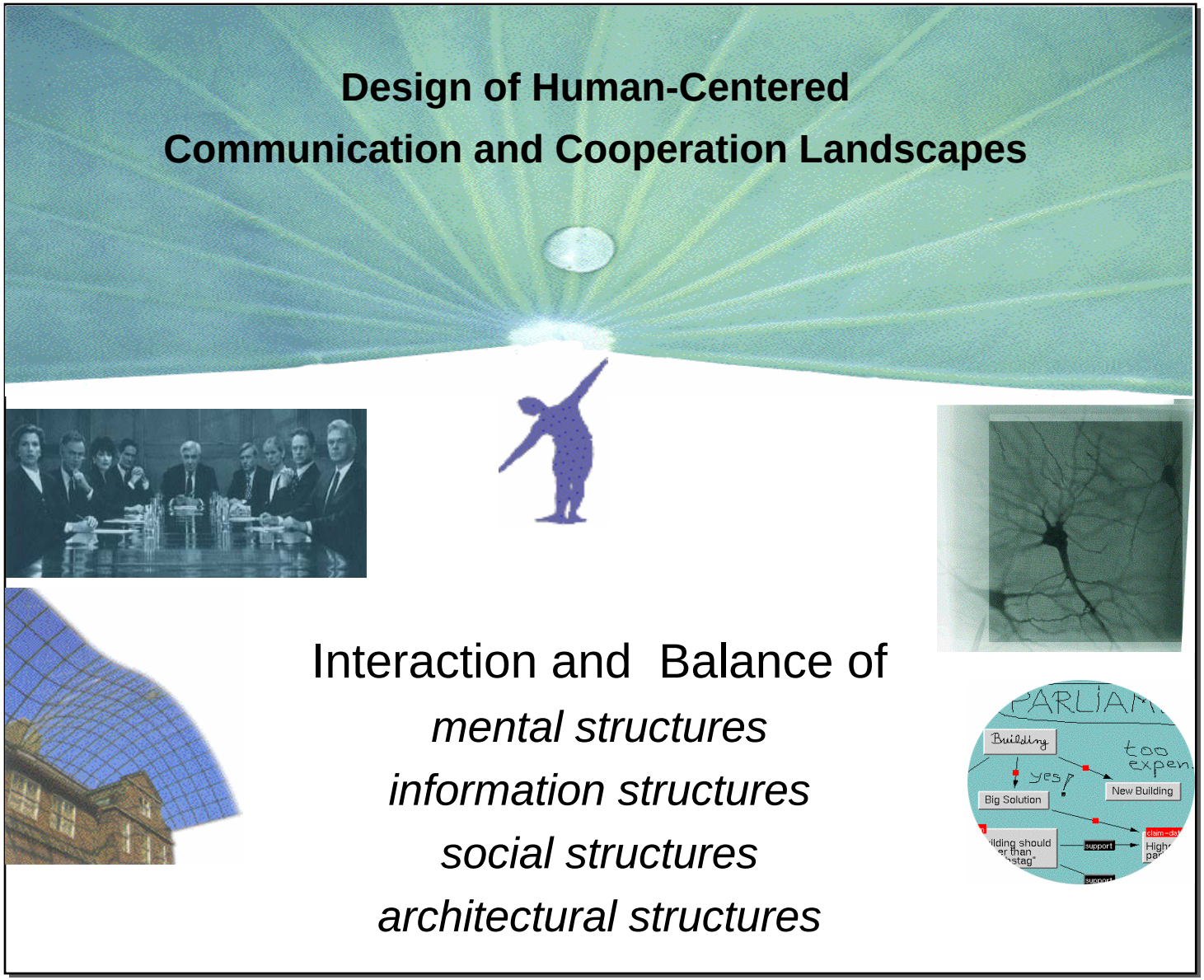
Smart Environments: Applications

- Cooperative Buildings
  - Offices and Workspaces
  - Electronic Classroom for Schools & Universities
  - Hospitals
  - Smart Home / House
- Public Spaces
- Smart City and Urban Environments
- Social and Leisure Activities
  - Communication and Coordination
  - Awareness and Connectedness
  - Engagement and Involvement (responsible citizenship)

Our Approach in AMBIENTE (since 1997)

Interdisciplinary Team

- Computer Science
- Electrical Engineering
- Psychology
- Design
- Architecture
- Sociology



Cooperative Buildings and Roomware®

Cooperative Buildings

- are serving the purpose of cooperation and communication
  by providing facilities and computer-supported functionality

and at the same time

- they are „cooperative“ towards their inhabitants, visitors, users, …
  via attentive, active, adaptive environments
  => *Smart Environments*

- *Roomware*®:integration of room elements (walls, doors, furniture, …)
  with information, communication, sensing technology
- Roomware as constituents of Cooperative Buildings

(CoBuild‘’98, CoBuild’99 Workshops, published as Springer LNCS)

2nd Generation of Roomware® (1999)

FOD
Future Office Dynamics

GMD
IPSI

DynaWall® CommChair® InteracTable® ConnecTable® Passa

Experiences:
Audio Augmentation - Sounds@Work

Augmenting movement of objects on surfaces with the noise of friction.

