



SIEMENS



UNIVERSITÄT PADERBORN

**Cooperative Computing &  
Communication Laboratory**

*NATO TG 12 Workshop on ‚Middleware in Mobile Networks‘*

# ***Context-Awareness in Middleware for Mobile Networks***

*Dr. Heinz-Josef Eikerling*

SBS D SOL C-LAB, Distributed Interactive Systems

# Report Documentation Page

Form Approved  
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>01 DEC 2007</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED	
4. TITLE AND SUBTITLE <b>Context-Awareness in Middleware for Mobile Networks</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>SBS D SOL C-LAB, Distributed Interactive Systems</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited.</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>UU</b>	18. NUMBER OF PAGES <b>21</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

*Introduction:*

# Middleware

What is middleware?

*An **enabling layer of software** that resides between the **business application** and the **networked layer of heterogeneous (diverse) platforms and protocols.***

*It decouples the business applications from any dependencies on the plumbing layer, which consists of heterogeneous operating systems, hardware platforms and communication protocols. (Source: International Systems Group)*

## *Introduction:*

# Mobile Middleware

**Data-Access Middleware** (JDBC,...)

**Message-Oriented Middleware** (MQ Series, JMS,...)

**Transaction Processing Middleware** (X/Open, OTS, JTS...)

**Desktop-Access Middleware** (Citrix,...)

**Object Middleware** (DCOM, CORBA,...)

## ***Mobile Middleware***

**Enabling Middleware**

Service and device management (Jini, UPnP) etc.

**Connectivity Middleware**

Network gateways etc.

**Front-End Middleware**

Content processing for the front-end.

**Back-End Middleware**

Processing of back-end data (server data access).

*Introduction:*

# Context and Context-Awareness

What is context?

*Context is **any information** that can be used to **characterize the situation** of an **entity**. An entity is a person, place, or object that is considered relevant to the **interaction** between a **user** and an **application**, including the user and applications themselves.*  
*(Source: A. K. Dey, Georgia Tech)*

*Introduction:*

# Context-Aware Computing

Features:

- ◆ **Presentation**

of personalised and adapted data / information and services to the user

- ◆ **Automatic execution**

of a service for the user

- ◆ **Logging**

of context information to support later retrieval and evaluation

*Introduction:*

## **Related Work**

- ◆ **MosquitoNet:** Mobile Computing Group at Stanford
- ◆ **Endeavour:** University of California in Berkeley
- ◆ **Oxygen:** MIT
- ◆ **Future Computing Environments (FCE):** Georgia Tech -> *Context Toolkit*
- ◆ **Portolano:** University of Washington at Seattle -> *Context aware computing esp. w.r.t. user interfaces*
- ◆ **2K:** University of Illinois at Urbana-Champaign (a component-based, network-centric operating system)
- ◆ **PIMA:** IBM T.J. Watson Research Center
- ◆ **Monads:** Department of Computer Science at the University of Helsinki

*Application domain:*

# Home Networking

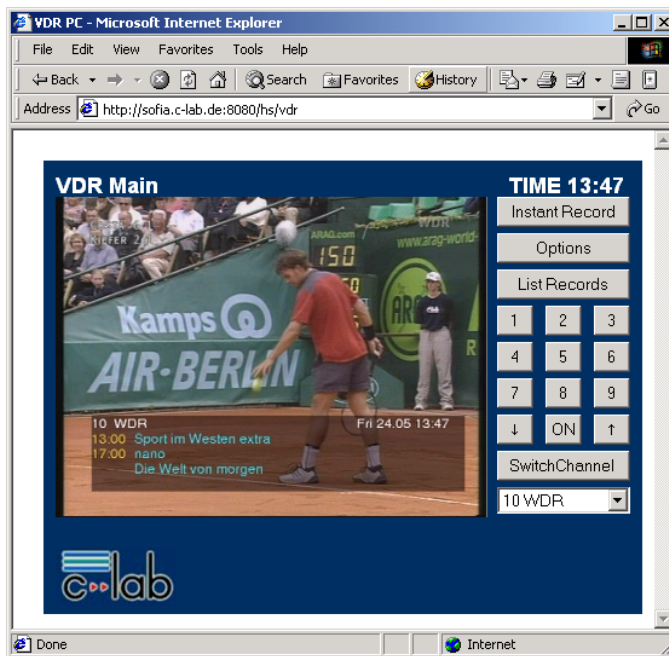
	Technology	Standard	Speed	Max. Distance
<b>Wired</b>	HomePNA	HomePNA v2.0	1 ~ 2 / 10 Mbps	150 ~ 1.5 km
	USB	USB v1.1	12 Mbps	30 m
	Ethernet	IEEE 802.3	10 M / 1 Gbps	100 m
	IEEE 1394	IEEE 1394	~ 400 Mbps	72 m
	Power Line	None	1 ~ 2 Mbps	100 m
<b>Wireless</b>	Bluetooth	Bluetooth v1.0	720 Kbps	10 m
	HomeRF	SWAP v1.2	1 ~ 2 Mbps	50 m
	IrDA	IrDA v1.3	max. 4 Mbps	1 m
	Wireless LAN	IEEE 802.11	5.5 ~ 11 Mbps	50 m



