SMIL Content Adaptation for Embedded Devices

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Outline

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3 SMIL Modularization
4 Architecture Overview
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6 Proxy Adaptation
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Introduction

• Ubiquitous and embedded computing represent one of the most active fields actually.

• Recent technologies has created a need to provide traditionally desktop accessed content on a new diversity of devices

• SMIL: The dominant representation in Web technology for describing timing and synchronization of multimedia presentations
Introduction

Objectives:

- The adaptation of the SMIL content for embedded devices

- Facilitate the use of multimedia presentations for limited devices

Ensure the adaptation on other levels: server or proxy
Framework Overview

- The framework that we define includes:

  - The definition of a complete architecture with different entities and the specification of the role of each entity:
    - Content server
    - Intermediary proxy
    - Client

  - Ensuring a context description in order to describe all the entities that can be involved in the final adaptation:
    - Document
    - Server and Proxy Capabilities
    - Client requirements
    - Network

  - Exchange protocol to ensure the negotiation-based information

  - Adaptation techniques to adapt the content for a given context
SMIL Modularization

• The Modularization is an approach in which markup functionality is specified as a set of modules

<table>
<thead>
<tr>
<th>Enables language designers to specify dedicated markup intended for particular contexts</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Helps to represent and negotiate which modules are supported by a user agent and</td>
</tr>
<tr>
<td>- Which modules are required to successfully deliver a document.</td>
</tr>
</tbody>
</table>

• Adaptation: SMIL content control modules (Dick B. and Jeffrey A.)
SMIL Content Control Modules

- Contain elements and attributes which provide for runtime content choices and optimized content delivery

- SMIL content control functionality is partitioned across four modules:
  - **BasicContentControl** content selection elements and predefined system test attributes
  - **CustomTestAttributes** author-defined custom test elements and attributes
  - **PrefetchControl** presentation optimization elements and attributes
  - **SkipContentControl** attributes that support selective attribute evaluation
Architecture Overview

PocketSMIL

- SMIL 2.0 Basic player developed for experimental purposes to meet resource constrained clients (See my PDA ;-) )
Architecture Overview

User Context Module (UCM)

Allows:

- Selecting the intermediate proxy or a negotiation-enable server
- Selecting the user context
- Application of the negotiation protocol:
  * Client profile sending to the proxy
  * Replying to proxy request if the user context changes…
Architecture Overview

- Proxy: a third entity to handle profiles and achieve adaptation
  - Handling directly client requests
  - Client and server profiles processing
  - Services delivery
  - Support of adaptation enrichment
  - Cooperation with the UCM module
Architecture Overview

- **Communication**: traditional requests
- **Multithreading concept**: used to support concurrent access of clients, i.e. players and UCM modules
- **Negotiation**: information about the context and the context change
Context Description

UPS (Universal Profiling Schema)

New framework that completes CC/PP and HTTP for content adaptation

The definition is based on

- **CC/PP**: Composite Capabilities/Preference Profiles
  - [http://www.w3.org/2000/07/04-ccpp#](http://www.w3.org/2000/07/04-ccpp#)

- **RDF**: Resource Description Framework
  - [http://www.w3.org/1999/02/22-rdf-syntax-ns#](http://www.w3.org/1999/02/22-rdf-syntax-ns#)

- Extension: Six new schemata
  - Proper to the Content Negotiation
Context Description

In order to meet the content negotiation needs, we have designed our proper schema

Our schema includes

A) **Client**
   1/ Client Profile (platform: software & hardware, main services )
   2/ Client Resource Profile (services requirements detail)

B) **Server**
   3/ Document Instance Profile (HTML, WML, etc.)
   4/ Resource Profile (wbmp, jpg, gif, au, etc.)
   5/ Adaptation Method Profile (XSLT style sheet, programs, scripts, etc.)

C) **Network**
   6/ Network Profile (network speed, bandwidth, sessions, etc.)

UPS package: handling UPS profiles, can be downloaded from the CC/PP home page (http://www.w3c.org)
A Client Profile Example

<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:ccpp="http://www.w3.org/2000/07/04-ccpp#"
    Lemlouma/NegotiationSchema/ClientProfileSchema03012002#" >
    <ccpp:component>
        <rdf:Description rdf:about="TerminalHardware">
            <rdf:type rdf:resource="http://www.inrialpes.fr/...
            HardwarePlatform"/>
            <neg:DeviceName>Ericsson-R320</neg:DeviceName>
            <neg:screen>30x23mm</neg:screen>
            <neg:PixelStretch>1.24</neg:PixelStretch>
            <neg:PhoneNumber>+33610987326</neg:PhoneNumber>
        </rdf:Description>
    </ccpp:component>
    <ccpp:component>
        <rdf:Description rdf:about="MultimediaServicesRequireement">
            ...
        </rdf:Description>
    </ccpp:component>
</rdf:RDF>
Proxy Adaptation

UPS profiles can be represented by the following components:

- **Content** (document or media)
- **Network Description**
- **Client Requirements**
- **Network**
- **Input Requirements**
- **Output Description**
- **Adaptation Method**
- **Content Description**
Proxy Adaptation

A content negotiation is equivalent to find the optimal path of connected components from the content description to the client requirements.