The sound

- conveys the speed of an object
- imitates the natural behaviour
- supports the metaphor of a whiteboard

Dynamic distribution
of audio augmentation
(based on physical model)
via multiple hidden loudspeakers
during the interaction
(spatial audio)

Example: moving and throwing of a ‘workspa

- "The Disappearing Computer" was a "proactive initiative"
- Future and Emerging Technology (FET)
- Information Society Technology (IST)

Information Society Technologies

- 17 projects were accepted for funding
- 55 institutions from academia and industry, 21 universities, 16 research institutes, 18 companies in 15 countries

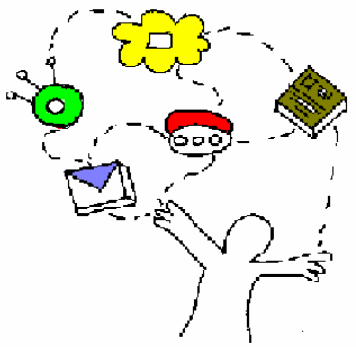
- Steering group of the DC-Network
  - Chair: Norbert Streitz (Fraunhofer-IPSI, Germany)

- DC website: http://www.disappearing-computer.net

Goal of “The Disappearing Computer”

To explore how everyday life can be supported and enhanced through the use of collections of interacting artefacts.

Together, these artefacts will form new people-friendly environments in which the “computer-as-we-know-it” has no role.



DC-Projects: Overview

2WEAR
A Runtime for Adaptive and Extensible Wireless Wearables

ACCORD
Administering Connected Co-Operative Residential Domains

AMBIENT AGORAS
Dynamic Information Clouds in a Hybrid World

ATELIER
Architecture and Technologies for Inspirational Learning Environments

e-GADGETS
An architectural style for Extrovert Gadgets

FEEL
Non-intrusive Services to Support Focused, Efficient and Enjoyable Local Activities

FICOM
Fiber Computing

GLOSS
Global Smart Spaces

GROCER
Grocery Store Commerce Electronic Resource

INTERLIVING
Designing Interactive, Intergenerational Interfaces for Living Together

MIME
Multiple Intimate Media Environments

ORESTEIA
Modular Hybrid Artefacts with Adaptive Functionality

PAPER++

SMART-ITS
Interconnected Embedded Technology for Smart Artefacts with Collective Awareness

SHAPES
Situating Hybrid Assemblies in Public Environments

SOB
The sounding object

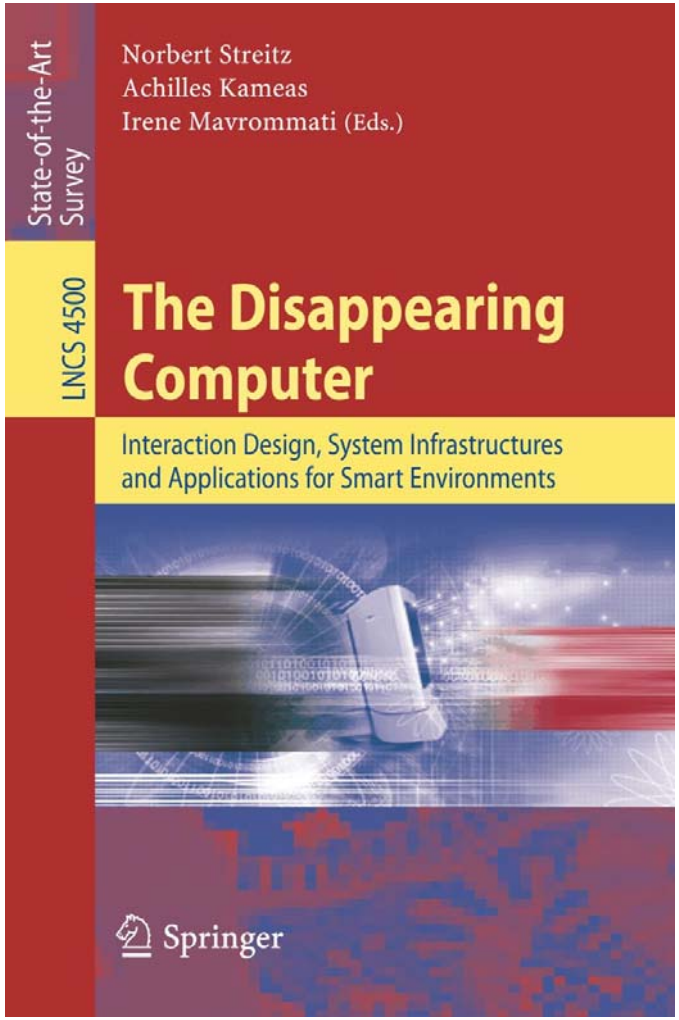
WORKSPACE
Distributed Work Support through Component-based Spatial Computing Environments

New Book on „The Disappearing Computer“

Norbert Streitz
Achilles Kameas
Irene Mavrommati (Eds),
The Disappearing Computer:
Interaction Design,
System Infrastructures and
Applications for Smart Environments

State-of-the-Art Survey
LNCS 4500
Springer, Heidelberg, 2007

Forewords from:
- The European Commission
- Emile Aarts (Philips)
- Gregory Abowd (Georgia Tech)



