객체-기반 스케일링에 의한 MPEG-4 컨텐츠의 다양한 터미널 적응 기법

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An Adaptation Technique for Various Terminals of MPEG-4 Contents by an Object-based Scaling

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Abstract

This paper describes a model and system development for support an object-based scalability to provide adaptive MPEG-4 contents. One of the problem encountered by a multimedia service in heterogeneous network environment is the variation in the client's playback capability. Therefore, we provide technique which give an adaptability to MPEG-4 encoders so that make it possible to service adaptive MPEG-4 contents to a certain end terminal.

1. Introduction

This paper describes a model and system development for support an object-based scalability to provide adaptive MPEG-4 contents.
The MPEG-4 contents can be transmitted to heterogeneity network or end systems. One of the problem encountered by a multimedia service in heterogeneous network environment is the variation in the client's playback capability[1-6]. That is, when distributing contents under this environment, the encoding or multimplexing media streams at a fixed form may not be suitable for all receivers.
Therefore, it is very important to provide technique which give an adaptability to MPEG-4 encoders so that make it possible to service adaptive MPEG-4 contents to a certain end terminal[2, 6].
The proposed method is to scale the object in the MPEG-4 scene graph. This dynamically modifies a scene structure and multiplexes elementary streams in resulting encoded contents to be adapted on the end terminal's capabilities.
The section 2 describes the overview if the adaptation. The section 3 explains adaptation process. The section 4 describes evaluation of this method. In section 5, we conclude.

2. Overview of the Adaptation

In this section, we describe the system structure and the request structure to be used during the adaptation.

2.1 System Structure

We describe overview of the adaptation process. Figure 2-1 shows a outline the MPEG-4 content access procedure.
To access contents, the client requests the establishment of a service session by passing a request message to a delivery application.
When an application requests the activation of a service, the DMIF implementation then contacts the corresponding end and creates a network session

with it. The application peers then use this session to create connections which are used to transport application data e.g., MPEG-4 elementary Streams.
As result of the client's request, a special object descriptor called the *Initial Object Descriptor* is returned after the service session is built.
The overall behaviors for the adaptation occurring at the server side, are follows.
For adapting contents to the client's capability, the server demultiplexes MPEG-4 storage into elementary streams and then select proper objects. Moreover the modified contents are multiplexed for transmission.

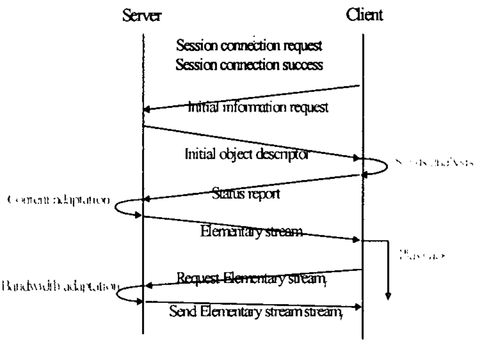


Figure 2-1 The Overview of the Adaptation Process

2.2 Structure of Object Descriptor

The *Initial Object Descriptor* conveys information to identify the elementary streams that contain the scene description and the associated object descriptors of media streams. This allows the receiving terminal to request the delivery of a meaningful subset of streams for each media object, so that the computational resources of the terminal are not exceeded.
Figure 2-2 shows the *Initial Object Descriptor* and other Object descriptors. Each elementary stream which is referenced by the initial object descriptor is characterized by a set of descriptors for configuration information within the elementary stream descriptors.

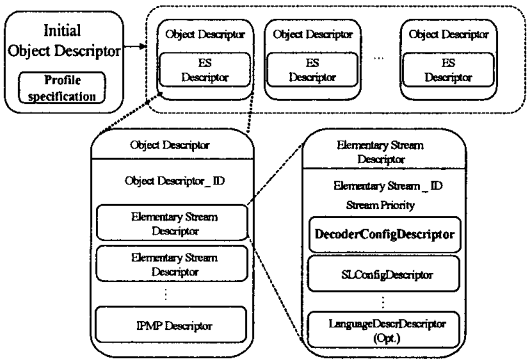


Figure 2-2 An Example of the Initial Object Descriptor

For example, the configuration value is the required buffer size, maximum bitrate, priority, etc.. As shown in Figure 2-1, client's terminal has its own decoding buffers and decoders. The client's terminal evaluates the configuration information and determines whether it's decoding capability is able to cover the streaming contents. Then it signals a list of elementary stream IDs which it can not handle as well as the available resources.
The server modifies the content in order to fit the receiver's capability by re-constructing scene structure, dropping or selecting media objects with the client's reports.
The modified Initial object descriptor which contains an adaptive contents is transmitted the client. Then the client requests delivery of the streams with elementary stream IDs and receives the respective streams through delivery interface.

