Cooperative Computing & Communication Laboratory

NATO TG 12 Workshop on 'Middleware in Mobile Networks'

Context-Awareness in Middleware for Mobile Networks

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Report Documentation Page  

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1. REPORT DATE
   01 DEC 2007

2. REPORT TYPE
   N/A

3. DATES COVERED

4. TITLE AND SUBTITLE
   Context-Awareness in Middleware for Mobile Networks

5. AUTHOR(S)

6. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
   SBS D SOL C-LAB, Distributed Interactive Systems

7. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSOR/MONITOR’S ACRONYM(S)

10. SPONSOR/MONITOR’S REPORT NUMBER(S)

11. DISTRIBUTION/AVAILABILITY STATEMENT
   Approved for public release, distribution unlimited.

12. SUPPLEMENTARY NOTES

13. ABSTRACT

14. SUBJECT TERMS

15. SECURITY CLASSIFICATION OF:
    a. REPORT  
       unclassified
    b. ABSTRACT  
       unclassified
    c. THIS PAGE  
       unclassified

16. LIMITATION OF ABSTRACT
    UU

17. NUMBER OF PAGES
    21

18. NAME OF RESPONSIBLE PERSON

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18
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 \textit{any information} that can be used to \textit{characterize the situation} of an \textit{entity}. An entity is a person, place, or object that is considered relevant to the \textit{interaction} between a \textit{user} and an \textit{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

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

Extended Home Environment (xEH)

- WLAN / GSM
- PDA
- Server (VDR / DTV)
- DECT
- Web Pad
Requirements and Approach:
Middleware for Integration

Networks
- Powerline
- 802.11
- DECT
- BT
- IP
- 3G, GSM

Devices
- Domotics
- Mobile
- WebPad
- TV
- STB
- PC, PDA

Services
- PKI
- Profiler
- WWW
- TV
- Radio
- SMS
- xHE MW

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Architecture:
Components xHE

xHE HS
Home Server (controls access to xHE-CDs)

xHE CD
Controllable Device (e.g. TV sets, VCR or other domestic appliances)

Network

Web Pad
xHE AD
Access Device (e.g., a PDA or a cell phone; addresses and controls specific xHE-CDs)

xHE AD
PDA
**Architecture:**

**Adaptation & Personalisation**

Central service to **adapt UI** access device (AD) capabilities.

User agent handling user **contexts and personalization**.
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

VDR Device

Registry

Location Service

Location Dispatcher

IR Beacon

Badge
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, Elecard,…
◆ 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

- TV Movie, USA, 1999.
  A satire of Soviet Russia, Animal Farm tells of the revolt of the animals of Manor Farm against their human master. Led by the pigs Snowball (Dean) and Napoleon (Stalin), the animals attempt to create a utopian society. Soon, however, Napoleon gets a taste for power, shares out Snowball, and establishes a dictatorship regime. An animal takes a human society: Manor Farm becomes a world where all animals are equal, but some are more equal than others. Mr. Fizzlebottom (Alan Blum) and Mrs. Fizzlebottom (Goldie) are played by Joan Collins and McFadden. John Badham is the Director; John Boorman and Alan Jones are the Producers; Martin Burke is the Editor.

- TV Movie, USA, 1999.
  One True Story is a woman whose love must be named, not bought. However, even when her husband Keith wins a prize of 25 million dollars, One True Story, and even if the love can repair their troubled marriage. Without agreeing, the actress falls in love with Keith, and after so many years the prize. The flight has a fatal ending, and the plane of forced to land somewhere on a snow-covered mountain. She discovers that their plane crashes isn't really accidently. One True Story is a woman whose love must be named, not bought. However, even when her husband Keith wins a prize of 25 million dollars, One True Story, and even if the love can repair their troubled marriage. Without agreeing, the actress falls in love with Keith, and after so many years the prize. The flight has a fatal ending, and the plane of forced to land somewhere on a snow-covered mountain. She discovers that their plane crashes isn't really accidently.
UI Technologies: Adaptation through Transcoding

- Tables
- Text blocks
- Images
- Audio Clips
- Sequential Table
UI Technologies:
Targeted UI-Middleware Technologies

- UIML Service
- UIML Renderer
- Java UIML Browser
- HelloIC
- Speech Synthesis
- VoiceXML browser
- VoiceXML Service
- OSGi Home-Server
- Voice XML
Data Management:
Peer-to-Peer Communications