DC-Project: Ambient Agoras

Ambient Agoras: Dynamic Information Clouds in a Hybrid World

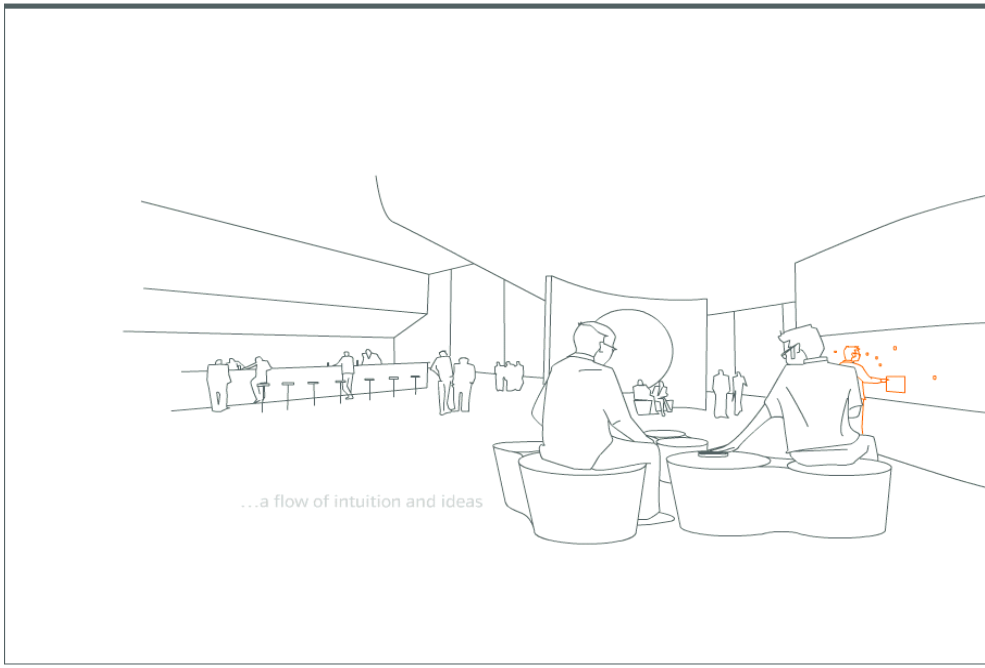
Partners:

- Fraunhofer-IPSI (Darmstadt, D) (coordinator)
- Electricité de France (EDF) (Paris, F)
  - Laboratory for the Design of Cognition (LDC)
  - DALT (design consulting firm, Brussels)
- Wilkhahn (Bad Münder, D)
  - FOD business unit and production unit
  - Wiege design

Website: www.ambient-agoras.org

DC-Project *Ambient Agoras*

- to transform places into social marketplaces of ideas and information (“agoras”)
- to add layers of situated services and place-relevant information
- to provide a spirit of the place (“genius loci”)
- to address privacy issues in sensor-based environments



