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SMIL Content Adaptation for Embedded Devices

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Outline

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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
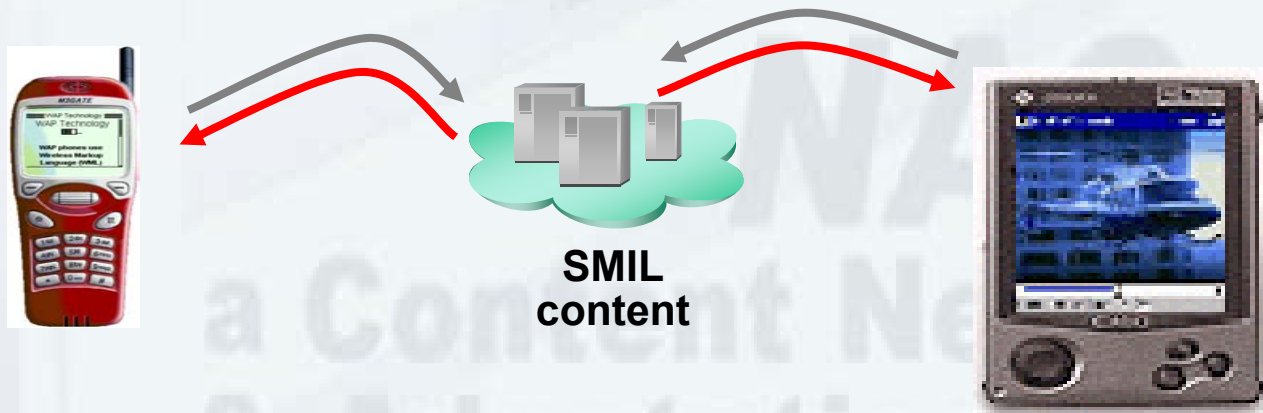
Introduction

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

SMIL content

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 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**

  > **Enables language designers to specify dedicated markup intended for particular contexts**

  > **- Helps to represent and negotiate which modules are supported by a user agent and**
  >
  > **- Which modules are required to successfully deliver a document.**

- **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

Wireless Network

Content Servers

Embedded Devices

PocketSMIL

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

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Architecture Overview

User Context Module (UCM)

Allows:

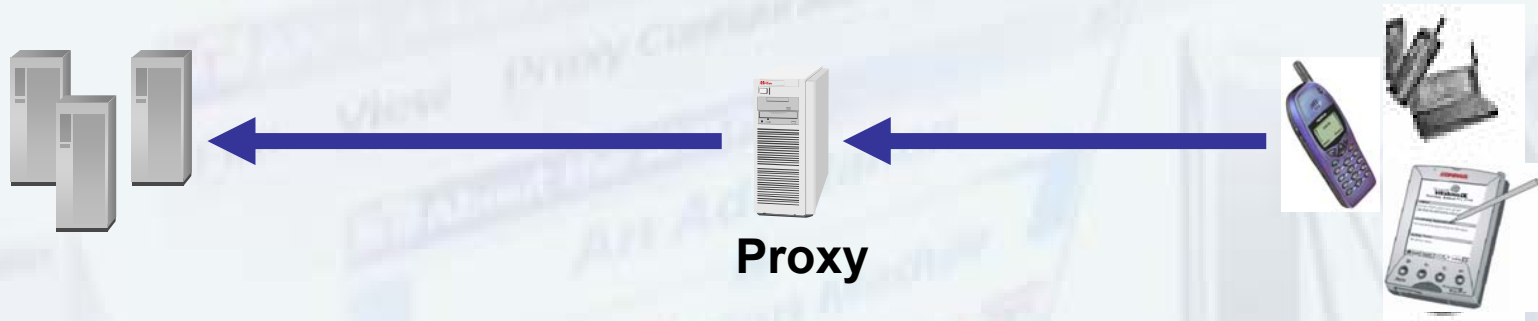➡ **Selecting the intermediate proxy or a negotiation-enable server**

