UMA ENABLED ENVIRONMENT FOR MOBILE MEDIA USING MPEG-21 CLIENT AND SERVER TECHNOLOGY

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ABSTRACT

Usage of a multimedia framework becomes important when delivering rich multimedia content to mobile devices. The capabilities of these devices are very limited when compared to a desktop computers or laptops. Media resources delivered to these devices therefore has to be adapted. MPEG-21 introduces efficient tools to set up such a capability negotiation, where finally an adapted media resource is delivered to the consumer device. The idea is that the media provider knows all the capabilities of the terminal receiving the media resource. This way, no network or terminal resources are wasted, and session failures caused by missing codecs, too large spatial video resolution and other limitations in terminal capabilities are avoided.
The tools developed in MPEG-21 are an important contribution to enable UMA (Universal Multimedia Access) in the rapid growing market for online exchange of rich media resources. This paper will demonstrate how MPEG-21 is used in an application delivering rich multimedia to a set of mobile devices.

1. INTRODUCTION

There has been a substantial progress the latest years in the way we use mobile devices. While regular phone calls and short text messages have shown to create great revenue for mobile operators, it is now possible to view video and listen to music on cellular phones.
When using a mobile terminal to consume rich multimedia, two factors must be taken into account. The QoS (Quality of Service) and the QoE (Quality of Experience) must be ensured. This is the fundamental idea behind both UMA and MPEG-21.

MPEG-21 defines the environment in which the exchange of media resources (Figure 1.1) is taking place. In MPEG-21 the media provider, the content consumer and the network has defined roles. Encapsulation of media resources in the MPEG-21 "Digital Item" [1], gives a standardized representation of a media resource and its metadata. Integration of the Digital Item in an application with a dedicated server and client software based on the tools of MPEG-21 will set up a UMA environment for online multimedia delivery to mobile terminals.

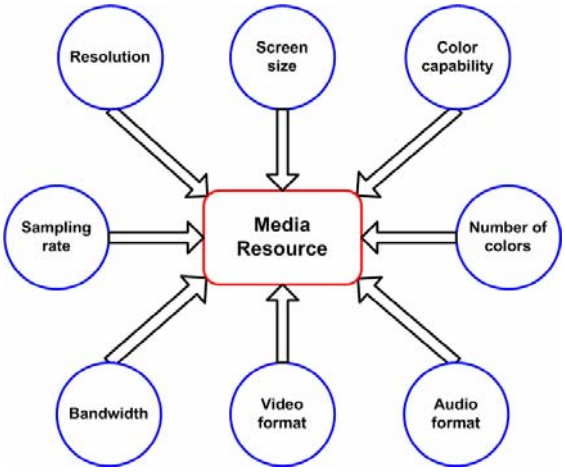

Figure 1.1 Example of metadata attached to a media resource

2. MPEG-21 INTEGRATION

Communication infrastructure enabling efficient delivery of media resources is growing rapidly, and a mechanism controlling the exchange of media resources is needed. MPEG-21 defines the framework enabling efficient and highly automated transactions of multimedia resources.

2.1 Digital Item

MPEG-21 defines a fundamental unit for transaction of a digital media resource. This unit is named the 'Digital Item'. The Digital Item is considered as the 'what', and is a standardized representation of digital content denoted the media resource. This Digital Item is defined using various tools available in the MPEG-21 standard. An example of a Digital Item is shown below (Figure 2.1).

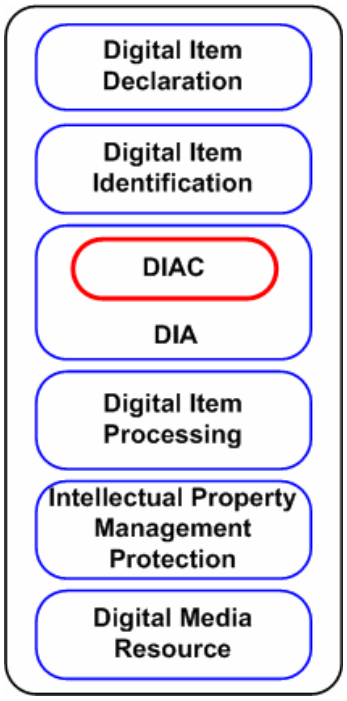

Figure 2.1 Digital Item

All MPEG-21 tools are declared using Extensible Markup Language (XML) schemas. Schemas provide a means for defining the structure, content and semantics of XML documents. When validating MPEG-21 documents against these schemas, a uniform representation within the standard is ensured.
First a digital media resource is declared and identified using part 2 and 3 of MPEG-21. Now that the declarations and identifications are attached to the digital resource, it has become something more than a digital resource. It is now a digital package (a Digital Item).
This Digital Item can also be adapted to fit the destination terminal. This is explained in section 2.2. Digital Item Processing is a tool telling how to process digital media resources.
Sharing of digital media resources also involves a possible threat. Protection of intellectual property is essential when sharing a digital media resource. MPEG-21 part 4, 5 and 6 defines tools that has the intention of preserving the intellectual property.