From Bits-of-Life to Prototypes

BITS OF LIFE

SCENARIOS &
VIDEO MOCK-UPS

FOCUS
GROUP

DESIGN
STUDIES

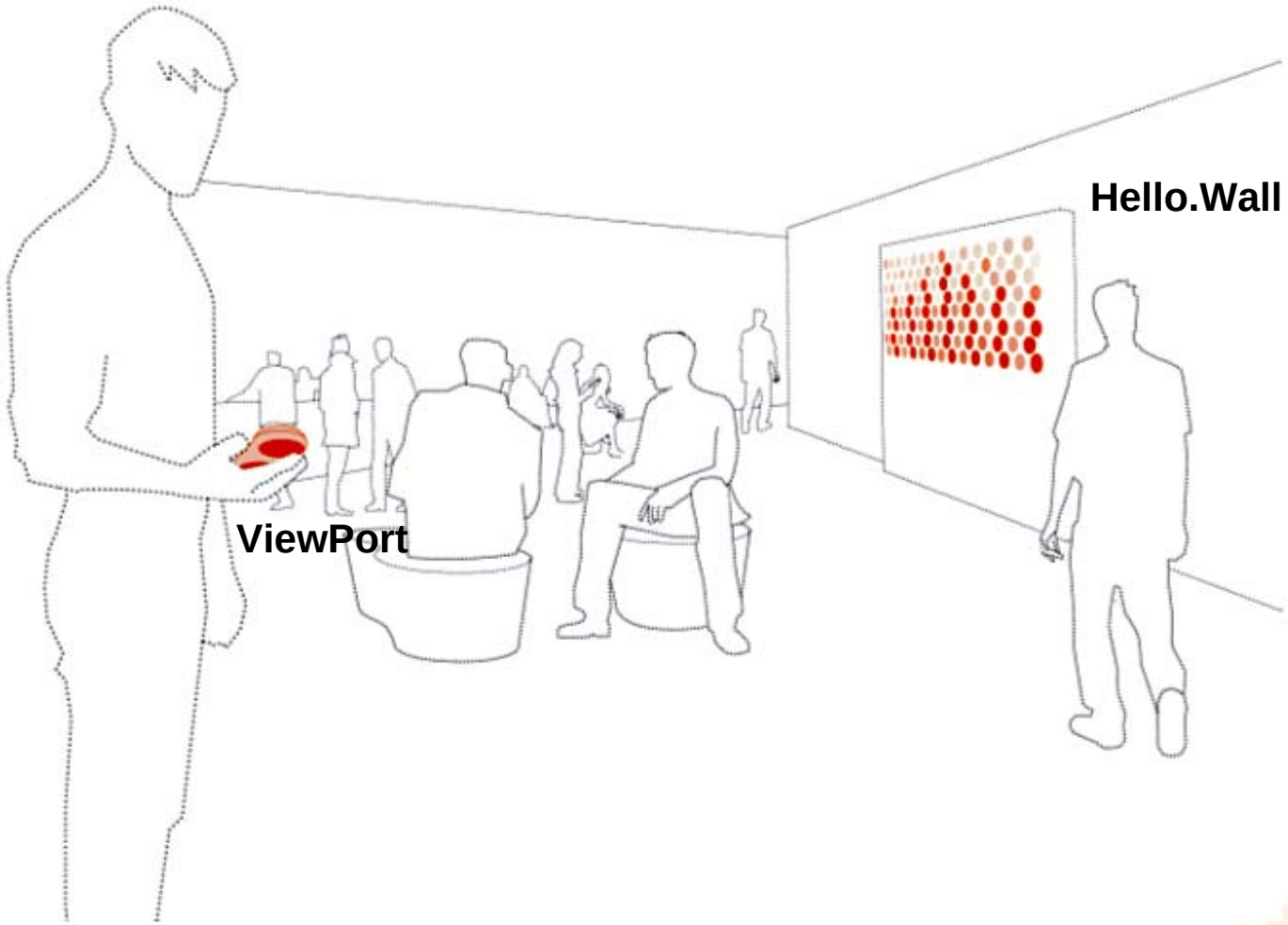
TECHNICAL
STUDIES

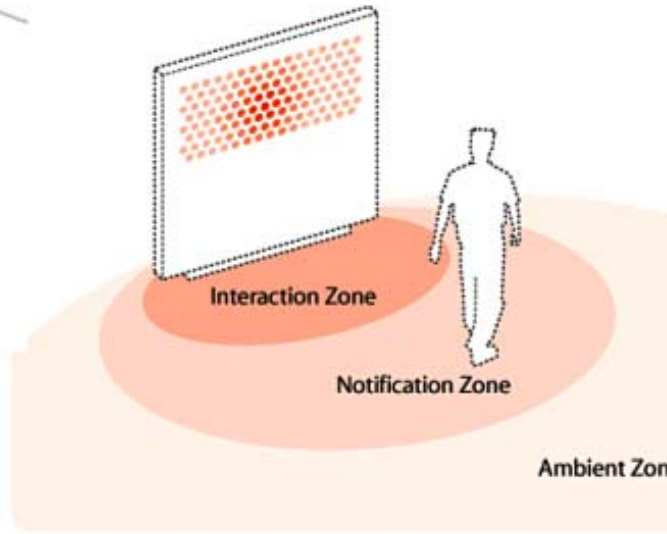
PROTOTYPES
at
JAMBOREE

EVALUATION
in TEST BED
at EDF-LDC

(iterative design feedback loop)

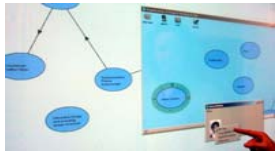
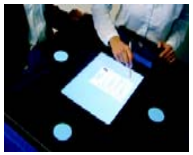
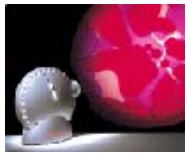
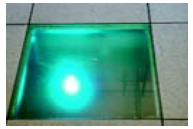
Augmented Lounge Area



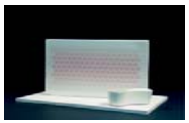
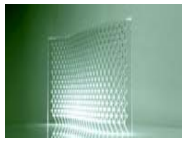
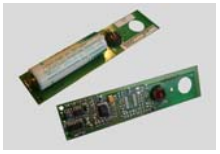
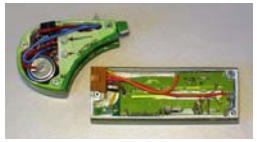
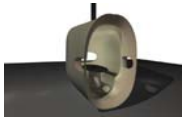
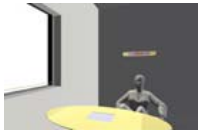


situated information based on sensing data

Overview over Artefacts - 1

InforMall		Prototype 1 	Prototype 2 	Prototype 3 	Prototype 2 + SIAM 	
ConsulTable	Tech. Model 1 	Prototype 1 		Prototype 2 		Product 1 
ViewPort	Design Model 	Prototype 1 	Prototype 2 		Design Model 	Prototype 3 
GossiPlace		Prototype 1 	Prototype 2 		Prototype 3 	Prototype 4 

Overview over Artefacts - 2

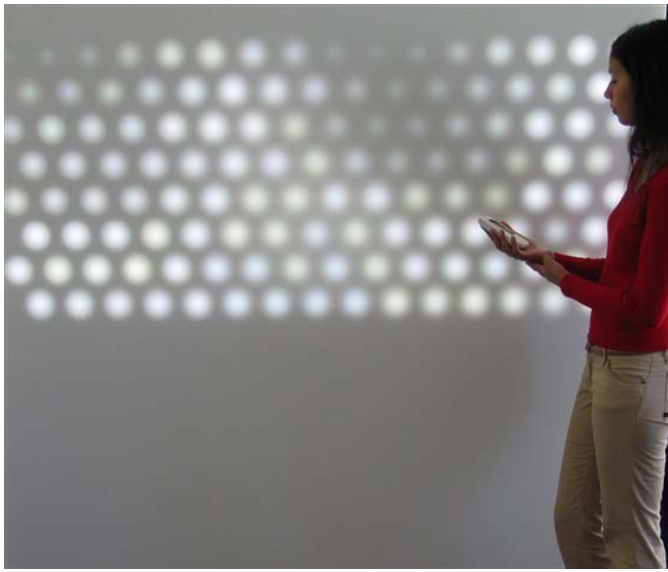
Hello.Wall			Design Model 1 	Design Model 2 	Prototype 1 	Design Model 3 
Personal.Aura		Technical Concept 	Technical Prototype 	Prototype (step 1) 	Prototype (step 2) 	Prototype (step 3) 
Smart Stone	Design Model 1 	Des. Model 2.2 	Des. Model 2.3 	Des. Model 2.4a 	Des. Model 2.4b 	Design Sketch 3 
Private Void			Design Sketch 1 	Design Sketch 1 (location) 	Design Sketch 1 (location) 	Design Sketch 1 (location) 
Talk Mate				Design Sketch 1 	Design Sketch 1 (location) 	Design Sketch 1 (location) 