➡ **Selecting the user context**

➡ **Application of the negotiation protocol:**

* Client profile sending to the proxy

* Replying to proxy request if the user context changes…

SMIL Content Adaptation for Embedded Devices. Tayeb Lemlouma, February 2003
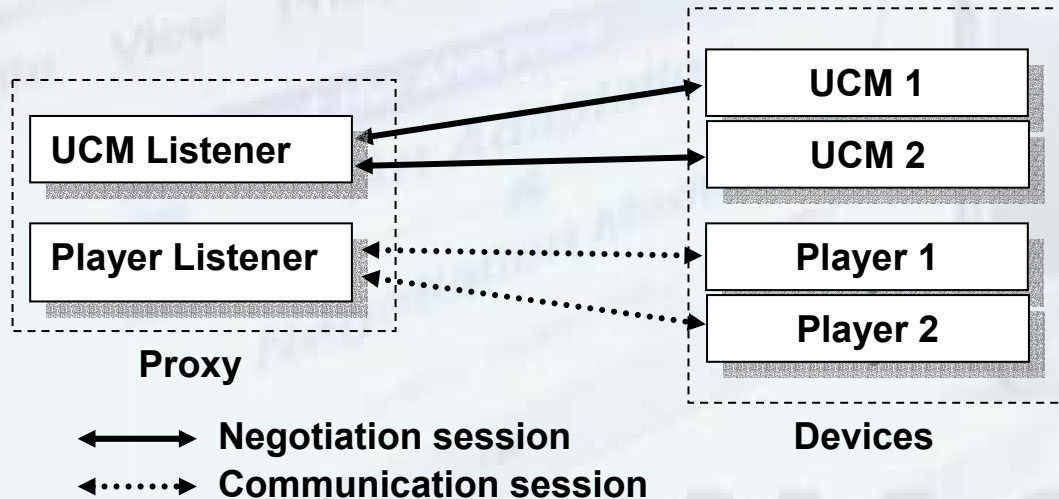
9
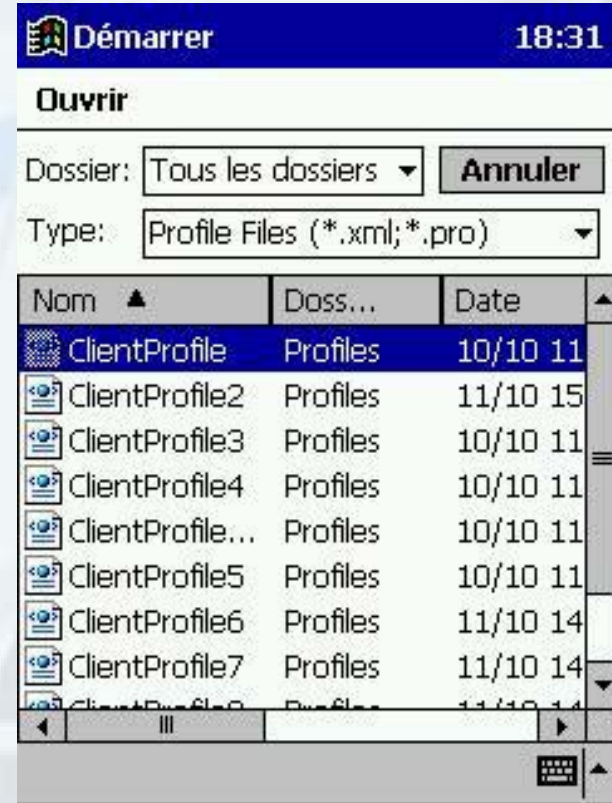
Architecture Overview