*Application example:*

# Mobile Inhome Entertainment

*Extended Home Environment (xHE)*



PDA

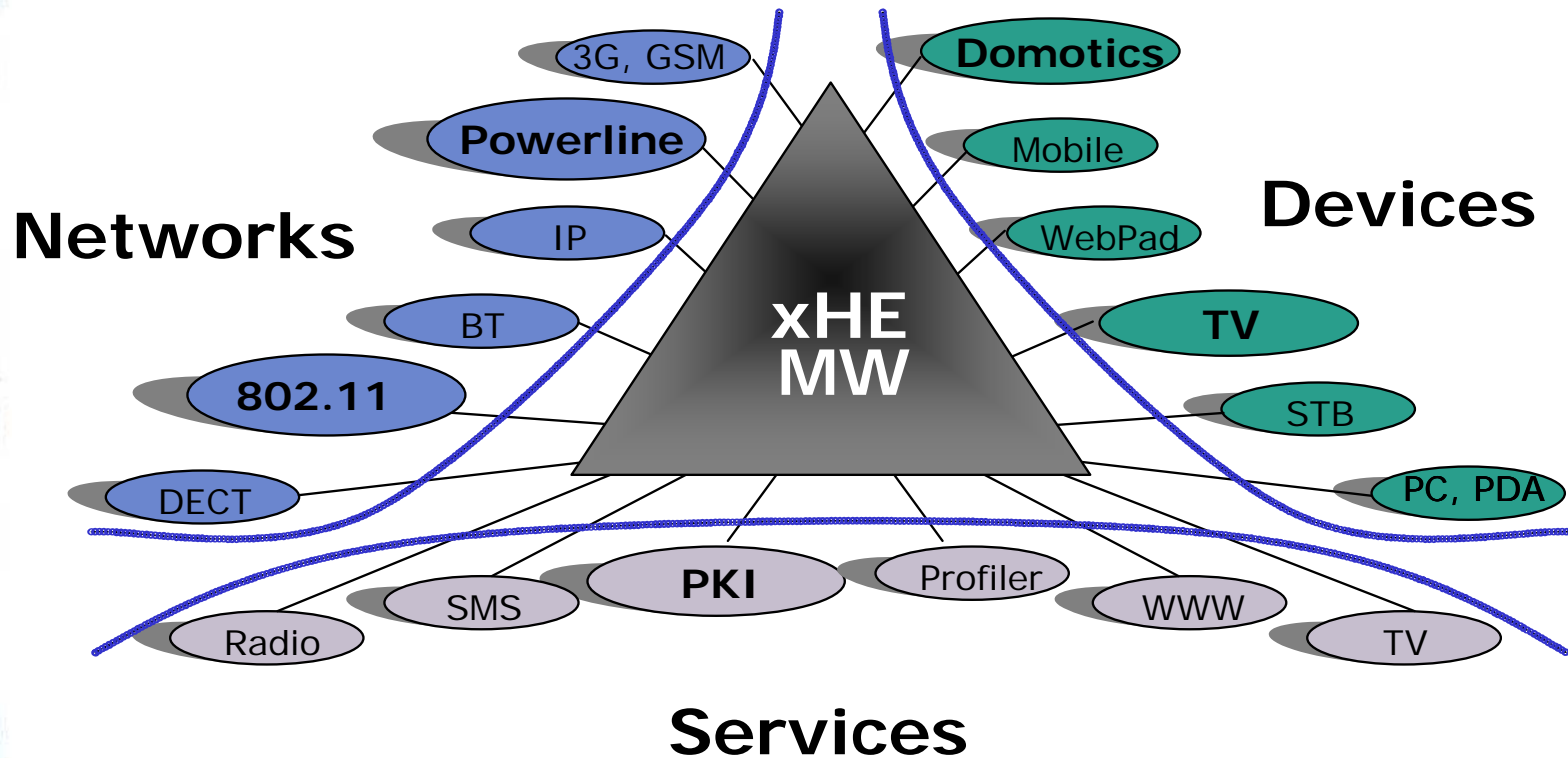
WLAN / GSM

Server  
(VDR / DTV)



