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The Disappearing Computer, Ambient Intelligence, and Smart (Urban) Living

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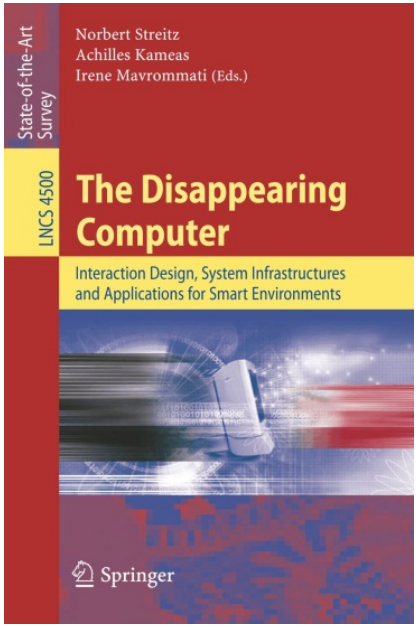
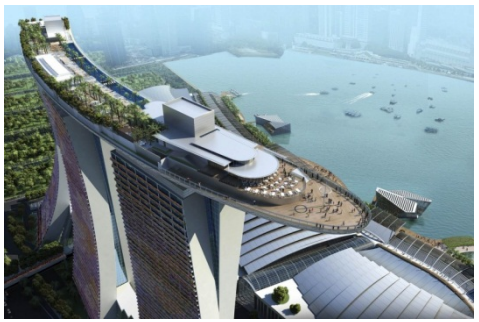
Overview

- Design Approach
- Disappearing Computer
- Ambient Intelligence
- Smart, Hybrid and Humane City
- Research Agenda
- Conclusions



From Rooms via Buildings to Cities



Design Approach

Interdisciplinary Approach & Team

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

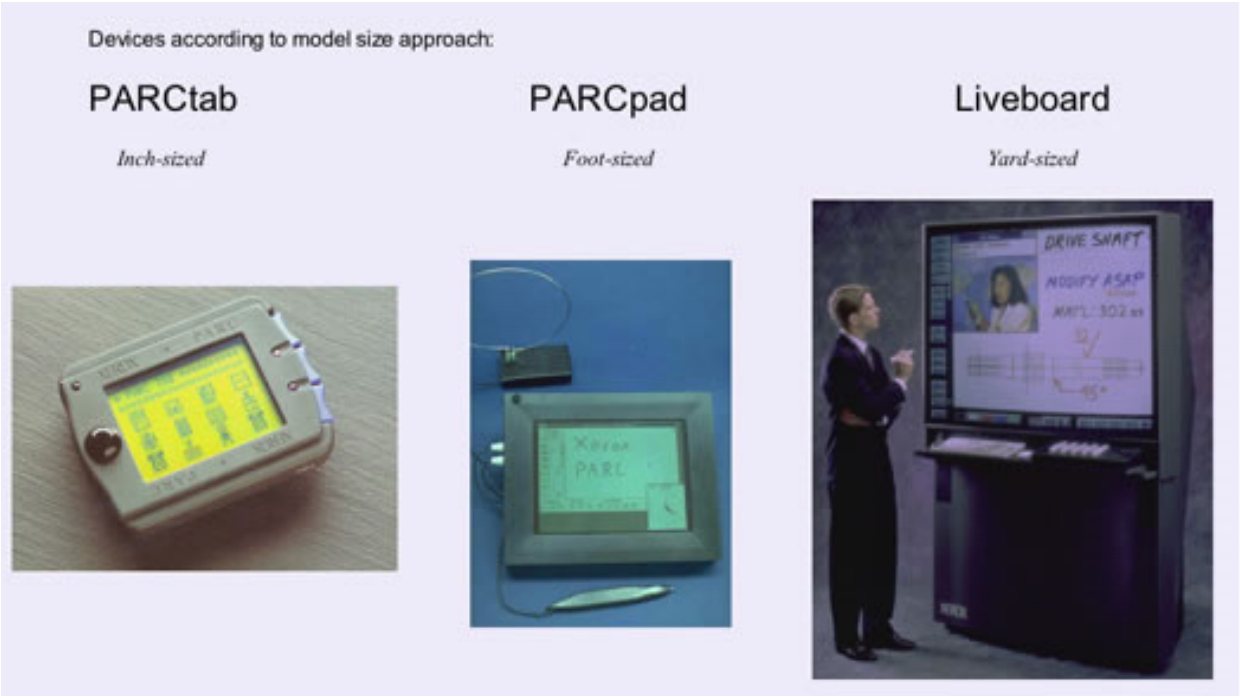
Ubiquitous Computing at Xerox PARC

The most profound technologies are those that disappear.

They weave themselves into the fabric of everyday life

until they are indistinguishable from it

(Marc *Weiser, Scientific American, 1991*)