Proxy

- **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
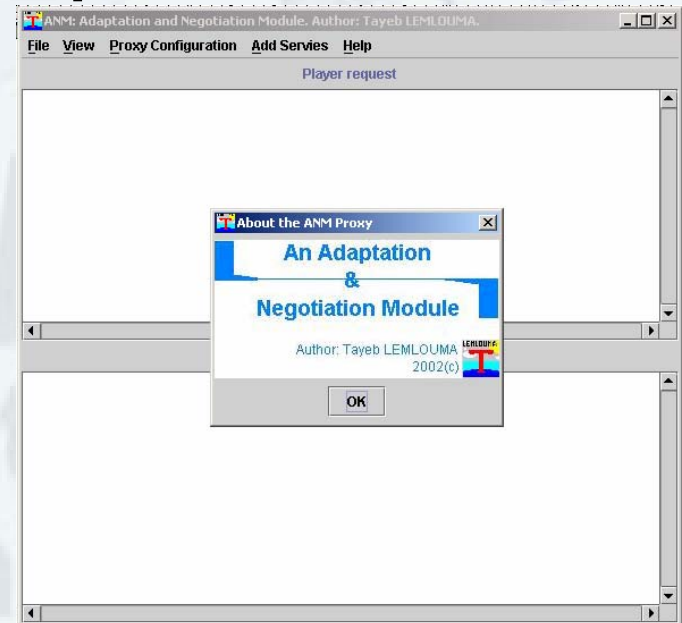
Architecture Overview

- **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#

RDF: Resource Description Framework
http://www.w3.org/1999/02/22-rdf-syntax-ns#

+

Extension: Six new schemata
Proper to the Content Negotiation
http://www.inrialpes.fr/opera/people/Tayeb.Lemlouma/
NegotiationSchema/*03012002#

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
<?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#"
 xmlns:neg="http://www.inrialpes.fr/opera/people/Tayeb.
 Lemlouma/NegotiationSchema/ClientProfileSchema03012002#">

<rdf:Description ID="ClientResourcesProfile">

<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="MultimediaServicesRequierement">