Examples:

1) Content (document or media) → Content description → Client Requirements → Client

2) Content (document or media) → Adaptation Method → Client
Exchange Protocol

• Independent to the communication protocol => can be used with existing protocols HTTP, etc.

• The protocol defines the following minimal set of message types:
  – GET_GLOBAL_PROFILE
  – OK_SENDING_PROFILE
  – OK_SENDING_CHANGE
  – NO_PROFILES_CHANGE
  – NO_PROFILE_ACQUISITION

• Messages are exchanged between the UCM listener (proxy) and UCM of the embedded device
Exchange Protocol

- Client Profile Initialization
- Document Request
- Profile Interrogations
- UCM Module Reply
- Adapted Document

UCM Listener <-> Player Listener <-> UCM Module <-> Player

Content provider <-> Device
Example

- After the NAC installation:
  - The device (Pocket PC here) selects its profile using UCM module:

  The client requests the content using its browser (e.g. PocketSMIL)
Example

- The client requests a SMIL 2.0 document

  The proxy adapts the SMIL presentation with respect to the client profile: here the criteria is the user language

```xml
- <switch>
  <audio id="sound" src="../media/audioVersions/russian.mp3" begin="1" dur="30" systemLanguage="ru"/>
  <audio id="sound" src="../media/audioVersions/japanese.mp3" begin="1" dur="30" systemLanguage="jp"/>
  <audio id="sound" src="../media/audioVersions/english.mp3" begin="1" dur="30"/>
</switch>
- <switch>
  <text src="Privyet. Menya zovout Dominique." region="lyrics1" dur="30" systemLanguage="ru"/>
  <text src="Konnichi-wa! Boku wa Dominiku desu." region="lyrics1" dur="30" systemLanguage="jp"/>
  <text src="Hello, my name is Dominique." region="lyrics1" dur="30"/>
</switch>
- <switch>
  <text src="Ya zhivou v Kanade." region="lyrics2" dur="30" systemLanguage="ru"/>
  <text src="Kanada ni sunde-imasu." region="lyrics2" dur="30" systemLanguage="jp"/>
  <text src="I live in Canada." region="lyrics2" dur="30"/>
</switch>
```
Example

HTTP request

accept-language: fr

UPS profile

SMIL content is adapted (UPS overrides HTTP parameters)
Variants Selection

• Choose the best variant of the multimedia content or object on behalf of the user agent

• Based on:
  – Available variants (server)
  – Variants descriptions (UPS)
  – User requirements (UPS)

• Selection criteria may include the language, the media type, the char-set, etc.

• SMIL 2.0 allows using the `switch` element to specify inside the document a collection of alternative elements
Variants Selection

$SMIL + UPS = Adapted SMIL$

- The content selection can be expressed using the SMIL system test attributes.
- The proxy evaluates the test using the information extracted from the different UPS profiles.
- New SMIL content is sent to the client.
Variants Selection

A ‘switch’ example

SMIL:

<par>
  <audio src="welcome_to_inria.wav"/>
  <switch>
    <img src="inria_1024_1280.gif" systemScreenSize="1024X1280"/>
    <img src="inria_480_640.gif" systemScreenSize="480X640"/>
    <img src="inria_240_320.gif" systemScreenSize="240X320"/>
    <img src="inria_default.gif"/>
  </switch>
</par>
Variants Selection

A ‘switch’ example

UPS: ..., Device screen: (240, 320), ...

Adapted SMIL:

<par>
    <audio src="welcome_to_inria.wav" ... />
    <img src="inria_240_320.gif" systemScreenSize="240X320"/>
</par>
Variants Selection

A ‘in-line test attribute’ example

SMIL:

<par>
<textstream src="presentation_speech_translation.rt" systemLanguage="fr"/>
<audio src="presentation_speech.mp3" . . . />
<video src="presentation.mpg" . . . />
</par>
Variants Selection

A ‘in-line test attribute’ example

UPS:

language: English

SMIL:

<par>
    <audio src="presentation_speech.mp3" . . . />
    <video src="presentation.mpg" . . . />
</par>
Document Transformation

• Concerns the transformation applied in the SMIL document structure

• The SMIL structural transformation applied by the proxy can:
  – Keep the same media resource used by the original SMIL document,
  – Filter it, or
  – Require an external transformation to adapt the media AND/OR the structure
Document Transformation