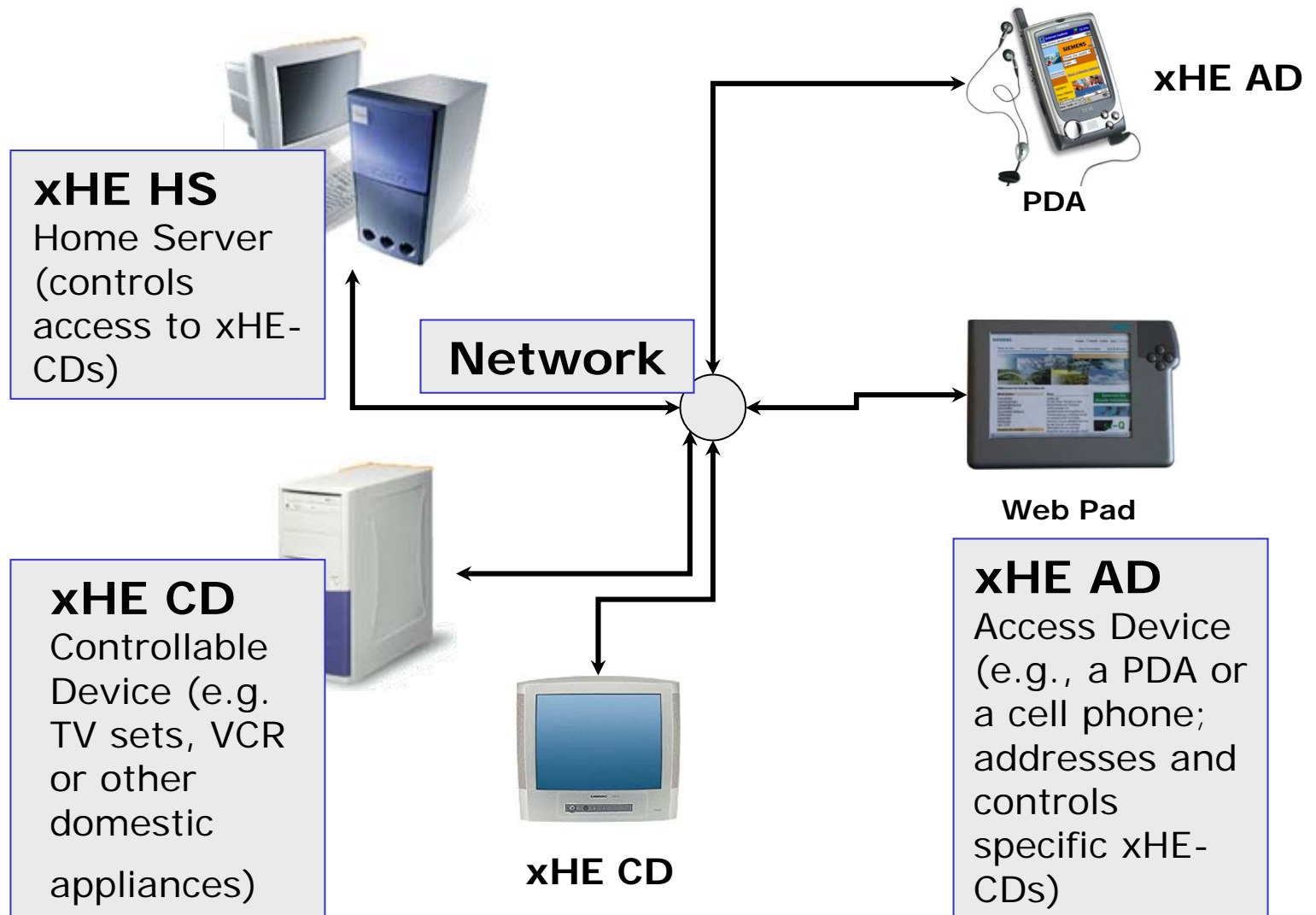
Web Pad

DECT

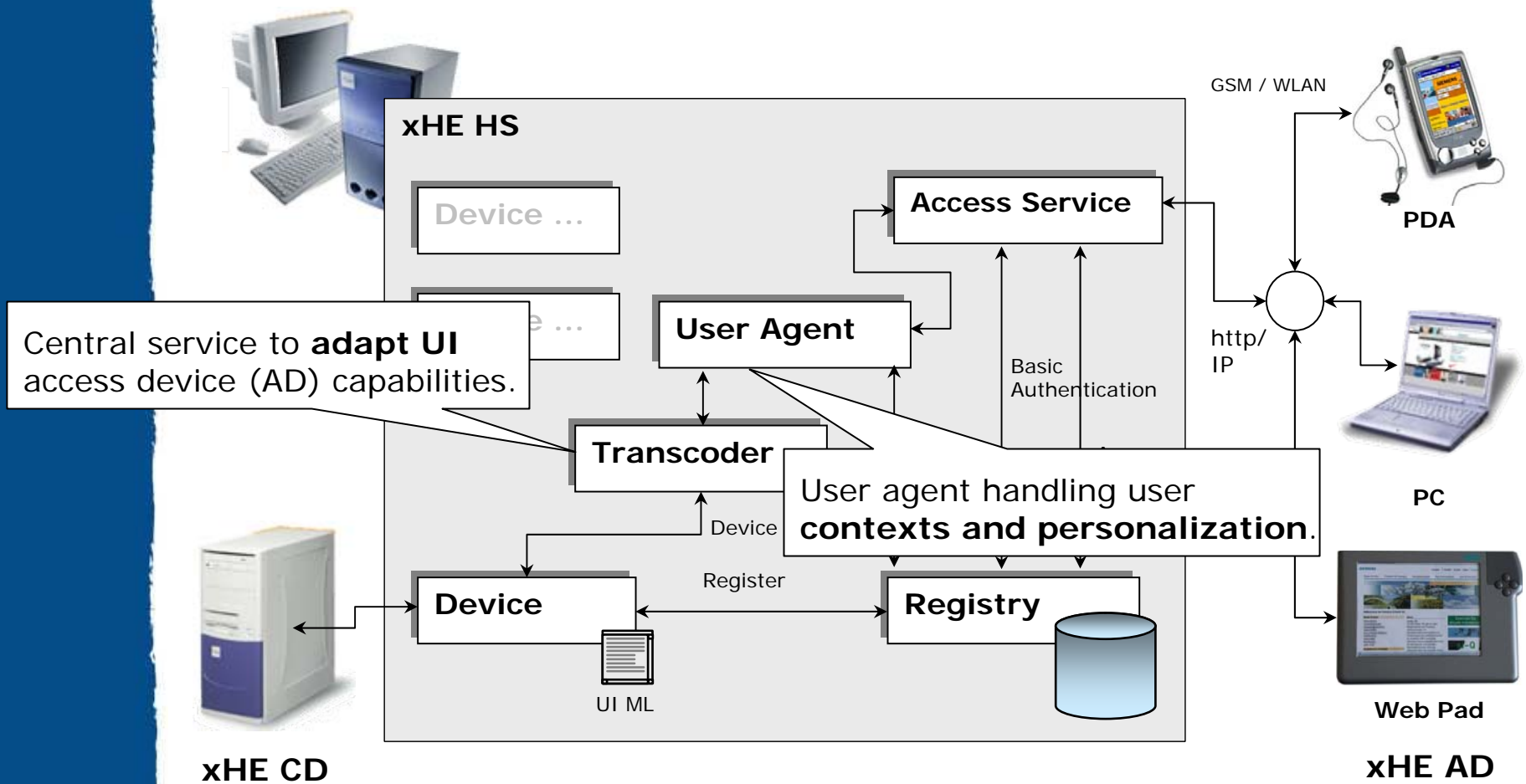
*Requirements and Approach:***Middleware for Integration**