- Visiting Scholar at Xerox PARC in 1990

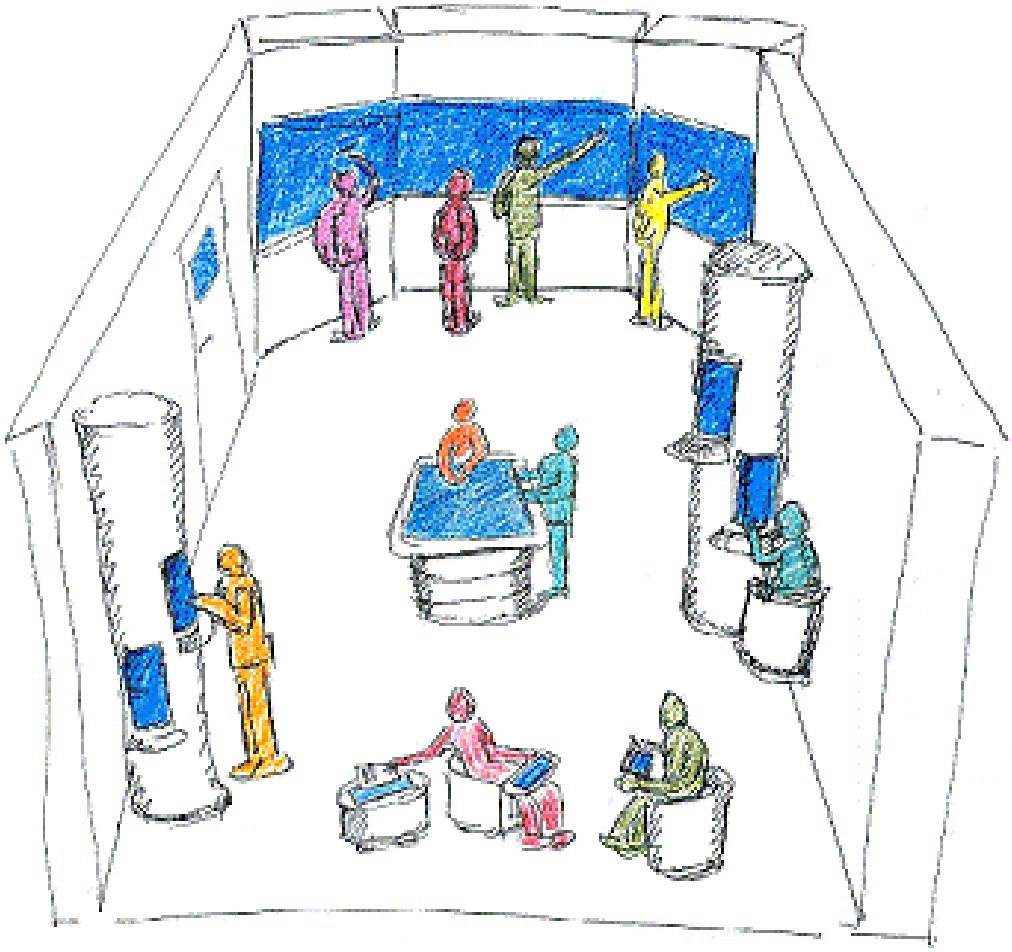
DOLPHIN – Electronic Meeting Room Support

- The first two LiveBoards (serial # 007 and 008) outside of PARC were shipped to GMD-IPSI in Darmstadt, Germany, in 1992
- basis for developing an Electronic Meeting Room (OCEAN Lab)

- networking the LiveBoard and individual computers integrated in the meeting room table

- connecting all devices via the Cooperative Hypermedia System DOLPHIN (pen-based and truly collaborative multi-person authoring/ brainstorming tool), 1992 – 1995

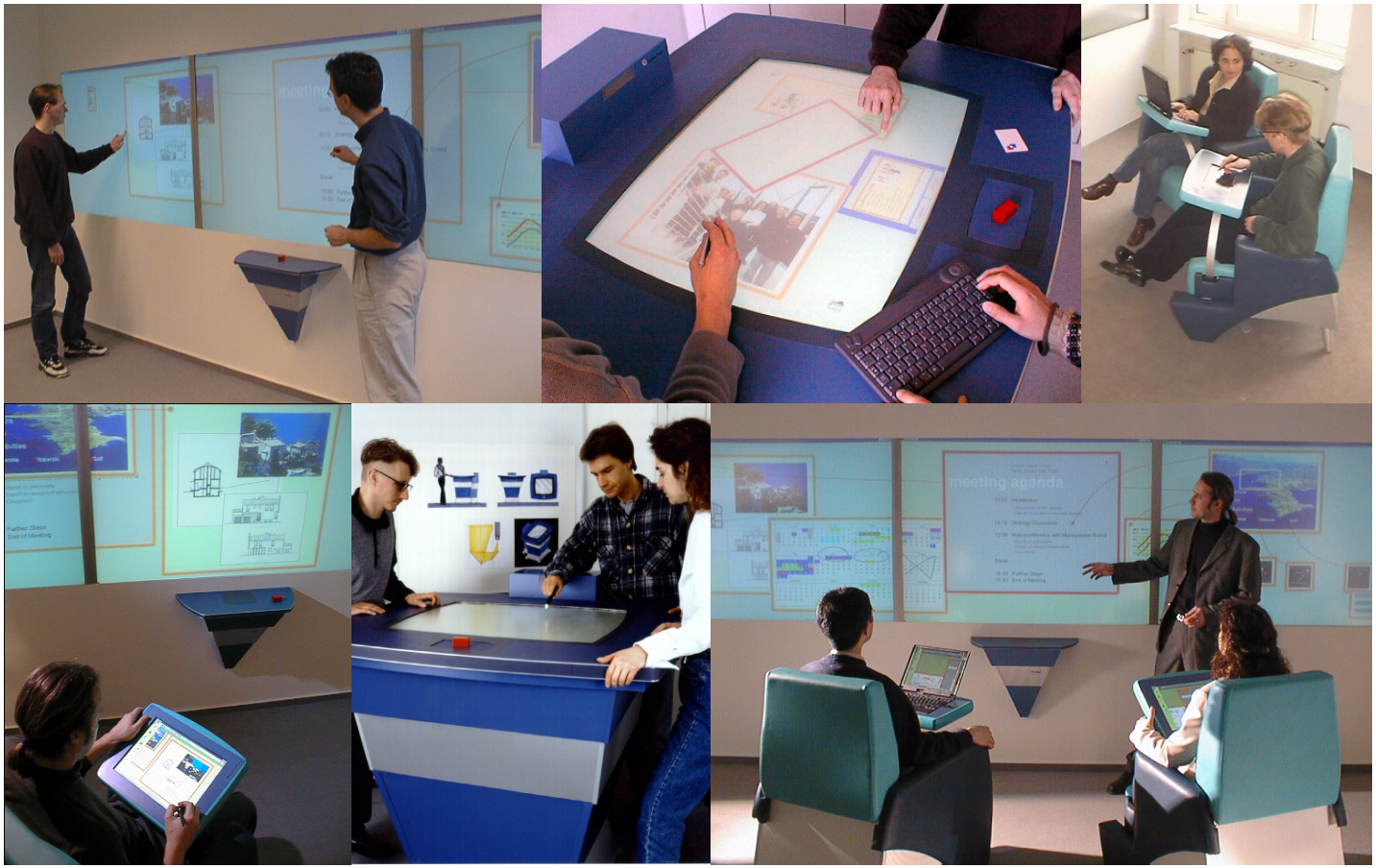
i-LAND -
an interactive landscape for creativity and innovation



Vision Scribble of i-LAND (1997)

1st Generation of Roomware® (1997-1998)

Complemented with the BEACH Collaboration Software



2nd Generation of Roomware® (1999-2000)

FOD
Future Office Dynamics

GMD
IPSI

Wilkhahn

DynaWall® CommChair® InteracTable® ConnecTable®
+ Passage (physical bookmark in the virtual world)

Information Society Technologies

- FET proactive initiative “The Disappearing Computer” (2000 – 2004)
- 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

- *Vision: To develop people-friendly environments in which the “computer-as-we-know-it” has no role.*

The Disappearing Computer

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.