     ......
     </rdf:Description>
 </ccpp:component>

</rdf:Description>
</rdf:RDF>
```
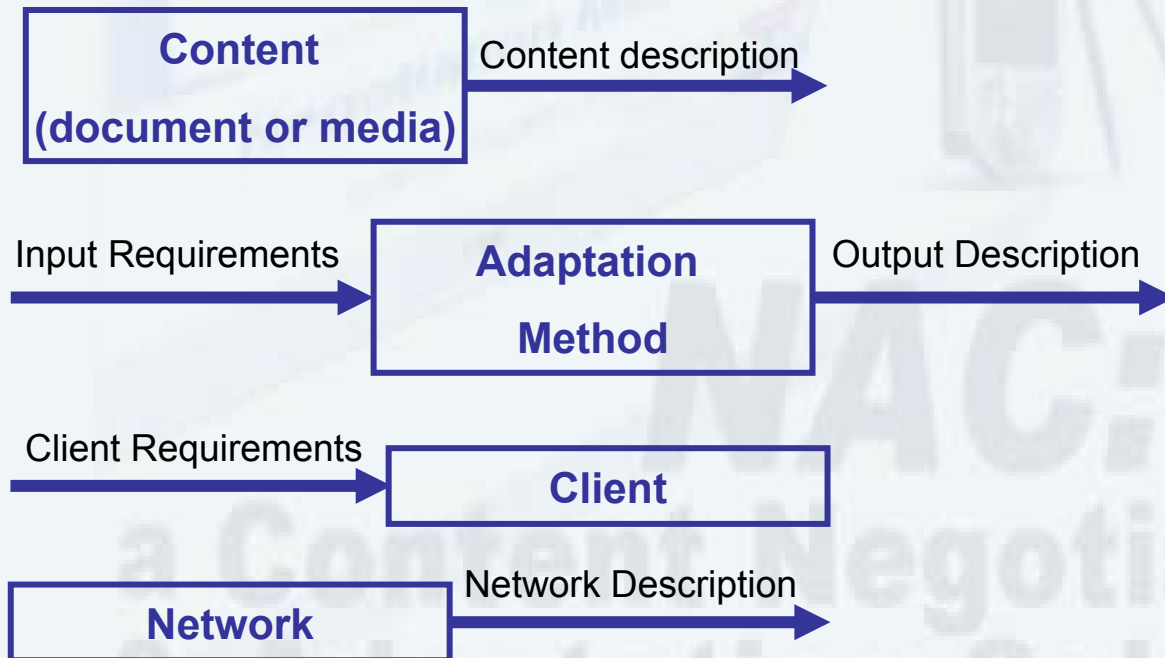
SMIL Content Adaptation for Embedded Devices. Tayeb Lemlouma, February 2003
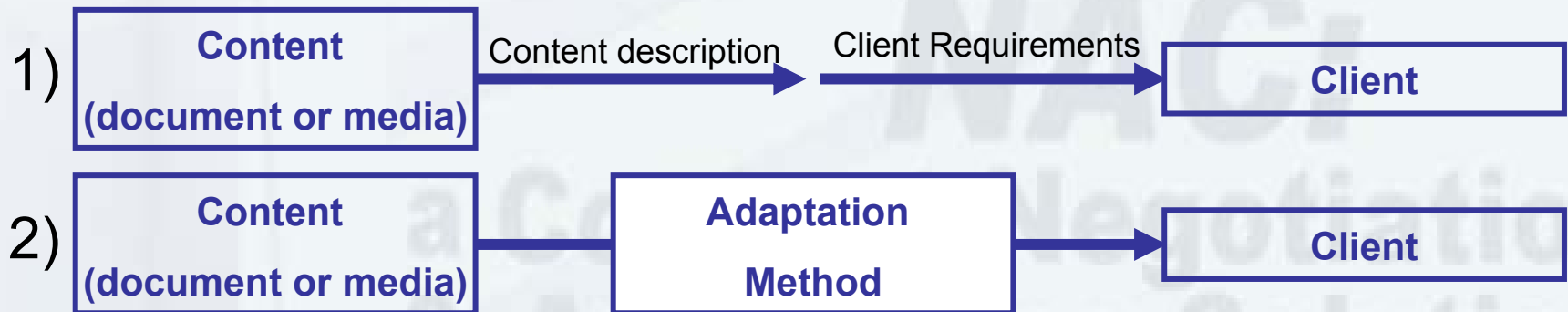
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Proxy Adaptation