# Architecture:

## Components xHE



# Architecture: Adaptation & Personalisation



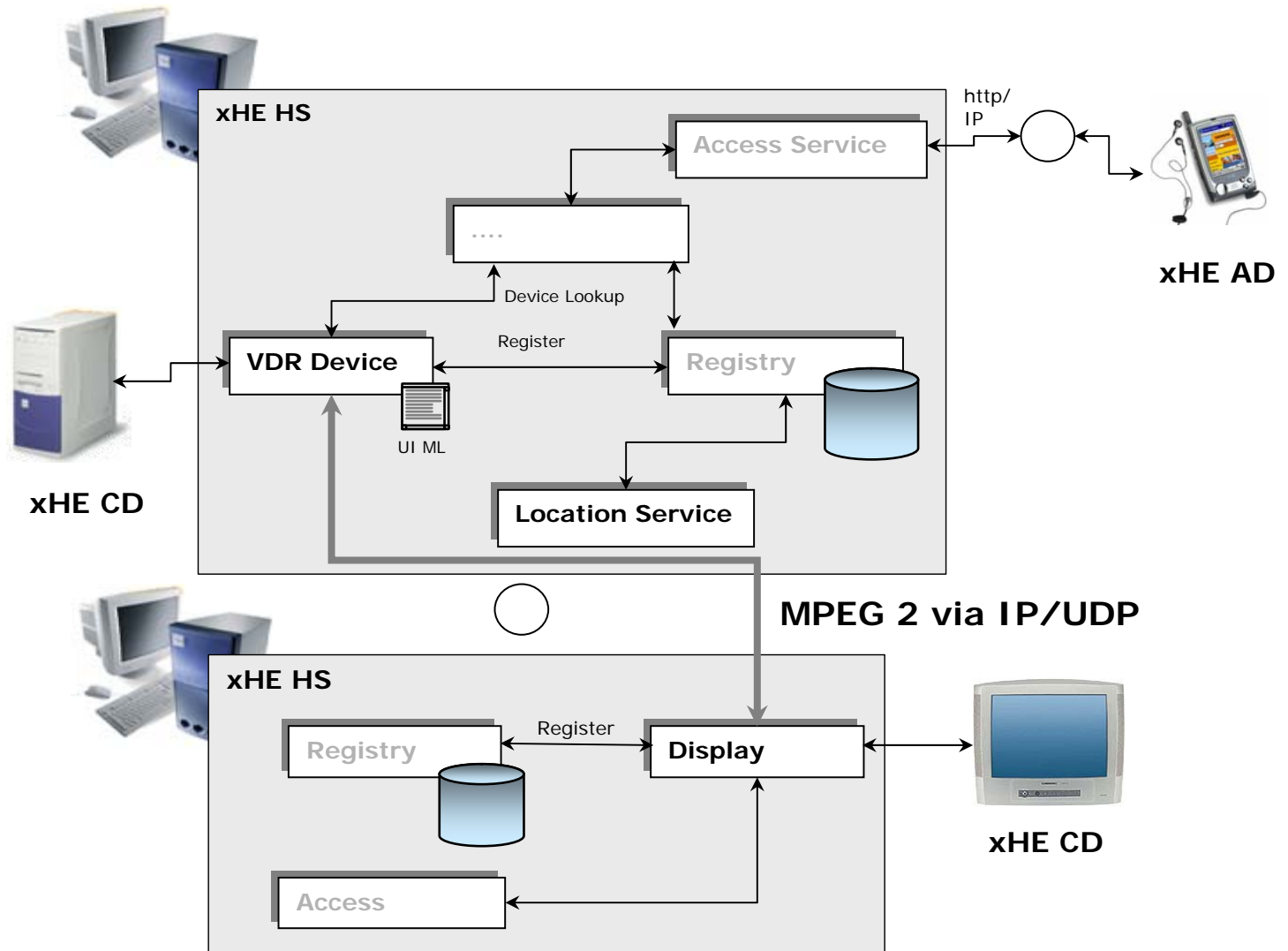
*Prototype System:*

## **OSGi-compatible HS**

**Open Services Gateway initiative:**

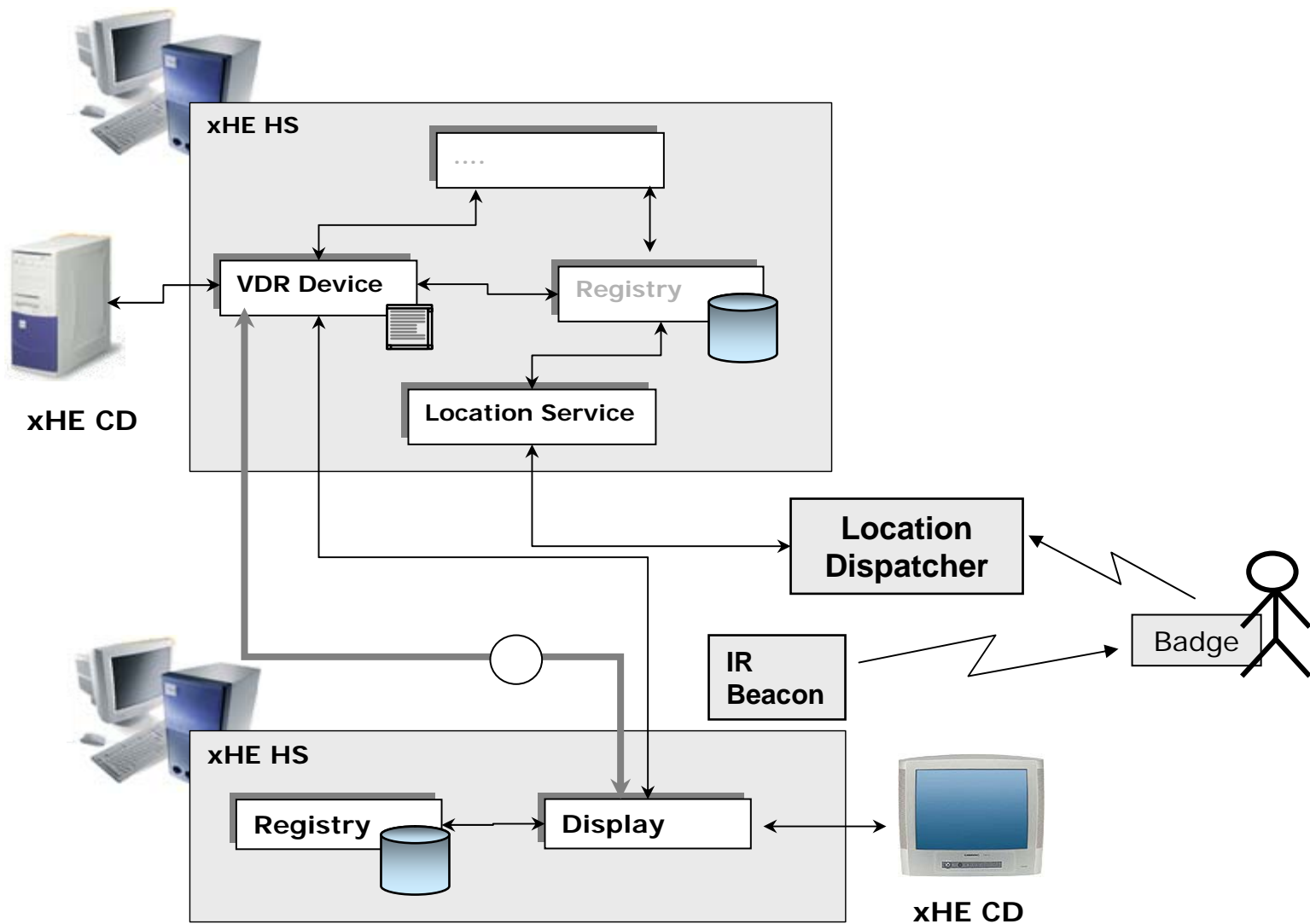
- ◆ **Java** Technology for the web-based access to CDs
- ◆ xHE Components/Services -> Bundles
  - ◆ **Servlet** Packages in Java
  - ◆ Deployment to **central Server** (HS)
- ◆ Consideration of other Middleware Models:
  - ◆ HAVi, Jini, UPnP,...
- ◆ Different Products:
  - ◆ JES (Sun), ProSyst, IBM,...
  - ◆ OSCAR, JEFFREE, DC Server, Oxygen,...