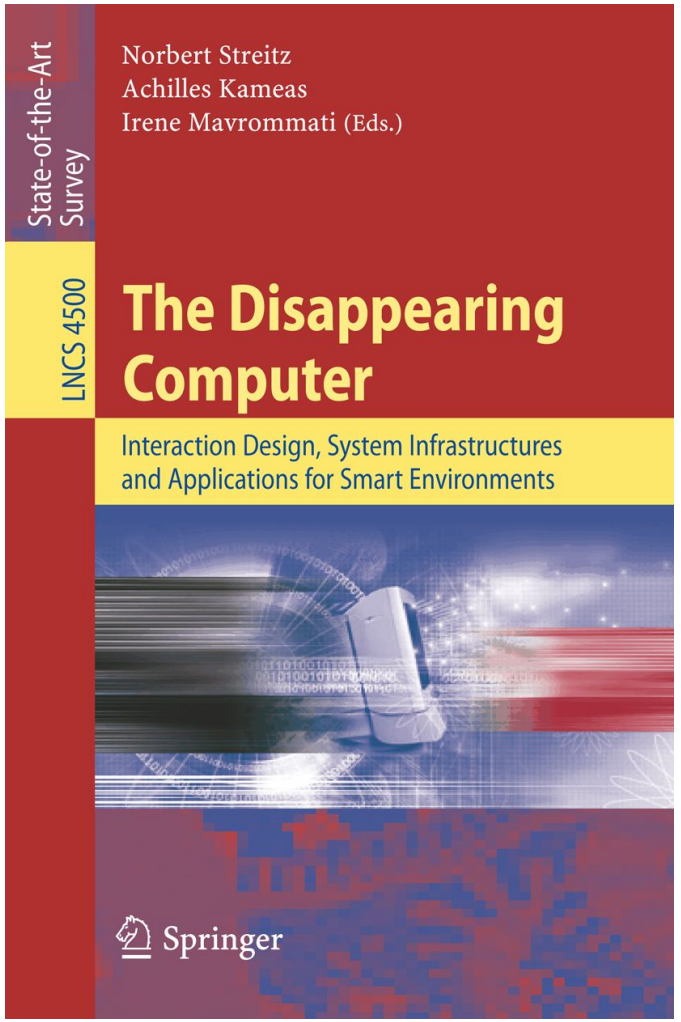
(*Streitz & Nixon, Communications of the ACM, March 2005*).

Comprehensive Book on „The Disappearing Computer“

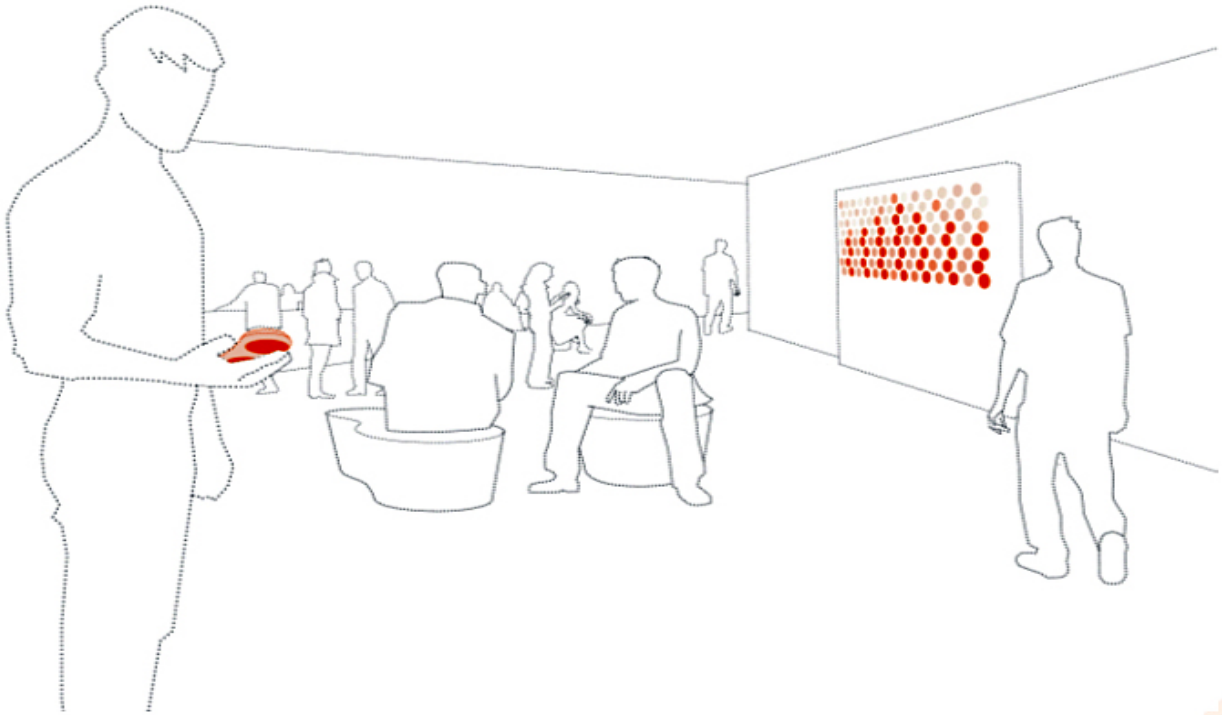
Norbert Streitz
Achilles Kameas
Irene Mavrommati (Eds),
The Disappearing Computer:
Interaction Design,
System Infrastructures and
Applications for Smart Environments