UPS profiles can be represented by the following components
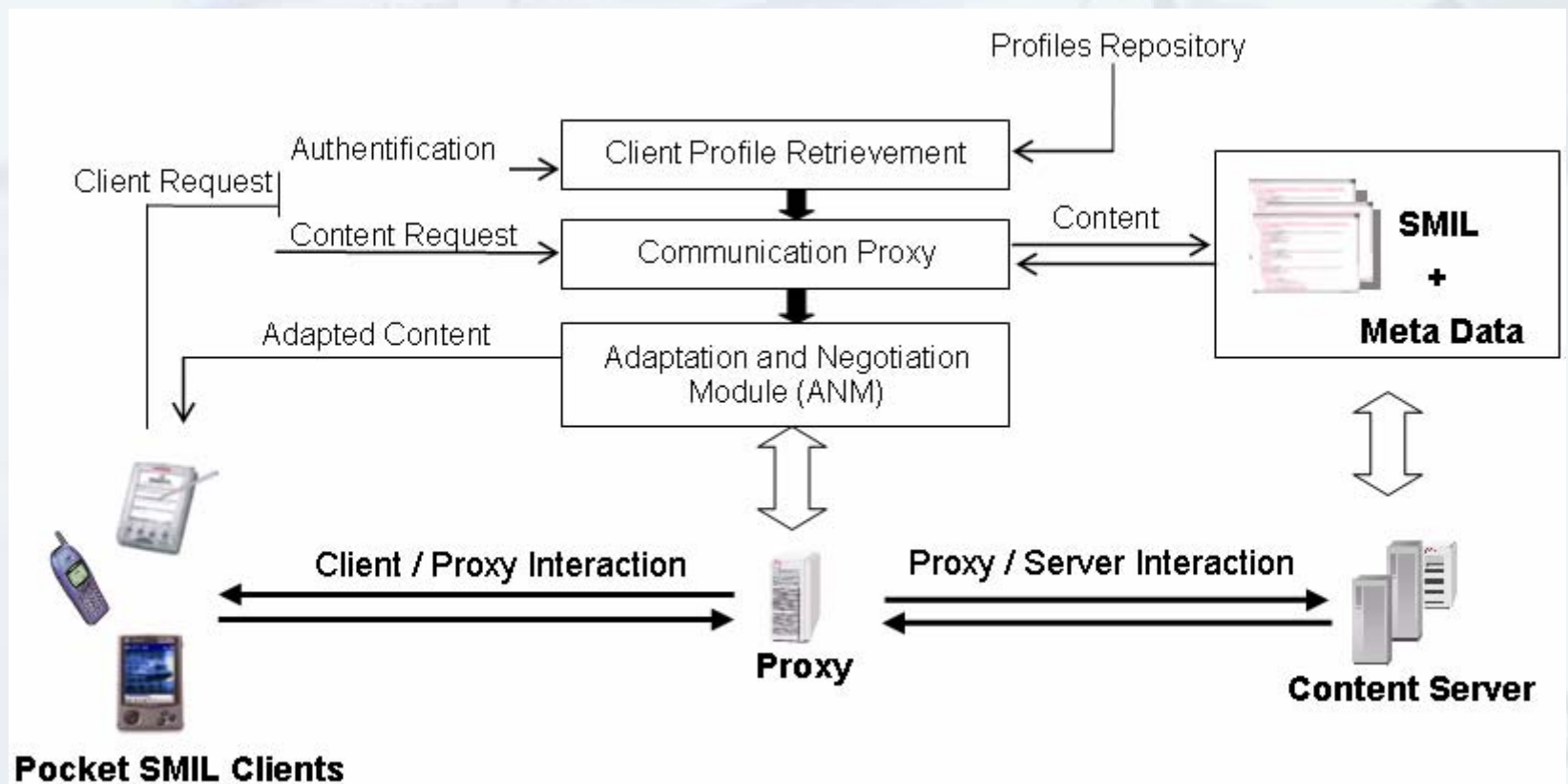
Proxy Adaptation

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** |

Proxy Adaptation

Exchange Protocol

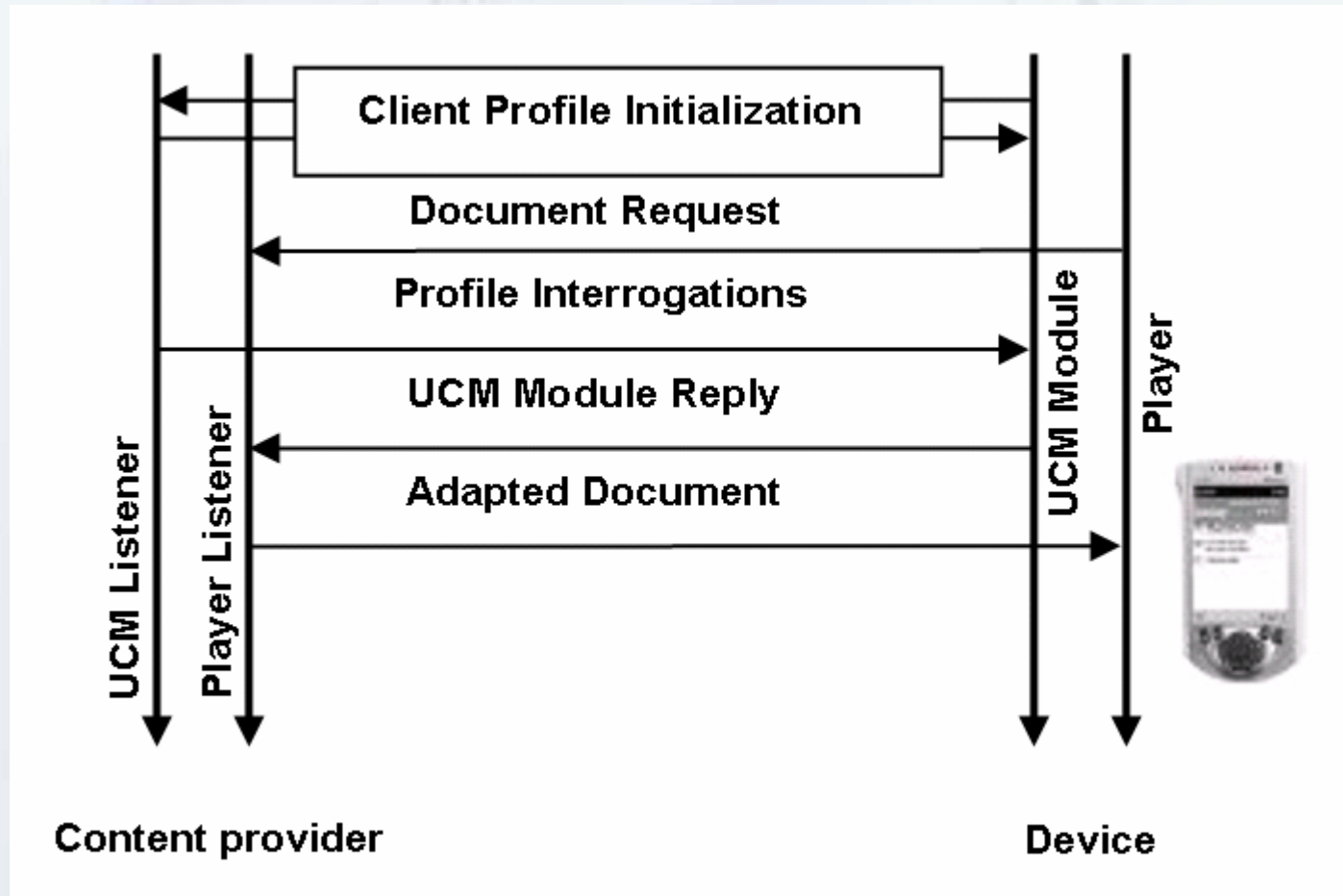- Independent to the communication protocol => can be used with existing protocols HTTP, etc.

