Multimedia Routing on OSGi Platforms
Multimedia Routing Index

- Introduction
- Architecture
- Multimedia Pins
- Categories
- Multimedia Filters
- Browsing Pins
- Connection Setup
- Conclusions
Introduction

• Setting up data flows among multimedia devices connected to a Service Gateway
  – User: gets the best from their multimedia devices
  – Provider: broader range of target devices for his services
Multimedia Routing Concept

- Service Gateway as the interconnection and integration point
  - Takes data from a source
  - Do processing
  - Send result to target
- Connection Manager monitors
  - Available bandwidth
  - Available computing power on the gateway
Browser Service

• Querying for multimedia sources and targets (multimedia pins)
• Classified in *Categories*
  – Description through *Properties*
• Registering devices capabilities
  – Returns only pins that are compatible with the query parameter
  – Taxonomies for standard media types
Translation Service

• Goal: Seamless connection between heterogeneous devices
• Media Data Translation
• Event and Timing Translation
• Conversion through concatenation of filters
  – Filter chaining
  – Reusable filters
Admission Service

New Connection

Available Bandwidth

Available Computing Power

Running Connections

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Multimedia Pins

• Abstract representation of multimedia *producers* and *consumers*
  – Microphone/loudspeaker, movie/TV
  – Virtual entities: no direct relation to a physical device is required (i.e. stored song)

• Referenced using URL Schemes
  – `immpin://` and `ommpin://`

• Objectives
  – Hide internal complexity of the different multimedia sources and devices
  – Support quick and easy interaction of interconnect devices
Multimedia Pin Categories

- Multimedia Pin Categorization
  - Grouping and Management in a hierarchical form
  - Remote update of some branches allowed on demand

- Multimedia Pin Priorities
  - Numerical value given at register time
  - Helps on the automatic selection of the best pin
Multimedia Conversion Filters

Output and Input Pin Comparision

Compatible Media Type and Format?

Yes

Same Media Type but different Format?

Yes

Different Media Type but conversion has sense?

Yes

Different Media Type and non-sense conversion?

No additional processing needed

Data Flow conversion

Media Type conversion

Rejected Connection
Cascading Filters

• Playing back a MP3 song stored on a local jukebox into a portable Bluetooth-enabled mono OGG-Vorbis music player
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New URL schemes

• Point to input or output multimedia pins
  – Category information is included
  – Or they can point to a whole category
    • If the URL ends with a backslash (\)

  \immpin://./Living%20Room/Speakers/1

  \ommpin://./VideoDoor/Mic

• Opening a multimedia pin
  – Output: Start sending media data
  – Input: Waits for incoming media data
<?xml version="1.0" encoding="ISO-8859-1"?>
<category targeturl="immpin://./Living%20Room/">
    <caption>Living Room</caption>
    <description>Living Room devices</description>
    <subcategory targeturl="immpin://./Living%20Room/TV/"
        <caption>TV-set</caption>
        <description>TV-set at the Living Room</description>
    </subcategory>
    <subcategory targeturl="immpin://./Living%20Room/Speakers/"
        <caption>Speakers</caption>
        <description>Stereo speakers at the Living Room</description>
    </subcategory>
    <subcategory targeturl="immpin://./Living%20Room/HiFi"
        <caption>Hi-Fi</caption>
        <description>HiFi-set at the Living Room</description>
    </subcategory>
    <subcategory targeturl="immpin://./Living%20Room/DVDRec"
        <caption>DVD Video Recorder</caption>
        <description>DVD Video Recorder</description>
    </subcategory>
</category>
<category targeturl="immpin://./Living%20Room/Speakers/">
  <caption>Speakers</caption>
  <description>
    Stereo speakers at the Living Room
  </description>

  <pin targeturl="immpin://./Living%20Room/Speakers/1" priority="10">
    <caption>PCM audio input</caption>
    <content>
      <audio format="PCM">
        <bitspersample>16</bitspersample>
        <samplerate>44100</samplerate>
        <numchannels>2</numchannels>
      </audio>
    </content>
  </pin>

  <pin targeturl="immpin://./Living%20Room/Speakers/2" priority="9">
    <caption>MP3 audio input</caption>
    <content>
      <audio format="MPEG_layer3">
        <bitrate>*</bitrate>
        <samplerate>*</samplerate>
        <numchannels>1</numchannels>
        <numchannels>2</numchannels>
      </audio>
    </content>
  </pin>
</category>
Browser Service Functionality