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

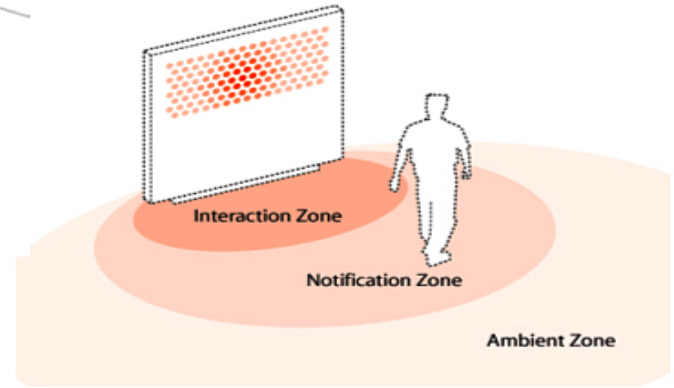
Forewords from:
- The European Commission
- Emile Aarts (Philips)
- Gregory Abowd (Georgia Tech)



Ambient Agoras: Dynamic Information Clouds in a Hybrid World



Lounge areas
in office buildings
and public spaces



Fraunhofer IPSI Institut Integrierte Publikations- und Informationssysteme

EDF Electricité de France

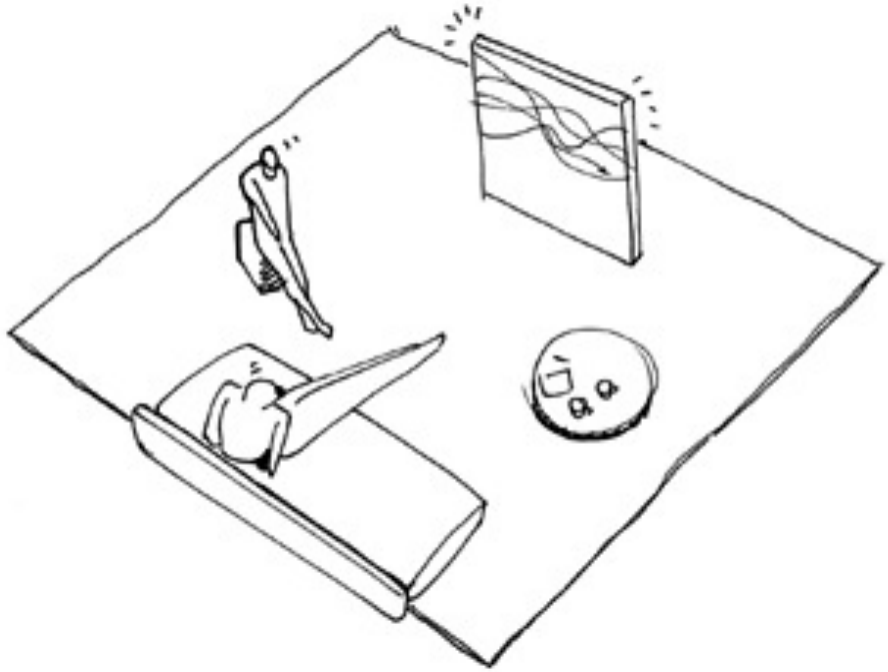
LDC

DALT

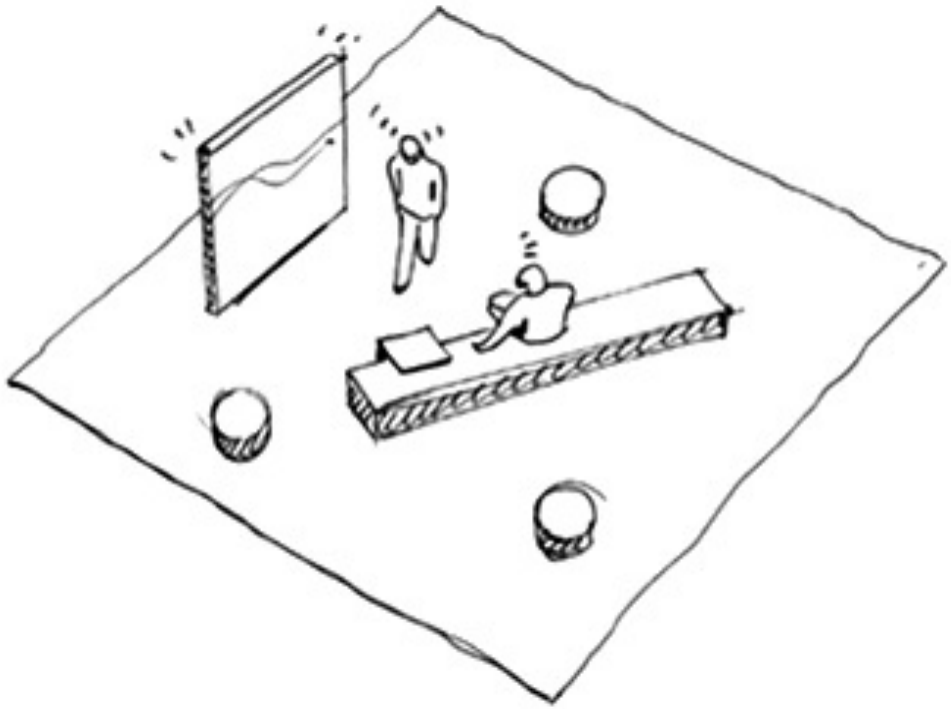
Wilkhahn

Sample Scenario: “Connecting Remote Sites”