Conveying Experiences via Ambient Displays

- Communication by using simple, atmospheric (light) patterns that are intuitively experienced

Hello.Wa

- public patterns: are known to everybody



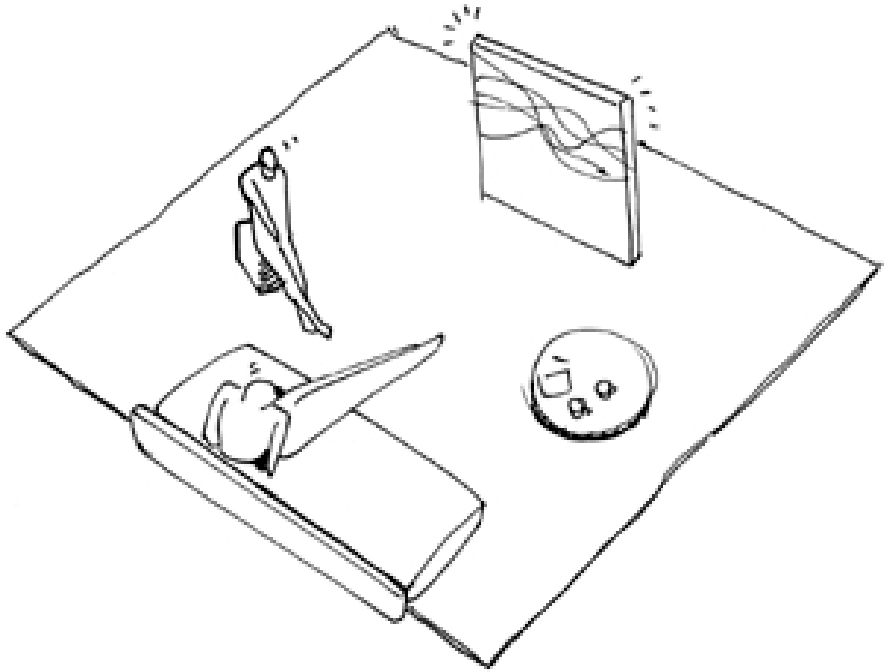
- personal patterns: users can create them on their own or for a defined group. signs with “exclusive semantics” allow to show private information in public spaces (notification, awareness, …)

- enriching and detailing information via “borrowed” displays of additional artefacts (e.g., ViewPort)

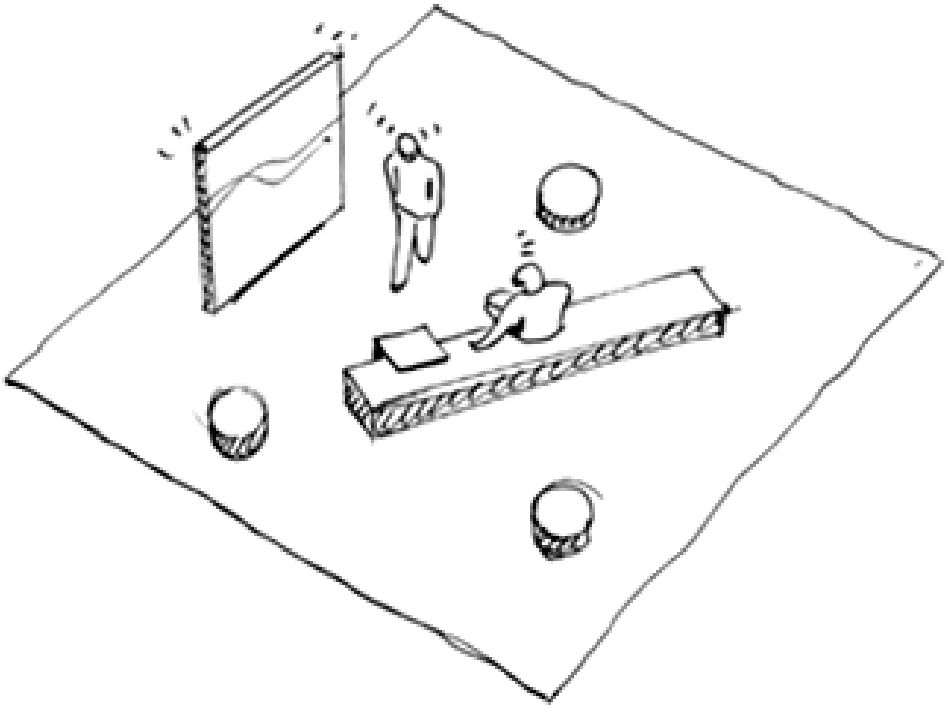
- aesthetic quality => Informative Art

“Connecting Remote Sites” Scenario

Goal: Providing notification and awareness about presence and mood of teams in different locations in order to facilitate informal communication