# Prototype System: Deployment for *Mobile Display*



*Prototype System:*

# Deployment *Follow-Me Display*





*Prototype System:*

# Java Board Tini

- ◆ Dallas Semiconductors
- ◆ Platform for small/tiny network-enabled applications
  - ◆ serial communications, 10Mb Ethernet, Controller Area Network and 1-Wire
  - ◆ JAVA programmable
  - ◆ TBM390 ca. 50\$ + socket board
- ◆ -> Platform for HW Gateway



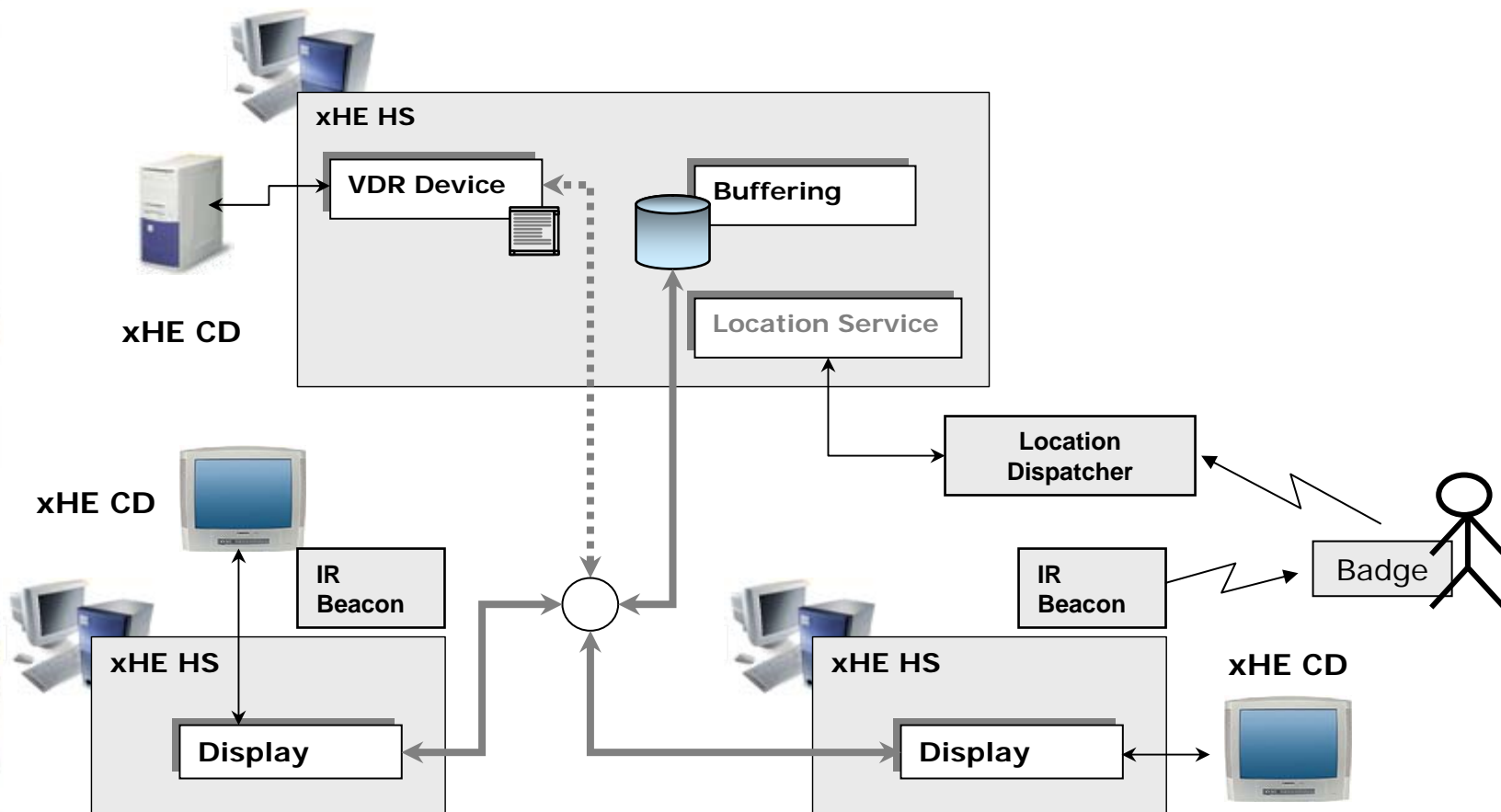


## Prototype System:

# Streaming & Timeshift Playout

Handling of streamed & recorded content:

- ◆ Handling of different client applications: Windows Media, JMF, MPlayer, Eleccard,...
- ◆ Platforms: Linux, Windows 2k



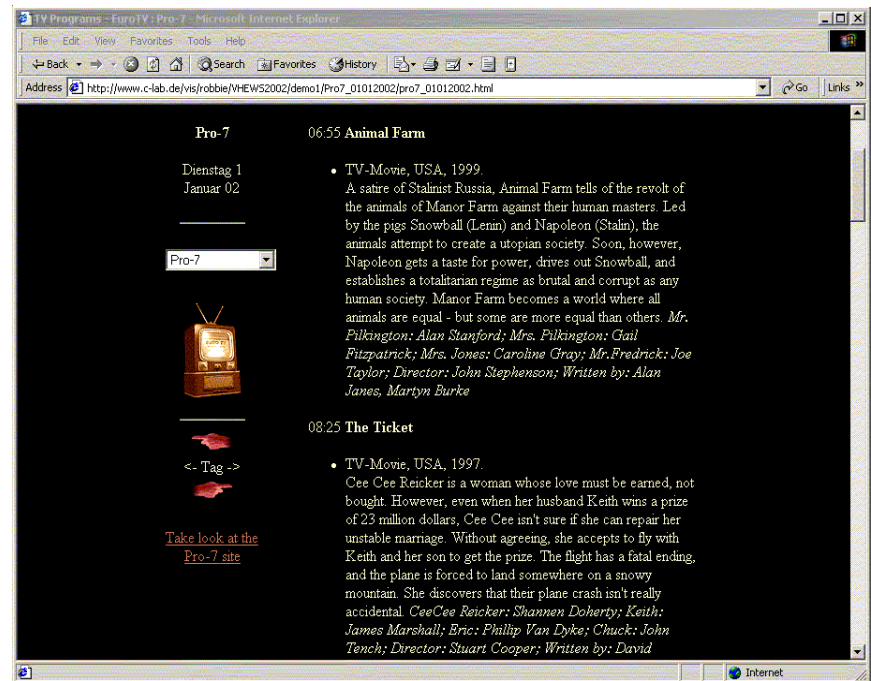
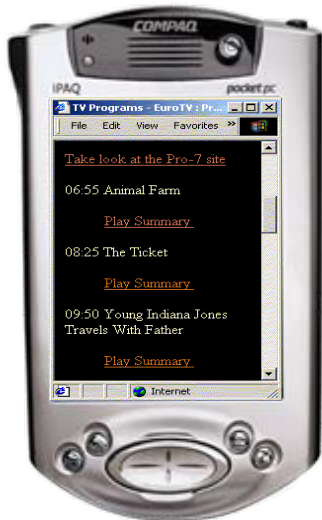
*Prototype System:*

## **Additional Options**

Additional Services:

- ◆ Personalisation of VDR Settings (Channel selections) via **SmartCard**
- ◆ **Portability**: HS-based profile (e.g. Playlist) to be used in car / office
- ◆ Distributed Media Archive utilising **Peer-2-Peer** technology (JXTA)
- ◆ ...
- ◆ **Transcoding** for different xHE-ADs using XML