2.2 Resource Adaptation

This implementation includes a mobile device as the client, and a 2.5G mobile network. Resource delivery in this environment requires adaptation. MPEG-21 part 7, DIA (Digital Item Adaptation) [2], contains tools controlling the adaptation of MPEG-21 Digital Items, and is implemented extensively in this application. The adaptation process is shown in figure 2.2.
In order to deliver multimedia content to a mobile device, several important parameters must be considered. Information regarding supported audio- and video codec, number of displayable colors, screen size, resolution, and number of audio channels are examples of parameters controlling the adaptation. All these parameters return values used as input for the adaptation.

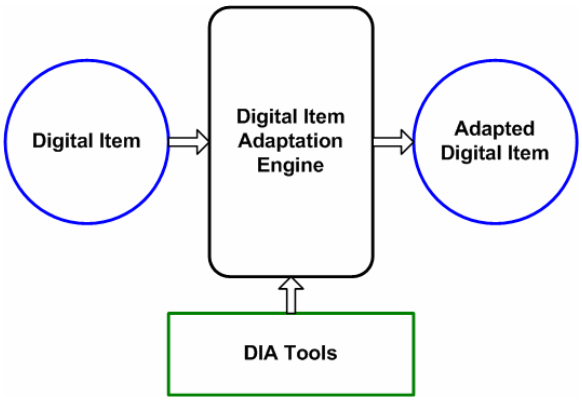

Figure 2.2 Digital Item Adaptation Engine

2.3 Adaptation Configuration

To control the adaptation process, a tool in MPEG-21 DIA called DIAC (Digital Item Adaptation Configuration) [2] is used. DIAC lets the programmer decide where the decisions controlling the adaptation take place. DIAC also specifies if the adaptation is hidden to the client. This is the intention in this implementation. The description of the terminal is generated in the background as the client makes his selections in the graphical user interface.

3. CLIENT IMPLEMENTATION

A programmable platform must be available on the client side. In our case, the client software is implemented using the Java 2 ME platform which supports all functionality required in this application. By using the KXML2 [5] package, support for XML is also available on the client side.