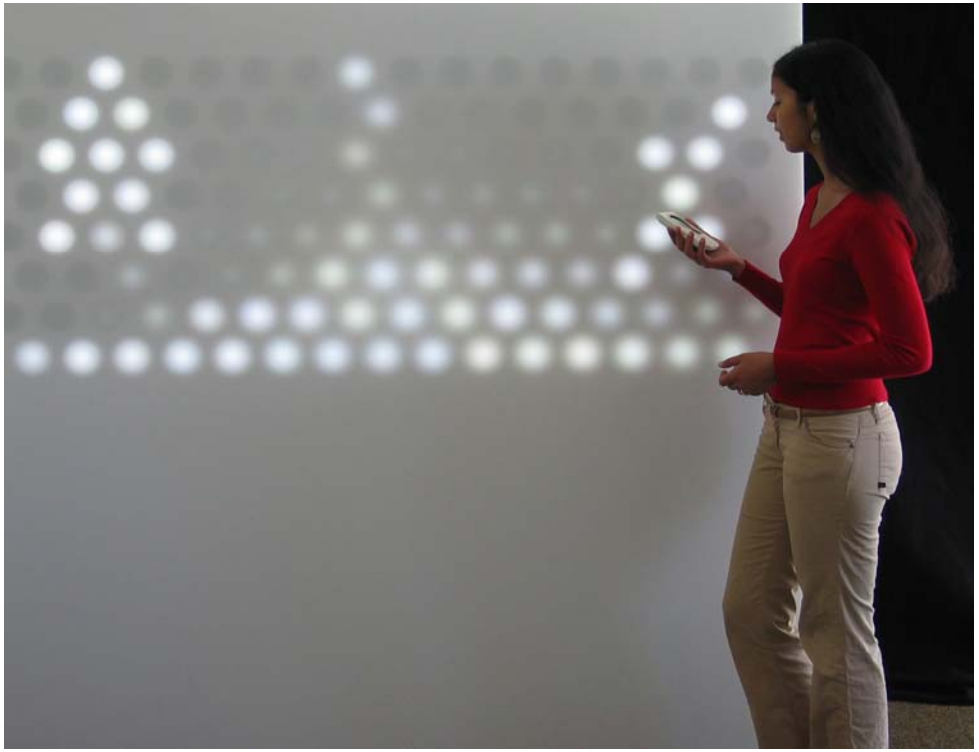
Fraunhofer IPSI, Darmstadt

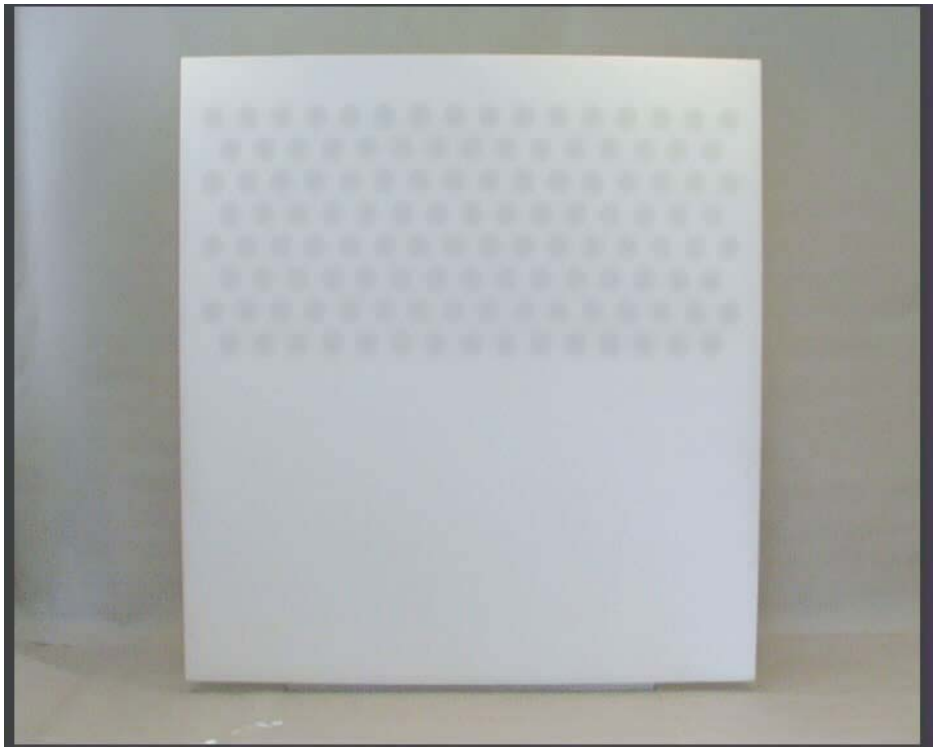


EDF-LDC, Paris

Hello.Wall in Lounge Area

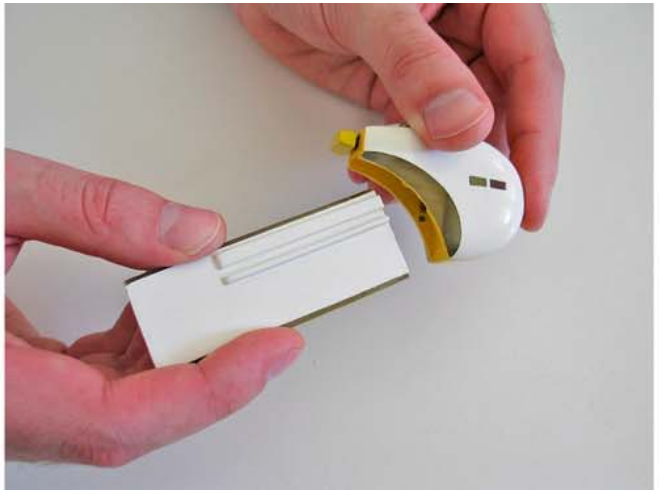
ViewPort and Pattern Combination at Hello.Wall