Example

**SMIL:**

```
<body>
  <seq>
    <par>
      <audio id="audio" src="sarah.mp3" begin="0s" end="12s"/>
      <img id="img1" region="r1" src="image01.jpg" begin="0s" dur="12s"/>
      <img id="img2" region="r2" src="image02.jpg" begin="00:00:6" dur="6s"/>
    </par>
    <video region="r4" src="iceage.mpeg" begin="3s" end="30s"/>
    <par>
      <img id="img3" region="r3" src="image03.jpg" begin="0s" dur="6s"/>
      <img id="img4" region="r5" src="image04.gif" begin="3s" dur="3s"/>
    </par>
  </seq>
</body>
```
Application using XSLT

- Client profile: device context
- Predefined style sheet: a set of generic templates
- Generated style sheet: a set of static templates
Document Transformation

**UPS:**

```xml
<ccpp:component>
    <rdf:Description rdf:about="NonSupportedResources">
        <rdf:type rdf:resource="Resources"/>
        <neg:NonSupportedResources>
            <rdf:Bag>
                <rdf:li rdf:parseType="Resource">
                    <neg:type>video</neg:type>
                    <neg:format>mpeg</neg:format>
                    <neg:profile>device-profiles/mpeg-profile.xml</neg:profile>
                </rdf:li>
                . . .
            </rdf:Bag>
        </neg:NonSupportedResources>
    </rdf:Description>
</ccpp:component>
```
Document Transformation

Adapted SMIL

- `<body>`
- `<seq>`
- `<par>`
- `<audio id="audio" src="sarah.mp3" begin="0s" end="12s"/>
- `<img id="img1" region="r1" src="image01.jpg" begin="0s" dur="12s"/>
- `<img id="img2" region="r2" src="image02.jpg" begin="00:00:6" dur="6s"/>
- `<par>`
- `<par>`
- `<img id="img3" region="r3" src="image03.jpg" begin="0s" dur="6s"/>
- `<img id="img4" region="r5" src="image04.gif" begin="3s" dur="3s"/>
- `<par>`
- `<seq>`
- `<body>`
Media Adaptation

• Usually SMIL presentations reference media objects

• Media resources should not be sent directly if they do not respect the client requirements

• Media resources can be:
  • Substituted
  • Removed or
  • Transformed to an acceptable format using available adaptation methods

• Implemented media adaptations include:
  – image and video resizing, image compression, image generation (SVG to Image, mathML to SVG, mathML to image), video personalization, etc.
Media Adaptation for Capabilities

• Example

```xml
<body>
  <par dur="120s">
    <audio src="Frozen.mp3/>
    <img src="Ray_of_Light_CD.jpg"/>
  </par>
</body>
```
SMIL Content Adaptation for Embedded Devices. Tayeb Lemlouma, February 2003

Media Adaptation for Preferences

- SMIL adaptation to the user preferences
  - 1) User is a video client
  - 2) Content Adaptation Dimension = {Language}
  - Preferred language is:
    - French
    - English
    (See generated videos)
Media Adaptation

- Evaluation of delivery time and media adaptation:
- Adaptation: send only useful content
  => bandwidth gain, delivery time minimization

<table>
<thead>
<tr>
<th>Media Resource</th>
<th>Size (bytes)</th>
<th>Applied Compression (%)</th>
<th>Transformation Time (millisecond)</th>
<th>Delivery time (millisecond)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image 1</td>
<td>23366</td>
<td>50</td>
<td>362,20</td>
<td>356</td>
</tr>
<tr>
<td>Image 2</td>
<td>13998</td>
<td>80</td>
<td>360,20</td>
<td>214</td>
</tr>
<tr>
<td>Image 3</td>
<td>9776</td>
<td>90</td>
<td>297,16</td>
<td>149</td>
</tr>
</tbody>
</table>

Media adaptation and delivery time
Conclusions

• SMIL model has several advantages: it allows adaptability and provides flexibility thanks to modularization of the language profiles.

• In many cases content adaptation cannot be ensured by embedded devices:
  • The client has limited capabilities
  • It is difficult to capture a global picture of the environment at the client level

• In the proxy level, the adaptation facilitates the use of multimedia presentations by the target device

• The proxy guarantees an efficient consideration of the global environment constraints: content, client, server capabilities, etc.

• Adaptation techniques need to consider more the semantic of the SMIL content

• There is also a need to develop a vocabulary that includes the necessary set of semantic metadata to be added to the content and facilitates its adaptation

• Exploit SMIL advantages (e.g. selectivity and test attributes) for device independence principles
Thank you

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Useful links:

NAC architecture
http://opera.inrialpes.fr/people/Tayeb.Lemlouma/

Device Independence and CC/PP (W3C)
http://www.w3c.org