- 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
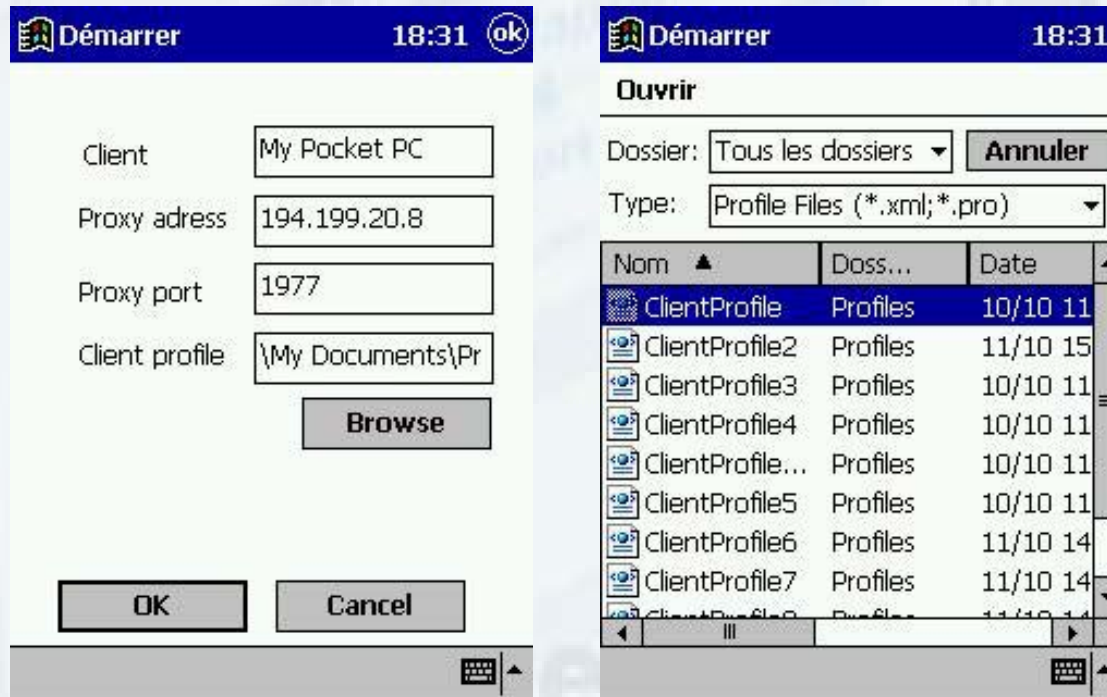
Exchange Protocol

Example

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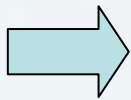 - **The device (Pocket PC here) selects its profile using UCM module:**

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