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



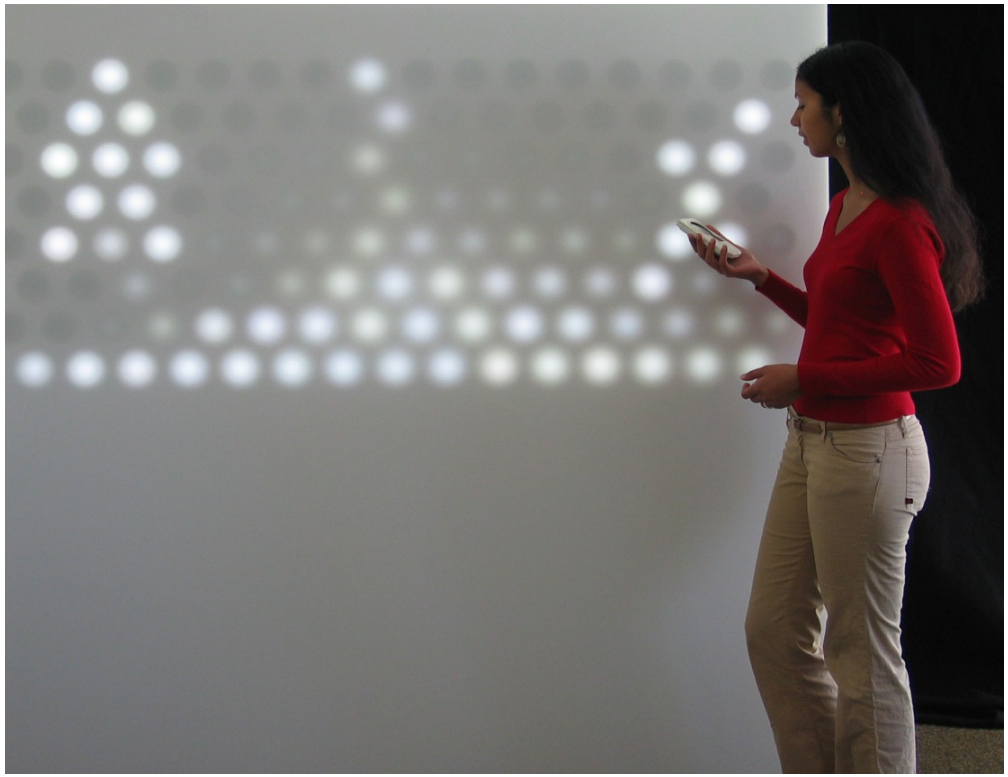
Fraunhofer IPSI, Darmstadt, Germany



EDF-LDC, Paris, France

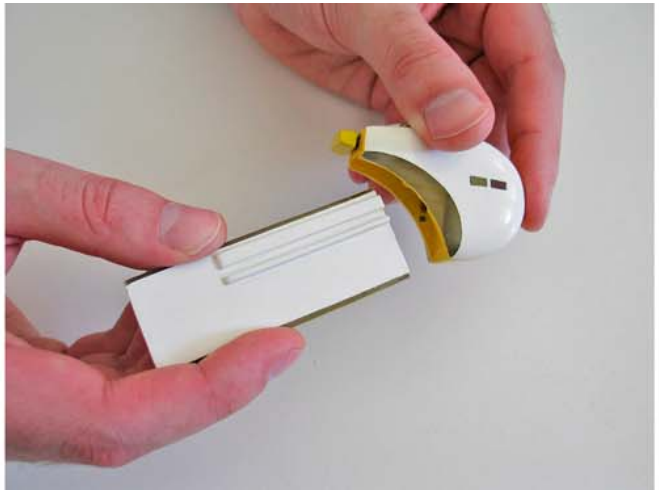
Hello.Wall in Lounge Area

ViewPort and Pattern Combination at Hello.Wall

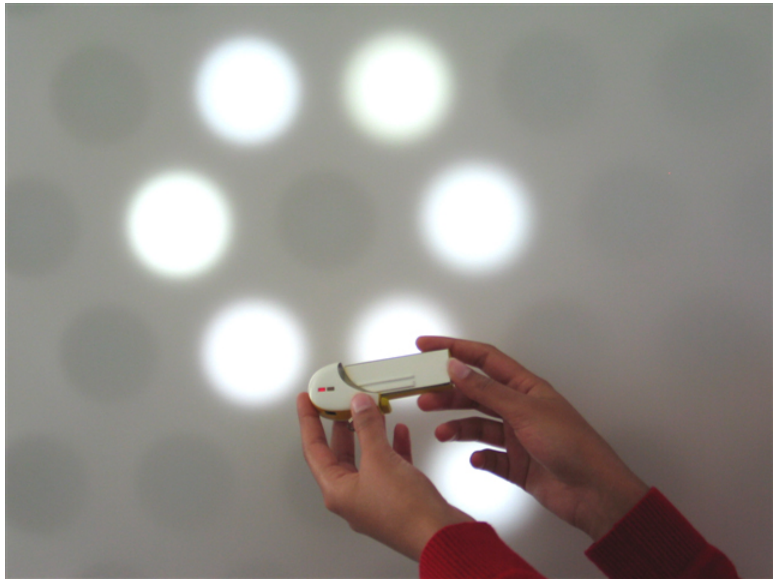


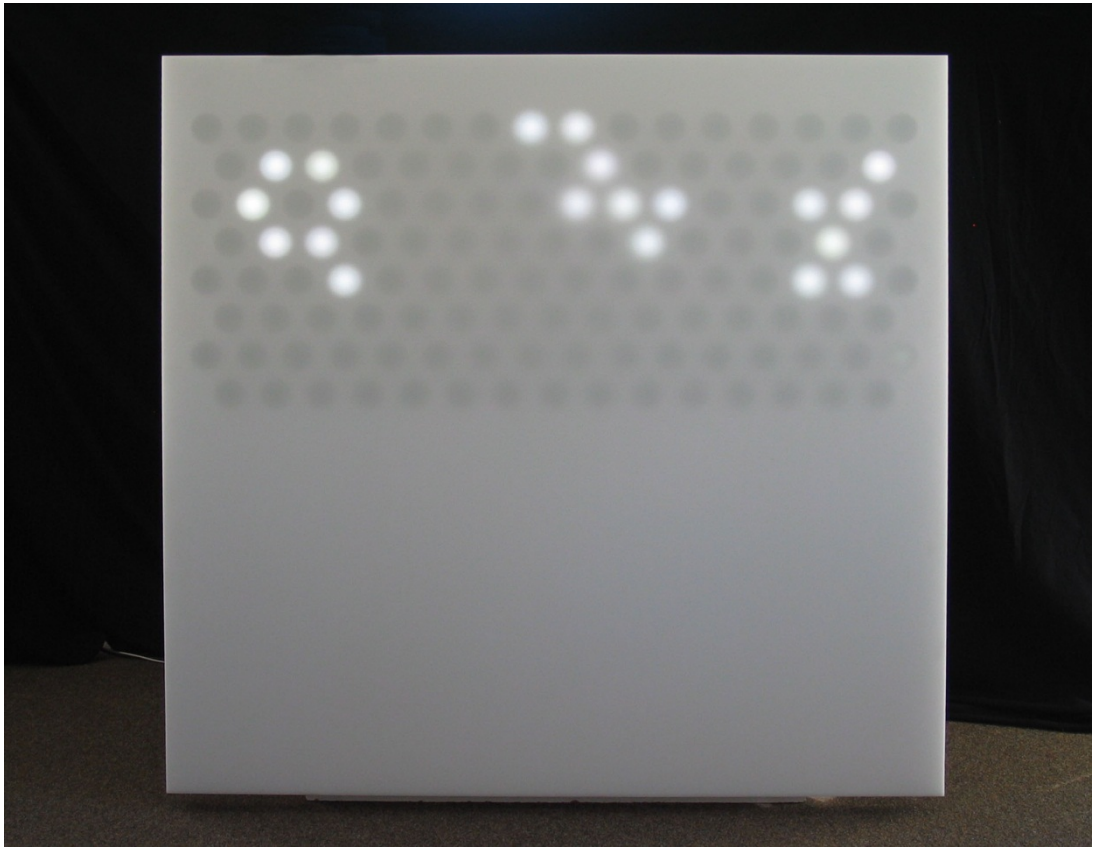
Privacy via the „Personal Aura“

- 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



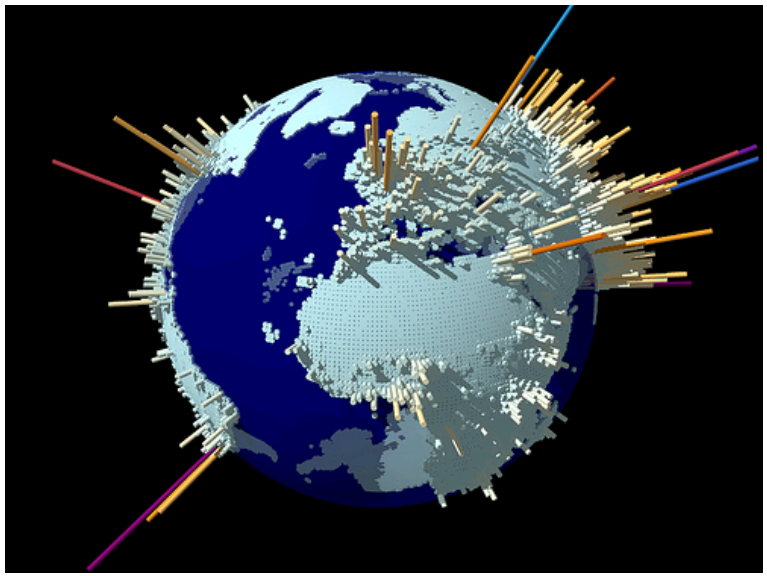


Appropriation of the Environment

- No need to carry computing devices with us.
- *It's all there in the environment*:
  everything is everywhere".
- *"The world around us"* is the ‚interface' to information

Urban Age: Extending the Perspective

- Word population:
  - will rise from 6.7 billion in 2007 to 9.2 billion in 2050
  - ***by the end of 2007, half of the world population lived in urban areas***
  - by 2050, 70 % will live in cities (growth especially Asia, Africa,..)
  - in cities will rise from 3.3 billion to 6.4 billion in 2050
  - Greater Tokyo has now about 35 million > Canada's population



Population density (G-Econ project, Yale)

City of the Future: A wide range of associations

The Future ?

Video

Future Cities: Different Names and Connotations

Digital/ Virtual City

- early notion of having virtual counterparts of cities
- no concrete relationship to the “real” physical city

Ubiquitous City (u-City)