# UI Technologies: Adaptation through Transcoding



# UI Technologies:

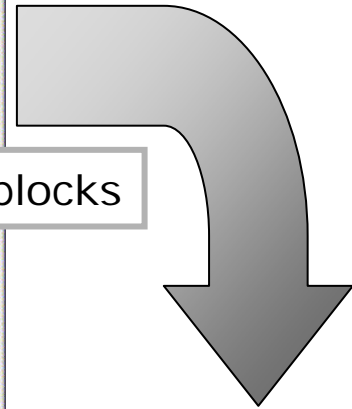
# Adaptation through Transcoding



**Tables**

**Text blocks**

**Images**

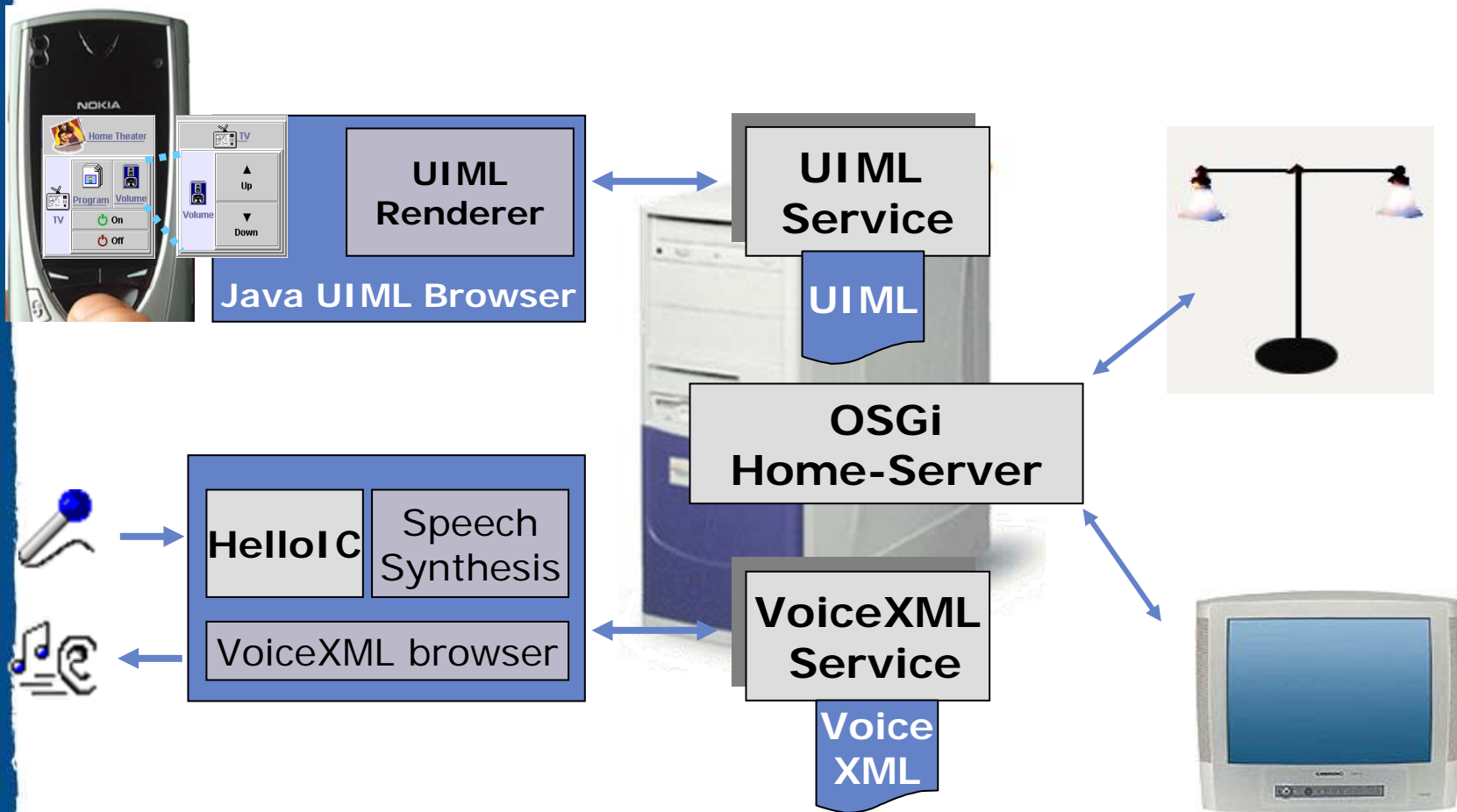


**Sequential Table**

**Audio Clips**

# UI Technologies:

# Targeted UI-Middleware Technologies



# Data Management: Peer-to-Peer Communications