```
- <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


```
<neg:display>101x52Pixels</neg:display>
<neg:PixelStretch>1.24</neg:PixelStretch>
<!--   Here the language   -->
<neg:systemLanguage>ru</neg:systemLanguage>
</rdf:Description>
</ccpp:component>
<ccpp:component>
```

UPS profile

accept-language: fr

HTTP request

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
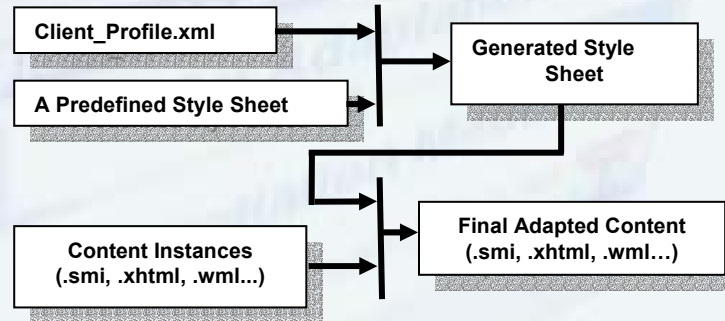
Document Transformation

Example

<u>SMIL:</u>

```
•        <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:

```
<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.
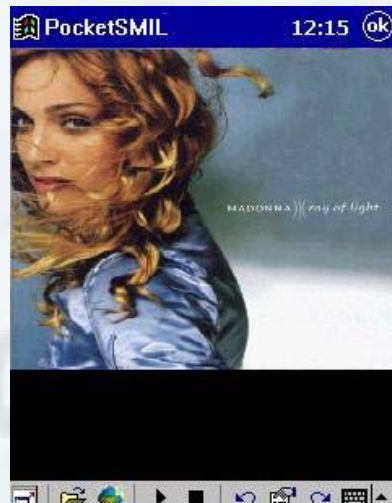
Media Adaptation for Capabilities

- ## Example

```
<body>
    <par dur ="120s">
    <audio src="Frozen.mp3"/>
    <img src="Ray_of_Light_CD.jpg"/>
    </par>
</body>
```
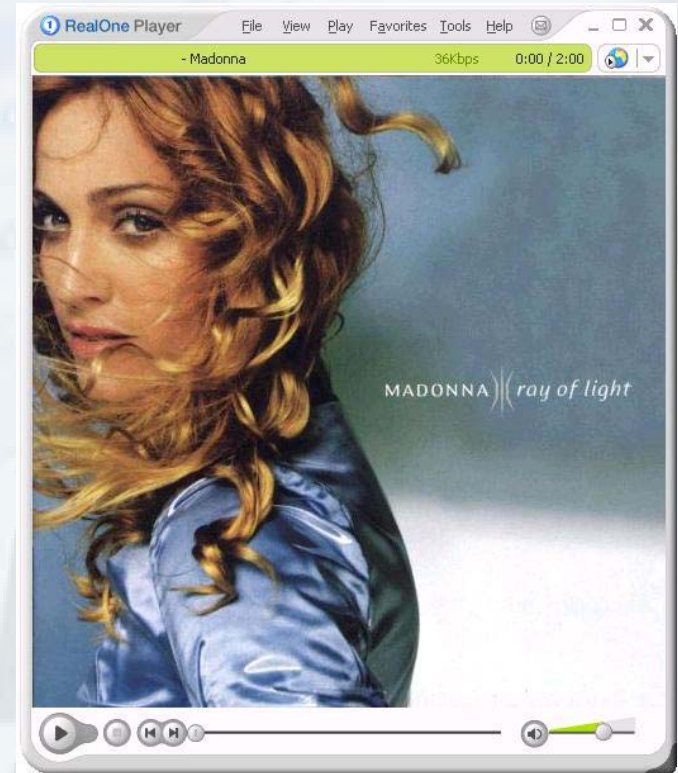
Original SMIL on a PDA

Adapted SMIL on a PDA

Original SMIL on a PC

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

Media Resource	Size (bytes)	Applied Compression (%)	Transformation Time (millisecond)	Delivery time (millisecond)
Image 1	23366	50	362,20	356
Image 2	13998	80	360,20	214
Image 3	9776	90	297,16	149

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 can not 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