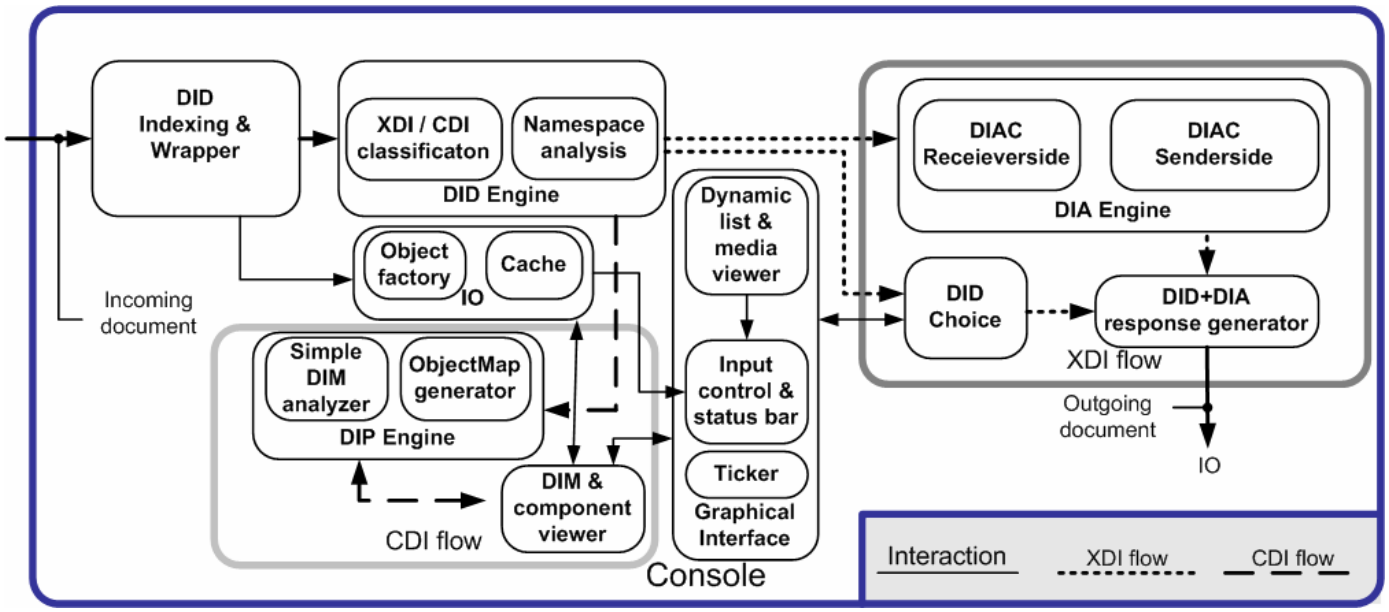

Figure 3.1 Client data flow

Note that (in figure 3.1) an 'Engine' does some kind of analysis, a 'Parser' simply extracts information and a generator combines and formulates information in XML. Thick arrow lines indicate MPEG-21 information.

3.1 Client data flow

The client first receives an XML document which is assumed to be a valid MPEG-21 Digital Item. The document is first preprocessed in order to give it a uniform representation.
A DID engine then runs through the document and extracts the different MPEG-21 namespaces it contains. The nature of the document is then determined using a tag from the Digital Item Identification (MPEG-21 part 3) [4] namespace. There are two alternatives, Context Digital Item (XDI) [1] and Content Digital Item (CDI) [1]. Each give rise to a corresponding data flow, XDI (in red and orange), and CDI (in blue). Furthermore, the DID owner of the XDI or CDI tag is considered the root of the document.

3.1.1 Context Digital Item (XDI)

Such a document usually requires that several actions are taken. Since short waiting time is an obvious design target, a two-fold strategy is employed:

1. Generate any menu that requires user input as quickly as possible.

2. Do as much as possible when there is free processing power.

The box 'DID Choice' in figure 3.1generates user menus, and is therefore given priority. The box 'DIA Engine' is responsible for generating a description of the terminal, as specified by the server. It therefore acts as a slave and completes its task in the background. Finally, results from both processes are combined in the 'DID+DIA response generator', and transmitted to the server.

3.1.2 Content Digital Item (CDI)

The server formulates a response in the form of a CDI, which, in contrast to an XDI, contains links to resources such as for example audio or video. The client detects the CDI and routes the document to a Digital Item Processing (DIP) engine.

3.2 Digital Item Processing

Digital Item Processing [3] defines how a Digital Item ought to be processed and presented once received. For instance, the Digital Item version of a copyrighted CD would allow you to play songs, view CD cover images and read the lyrics. Sending the Digital Item to your best friend and so on is not allowed. This can be controlled

using the Intellectual Property Management and Protection (IPMP) tool of MPEG-21 and the Event Reporting mechanism .Each 'action' is defined using a part of DIP called a Digital Item Method (DIM).
In our case 'DIP Engine' generates a list of available DIMs, and presents them using the 'DIM & component viewer' The user then selects a DIM, for example 'Play trailer', and receives the requested service. This process is repeated until the user closes the application or makes some other selections in the menu from the XDI and thus receives a new CDI.

3.3 Server side

The server first validates the document against its XML schema definition. It then has to process the received information and generate a response. This is done in the following way:
The server runs on top of a media base, an Oracle 10g in our case, which contains both media resources and corresponding MPEG-21 DIA descriptions. By combining DIA information from the client and the media base, the server becomes able to decide which resources the client can handle. The QoS evaluation is based on the 'QoS evaluation tool' specified in MPEG-21 DIA. A QoS document instance extracts data from the client DIA document using XPath. The document is then evaluated and the IOPins [2] determined. The server also determines if it holds a buffered resource instance or needs to do some kind of transcoding to create a new resource. This is where the 'magic' resource adaptation is done. It is possible because the media base contains **uniform** (MPEG-21) descriptions of its media resources. Using these uniform descriptions, the media base can wrap the resource in an MPEG-21 Content Digital Item, and thereby deliver a digital packet (DI) instead of only a digital resource.

4. CONCLUSION

This paper shows how a mobile device can collaborate with a media provider through MPEG-21 to enable UMA on mobile devices. When presenting multimedia on such a limited device, many parameters must be taken into consideration. Adactus has implemented this software using MPEG-21 as a tool to control the handling of digital media resources.
Correct handling of a digital media resource becomes important. Ensuring a standardized representation of the available media resources, retrieving the capabilities of the terminals, and using the tools of MPEG-21 to adapt each media resource to the destination terminal, creates a consistent and promising environment for multimedia delivery.
Usage of a multimedia framework like MPEG-21 enables rich and controlled delivery of multimedia content to a set of highly constrained devices. Mobile terminals render adapted multimedia, and the consumer gets an enhanced impression of the mobile terminal as a multimedia viewer.

5. REFERENCES

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