Middleware Support for Seamless Multimedia Home Entertainment for Mobile Users and Heterogeneous Environments

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Motivation

• **PC-centric approach**
  - Stand-alone multimedia PC
  - Network at most used for streaming
  - Many other multimedia devices
    • Different underlying technologies and resources
    • Unexploited networking capabilities
• Transparetnelly extend control to network
• Shift computation from endpoints of the network to the network itself

→ Network-Integrated Multimedia Middleware (NMM)
  - GNU/Linux, Open Source, C++
Overview

• Motivation
• Network-Integrated Multimedia Middleware (NMM)
  – Basic concepts
  – Distributed architecture
• Application framework
  – Stationary systems
  – Seamless integration of mobile system
• Conclusions and future work
Flow Graph

- Nodes
- Jacks & formats
- Messages
  - Multimedia data buffers, events
- Interfaces (from IDL)
Communication Channels

- Different serialization strategies
  - XML, magic numbers, CORBA any type, SOAP, ...

- Different transport strategies
  - Pointer forwarding, TCP, UDP, RTP, CORBA, HTTP, ...
  - Configuration

- Automatic negotiation
Benefits

- Open architecture
  - Independent of particular technology
- Support for heterogeneous environments
  - Mediating proxy objects, e.g. JMF
  - Optimized communication channels, e.g. for PDAs
- Explicit binding
  - Different setup and configuration for
    - Transmission of multimedia data
    - Control of components
- Reflection
  - Components can be queried for supported functionality
- Event notification
  - Application can be registered as event listener
**Home Entertainment Scenario**

<table>
<thead>
<tr>
<th>Location</th>
<th>Mobile device PDA</th>
<th>Multi-media-Box</th>
<th>Multi-media-Box</th>
<th>Multi-media-Box</th>
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</thead>
</table>

- **Networked stationary home entertainment centers**
  - Linux PCs, called Multimedia-Box

- **Seamless integration of mobile systems**
  - Compaq iPAQ H3870, Linux, with WLAN (11 Mbit)
  - Hand off of active parts of flow graph
    - Richer I/O capabilities and/or distribution of workload
    - E.g. hand off of MP3 playback
  - Same user interface on both devices
Multimedia-Box

- Linux-PC as open platform for multimedia home entertainment
  - Based on NMM
  - Replacement and extension of traditional devices
  - Controllable with remote control
  - Configurable via XML
  - Extensible application framework
• Current functionality
  - CD- Player
  - MP3 encoder
  - DVD- Player
  - DVD- Grabbing & transcoding
    • Transparent distribution of workload
  - TV with time- shifting
    • Transparent access to remote components for receiving TV
  - Video recorder
  - Player with play lists
  - Configuration
  - Task list
Multitasking

• Example
  - DVD grabbing state running in the background
  - MP3 player running in the background but is connected to audio sink
  - State for programming the TV timer is in the foreground and connected to the video sink
Session Hand Off

MMBox
Application

Playback
Node

MP3Read
Node

MP3Decoder
Node

Playback
Node

Proxy
Node

Proxy
Node

Proxy
Node

PDA
Session Hand Off

MMBox
Application

Proxy Node

MP3Read Node

State

Proxy Node

MP3Decoder Node

Proxy Node

Playback Node

PDA
Conclusions

• Open middleware architecture
  – Network- Integrated Multimedia Middleware (NMM)
  – Distributed proxy architecture
  – Communication channels

• Extensible platform for multimedia home entertainment
  – Stationary home entertainment centers
    • Multimedia- Box
  – Seamless integration of mobile devices
    • Session hand off
Future Work

- Extensions of the Multimedia-Box
  - Electronic program guide (EPG)
- Hand off of audio/video playback
- Multi-user scenarios
- Adaptive distribution of flow graphs
Acknowledgments

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• More information & public release
  www.networkmultimedia.org
Questions?