- primarily technology and infrastructure driven

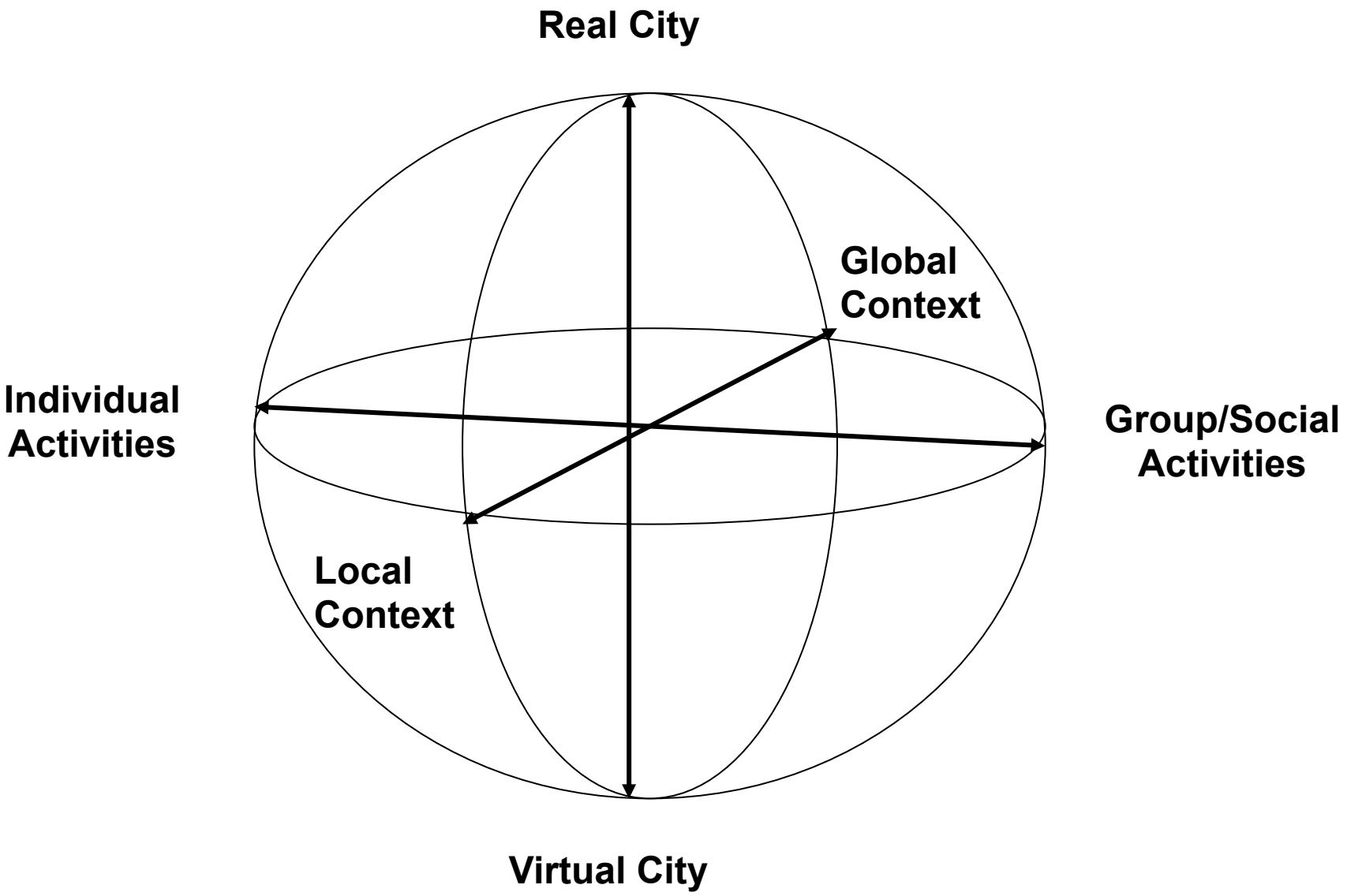
Smart City

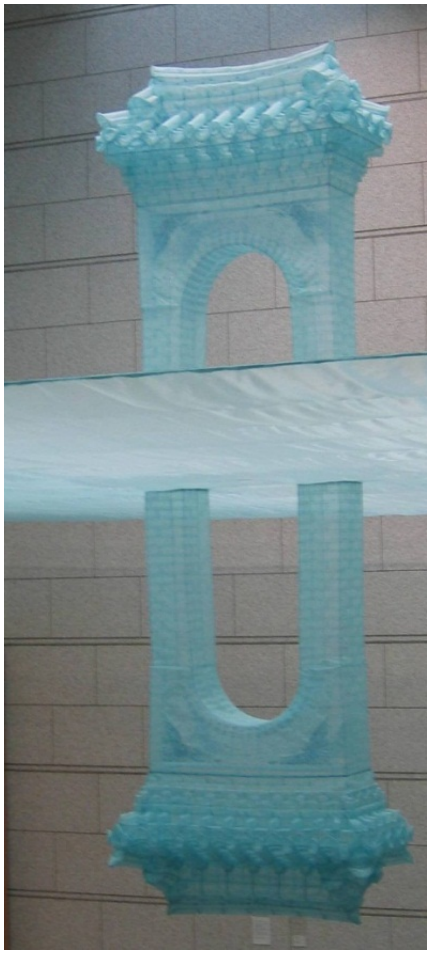
- city offering smart services, e-government, …
- most often used in the context of ICT research

Hybrid City

- equal significance of real and virtual worlds/cities
- comprehensive integration results in Hybrid City

Dimensions of Smart Hybrid Cities





Next Steps

There are many ways addressing the challenges and issues of Hybrid and Smart Cities.

What are the guiding value systems?

What kind of city do we like to have?

A technology-driven and –dominated one?

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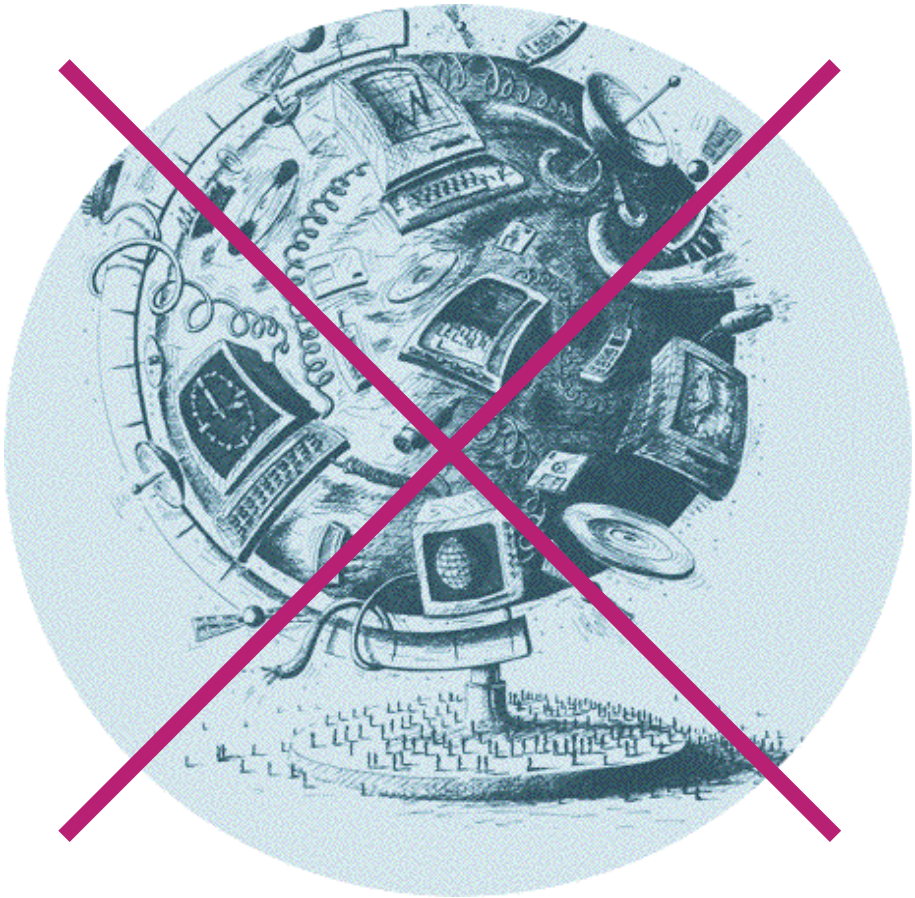
There are many ways addressing the challenges and issues of Hybrid and Smart Cities.

What are the guiding value systems?