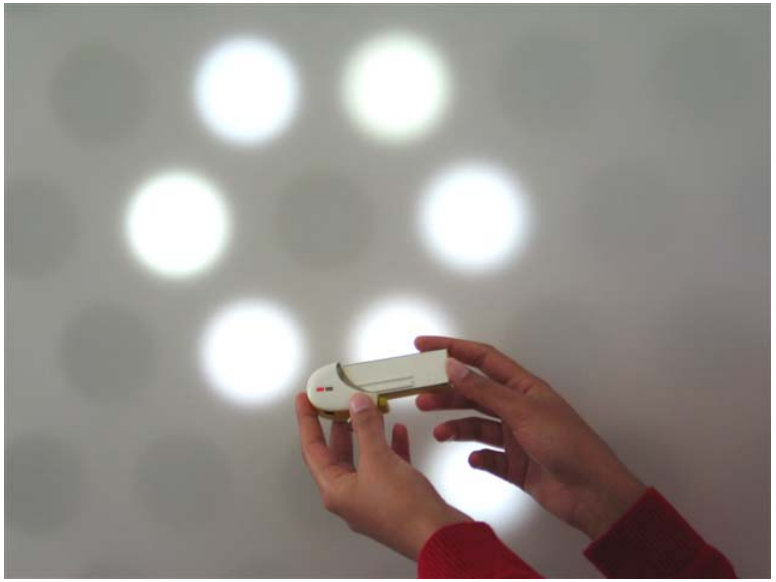


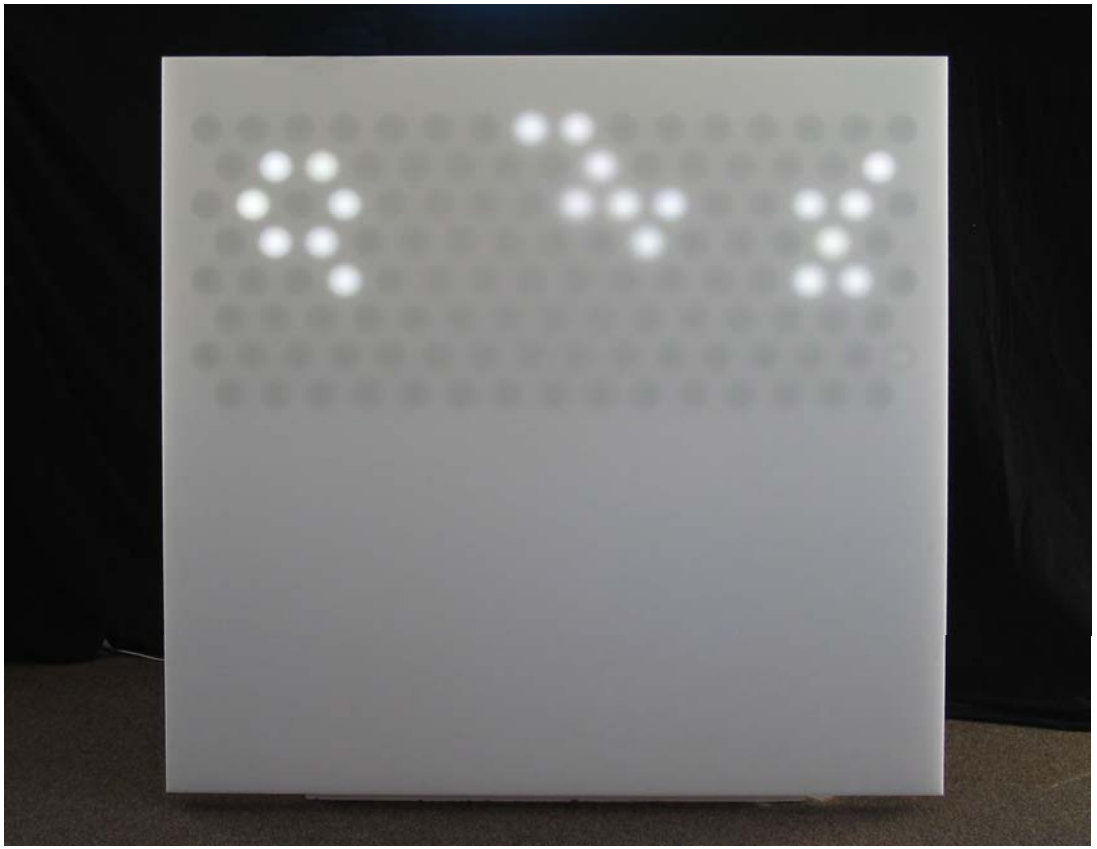
Privacy via the „Personal Aura“

- two matching parts:
  - ID stick (contains unique identity and optional personal information)
  - reader module (“broadcasts” different identities)
- each person has multiple ID sticks symbolizing different roles
- if people want to signal their current social role they do so by simply connecting a specific ID stick to the reader module or they stay “invisible” in a sensor-based environment


Hello.Wall and Personal Aura





InterLink-Project

- InterLink = International Cooperation Activities in Future and Emerging ICTs

- Coordination Action funded by the European Commission's IST (Information Society Technology) program FET (Future and Emerging Technologies)