- Multimedia Pin Registering

- Multimedia Pin Unregistering

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Browser Service Functionality

- **Pin Querying**
  - **Extensibility**: categories can be virtual so querying is only done when needed
  - Call-back for those categories supported on the Abstraction Layer

- **Filtering**: return only matching pins
  - A string containing a pattern is passed to the query

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Query Results Filtering

• Checking that the XML tags of the filter are supported on the result

Output Pin (Pattern Filter)

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<pin targeturl="omm:VideoDoor/Mic" priority="1">
  <content>
    <audio format="MPEG_layer3">
      <bitrate>48</bitrate>
      <samplerate>11025</samplerate>
      <numchannels>1</numchannels>
    </audio>
  </content>
</pin>
```

Input Pin

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<pin targeturl="immp:Sound/StereoSpeakers" priority="9">
  <content>
    <audio format="MPEG_layer3">
      <bitrate>24-320</bitrate>
      <samplerate>11025,22050,44100</samplerate>
      <numchannels>2</numchannels>
    </audio>
  </content>
</pin>
```

Mismatch
Query Results Filtering

- Checking that the XML tags of the filter are supported on the result

Output Pin (Pattern Filter)

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<pin targeturl="ommpin://./VideoDoor/Mic" priority="1">
  <content>
    <audio format="MPEG_layer3">
      <bitrate>48</bitrate>
      <samplerate>11025</samplerate>
      <numchannels>1</numchannels>
    </audio>
  </content>
</pin>
```

Input Pin

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<pin targeturl="immpin://./Sound/MonoSpeaker" priority="8">
  <content>
    <audio format="MPEG_layer3">
      <bitrate>24-320</bitrate>
      <samplerate>11025,22050,44100</samplerate>
      <numchannels>1</numchannels>
    </audio>
  </content>
</pin>
```

OK
Multimedia Pin Properties Format

• Caption, description and contents
  – Three content types: audio, video and mux
• Audio pin sample:

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<pin targeturl="..." priority="...">
    <caption>...</caption>
    <description>...</description>
    <content>
        <audio format="formatID">
            <parameter1>value_of_parameter1</parameter1>
            ...
        </audio>
    </content>
</pin>
```
Multimedia Pin Properties Format

<?xml version="1.0" encoding="ISO-8859-1"?>
<pin targeturl="..." priority="...">
    <caption>...</caption>
    <description>...</description>
    <content>
        <mux format="muxFormatID">
            <audio format="audioFormatID1">
                <parameter1>value_of_parameter1</parameter1>
                ...
            </audio>
            <audio format="audioFormatID2">
                <parameter1>value_of_parameter1</parameter1>
                ...
            </audio>
            <video format="videoFormatID">
                <parameter1>value_of_parameter1</parameter1>
                ...
            </video>
        </mux>
    </content>
</pin>

Mux type sample
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Setting Up a Connection

1. Output Multimedia Pin to Input Multimedia Pin
2. Output Multimedia Pin to Input Terminal Category
3. Output Terminal Category to Input Multimedia Pin
4. Output Terminal Category to Input Terminal Category
Admission Service Algorithm

Connection Request

Input and output are compatible

Take system snapshot

Suitable Filter Chain Available

Is there a lower priority flow

Yes

Connection Accepted

No

Non-sense Connection

Yes

Shutdown the lowest priority flow from the snapshot

No

Connection Rejected

Yes
Multimedia Flow Control

• Standard Commands will be defined
  – Pause, Stop, Rewind, etc.
• Commands depend on Media Type
  – Audio: volume control
  – Stored Media: position control
• Supported command can be queried
• Can be issued by either side of the connection or by external processes
Category Interface

• Category encapsulation
  – Those classes implementing the interface will be located on the *Abstraction Layer* (call-back mechanism)

Example:
FileDirectoryCategory implements a category that wraps a folder in the filesystem.
Pin Interface

- Encapsulate a multimedia pin
  - Those classes implementing it will be located in the *Abstraction Layer* (device specific)
Future Lines

• First prototype
  – Connection of a mobile device with the gateway for audio playback
• Define standard category classes
• Define standard command and measures units for multimedia data flow control.
• Define filters for the Translation Services
• Implement the Admission Service
Questions?