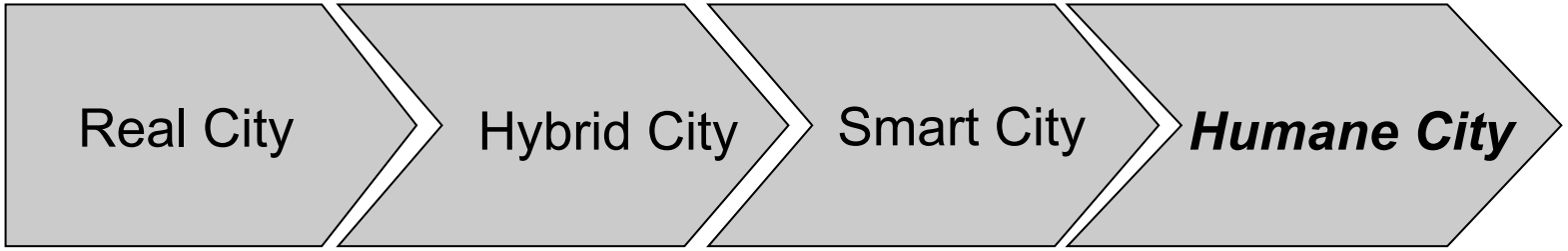
What kind of city do we like to have?

A technology-driven and –dominated one?

Probably not!



Towards the Humane City



Humane City

- *A city where people enjoy everyday life and work, have multiple opportunities to exploit their human potential and lead a creative life.*
- option of adapting concepts from cities in the old Greek tradition with institutions as the ‘agora’, etc.
- need for a less technology-driven but more human-oriented approach and vision for future cities
- supporting responsible citizenship and engagement
- part of a Creative and Inclusive Society (tangible emotion, fun for 5 seconds, …)

(=> EU-funded Project InterLink)

Smart Infrastructures

Ambient Intelligence Dimension

- pervasive and ubiquitous communication infrastructure combined with embedded systems, sensors, actuators, and interactive media embedded into the physical environment are available to the city's population.

Towards Smart Ecosystems

- shift from individual embedded sensors and actuators towards a *computing, communication, sensing and interaction substrate* that can be handled at the application/domain level (e.g., smart wall-paper, smart table-cloth, ..)

- seamless integration with a high degree of diffusion, "equilibrium" and "emergent" smartness of the overall environment that might soon parallel other existing ecosystems

EU-funded project InterLink

Focus of the orientation for the Working Group 2
"Ambient Computing and Communication Environments":

Towards the Humane City:
Designing Future Urban Interaction and Communication Environments

- Results of four Workshops (held in Germany, France, Japan) with international experts from Europe, Asia, Australia, US published as a "white paper".
- Identification of *12 Research Lines*
  bridging the gap between today's state
  and the vision of the future

Research Lines: 1-6

R1: Rationale for Humane/All-inclusive Cities (users are citizens, …)

R2: Tangible Interaction and Implicit vs. Explicit Interaction

R3: Hybrid Symmetric Interaction

symmetrical, bidirectional action/interaction between real and (multiple virtual) worlds transformations of representations

R4: Space-Time Dispersed Interfaces

dynamic allocation of resources following trajectories in space and time

R5: Crowd and Swarm Based Interaction

R6: Spatial and Embodied Smartness

smart spaces as distributed cognitive systems, outside-in robot

Research Lines: 7-12

R7: Awareness and Feedback
(sensors , physiological, environmental …)

R8: Emotion Processing (affective computing)

R9: Social Networks and Collective Intelligence

R10: Self-Organization in Socially Aware Ambient Systems

R11: Realization and User Experience of Privacy and Trust

R12: Scaling (a horizontal issue)
(fuzzy boundaries of smart spaces, conflict of interest among AmI-spaces, availability/ownership of public/private resources)

Conclusions: The City as an Urban Network for Humans

Humans – Citizens – Humane City

Urban Life Management

Computer disappears,
determines our lives
Experience Design
Privacy

Human-in-the-Loop
Creative Society
individual & collective
intelligence

Ambient Intelligence
Smartness
Public Spaces

Buildings
Sustainability
Smart Eco-System
Interaction substrate

Urban Age

Digital City – Hybrid City – Smart City

More Information …

www.smart-future.net

www.roomware.de

www.disappearing-computer.net

www.ambient-agoras.org

http://interlink.ics.forth.gr

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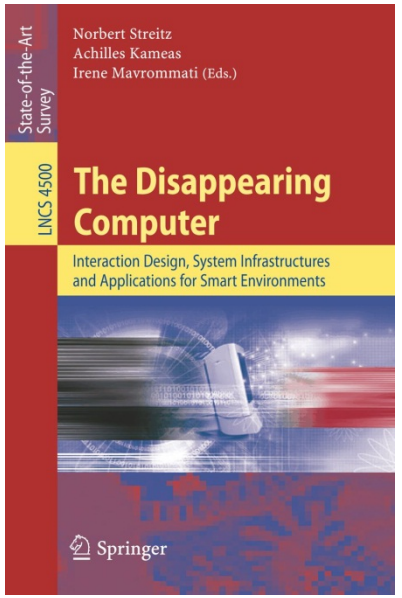
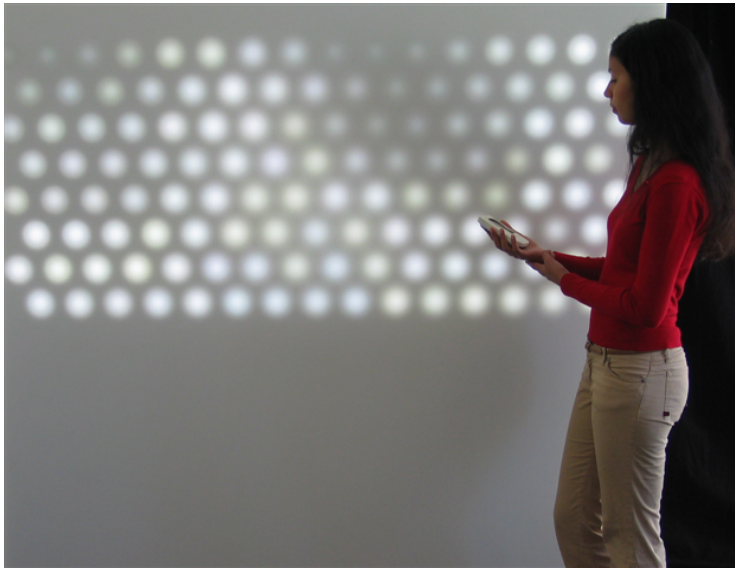


Conveying Experiences via Ambient Displays

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

- 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

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, …)