- Goal: Create „white papers" on future trends (input for FP7, FP8) and facilitate international collaboration
- Duration: October 2006 – March 2009

- Three Thematic Areas/Working Groups:
  - WG1: Software intensive systems and new computing paradigms
  - ***WG2: Ambient Computing and Communication Environments (Streitz)***
  - WG3: Intelligent and Cognitive Systems

InterLink: Issues and Applications

Two areas of issues:

- What is socially aware ambient intelligence
  and how do we realize it?
- Privacy and Trust:
  Conflicts of data provision vs. Control and human attention

Umbrella Scenario: *Urban Life Management*

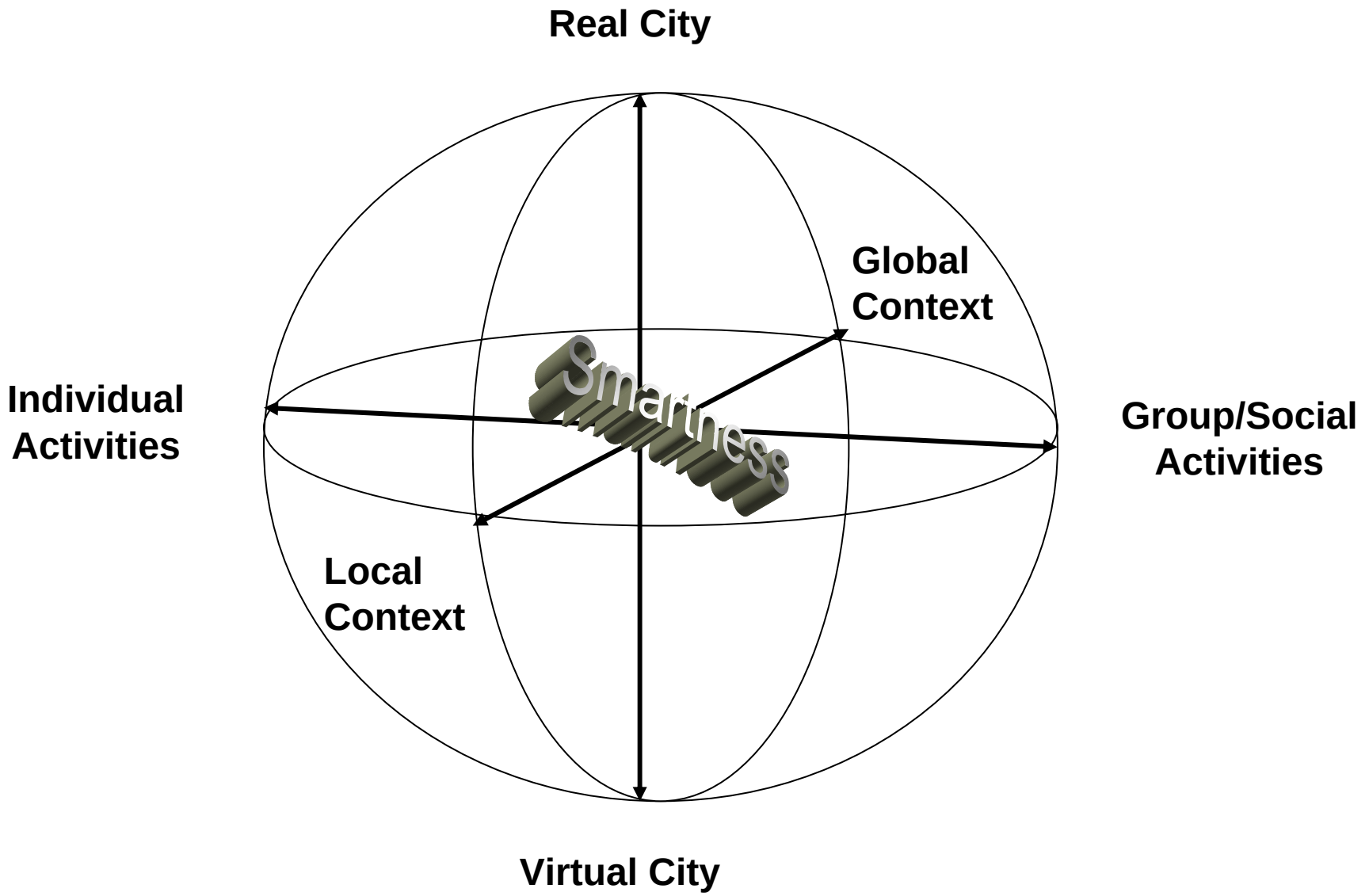
Two perspectives:

- How to manage a person's/a group's life in a city?
- How to manage the urban environment for the people?

Approach:

- *Hybrid City* as a concept integrating the real city and
  the parallel virtual city; addressing ubiquity and smartness

InterLink: Hybrid City



Claims and Theses Revisited

1) *The more the computer disappears and becomes invisible, the more it determines our lives*
2) *It's all there in the environment*
   => no need to carry devices
3) *People-friendly environments in which the "computer-as-we-know-it" has no role*
4) *From information design to experience design*
5) *New affordances for facilitating coherent experiences*
6) *Smart spaces make people smarter*
7) *Privacy might become a commodity and a privilege*

More Information …

www.ipsi.fraunhofer.de/~streitz

www.roomware.de

www.disappearing-computer.net

www.ambient-agoras.org

http://interlink.ics.forth.gr

contact: streitz@ipsi.fraunhofer.de