3. Adaptation Process

This section describes MPEG-4 System profiles and the scene complexity adaptation mechanism based on system profile information between a server and a client.

3.1 Scene Profile Adaptation

Graphics Profiles define which graphical and textual elements can be used in a scene. Graphics tools specifies the available BIFS nodes in one of the graphics profiles. Simple 2D, Complete 2D and Complete profiles are defined hierarchically.

Scene Graph Profiles defined in the Systems part of the standard, allow audio-visual scenes with audio-only, 2-dimensional, 3-dimensional or mixed 2-D/3-D content. They define what types of transformational capabilities need to be supported by the end terminal.

3.2 Scene Complexity Adaptation

The system profiles indicates available nodes in scene description. For matching the scene complexity between two ends, the values within the initial object descriptor should be referenced.

The modification rules for matching the scene complexity are defined as follows. The scene profile reducing module takes as input the scene composition tree that is generated by the parser. And it makes a modified scene composition tree compatible the expected profile.

Rule 1 : remove Group type node and modify scene structure

Rule 2 : remove route information

Rule 3 : remove object node

There is a four dimensional adaptation space associated with the four types of combinations of system profiles. The rules to be applied to match scene graph and graphics profiles are indicated in Table 3-1.

Table 3-1

Scene Graph Profile Complexity	Graphics Profile Complexity	Adaptation Rules
C(*current_p*) > C(*expected_p*)	C(*current_p*) <= C(*expected_p*)	Rule1+ Rule2
C(*current_p*) <= C(*expected_p*)	C(*current_p*) > C(*expected_p*)	Rule3+ Rule2
C(*current_p*) > C(*expected_p*)	C(*current_p*) > C(*expected_p*)	Rule1+Rule2 + Rule 3
C(*current_p*) <= C(*expected_p*)	C(*current_p*) <= C(*expected_p*)	No action

3.3 Decoding Feature Adaptation

The client status report carries the average buffer size, stream types which can be processed by the player. The server of the adaptive contents streaming service uses this information to determine which subset of elementary streams can be processed at the resources required to support the current status.

An MPEG-4 terminal plays an object-based MPEG-4 presentations by receiving, decoding and rendering all elementary streams. Thus the streams should be adaptive to the receiver's presentation abilities.

3.4 Adaptation for Efficient Optimization

We want to describe the trade-off method in order to find a subset of objects included in a scene so as to maximize the presentation quality.

Assume that there are *n* objects $O_1,\ldots O_n$ with average buffer requirements or bitrates $s_1,\ldots, s_n$ that may be included in the presentation. There is an aggregate buffer size constraint which is reported by the decoder, C, that must not be exceeded. If an object is included to the presentation, the overall quality is increased by p_i and the available resource is decreased by an amount s_i.

The objective is to find a subset of objects to include so as to maximize the overall quality.

Using the above assumption, we can make formula as follows:

$$\text{Maximize } \sum_{i=0}^{n} p_i X_i$$

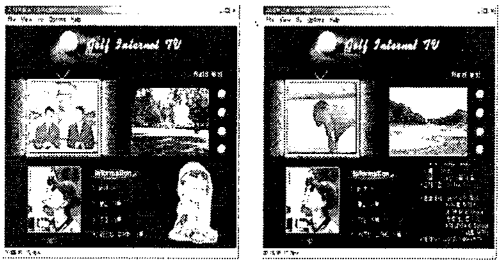
$$\text{subject to } \sum_{i=0}^{n} s_i X_i \leq C, \ with\ \ X_i \in \{0,1\}$$

4. System Development and Evaluation

The MPEG-4 authoring system is developed using C++ language under the Windows platform. This system uses various media types: JPEG, BMP, GIF, Animated GIF, MPEG-1, MPEG-4 video, AVI, H.263, G.723, Circle, Rectangle, Curve, Line, and Text.

Figure 4-1 shows an example scene that is created

using the MPEG-4 content authoring system.
For service the above the contents should be adapted to the receiver's capability for presentation. The PDA's scene complexity is reported Simple profile on graphic and scene graph profile. Moreover any image objects and geometric objects should be dropped from the scene because the PDA's MPEG-4 player is able to deal only video and audio object.
Table 4-1 shows the adaptation result for an example mp4 file [2, 6]. The mp4 size and some other information about the example are shown in table 4-1.



(a) (b)

Figure 4-1 MPEG-4 scene presentation (IM1 Player): (a) The initial frame of the scene; (b) The changed scene with user interaction

In this case, we dropped the geometry objects on the lower layer in resulting the scene to be composed of one text object and the image object. We can see the adapted contents bit rate is reduced considerably only scaling the scene description.

Table 4-1 Content Report of the MPEG-4 Scene

Scene	Object Type	Number of node	BIFS(byte)	mp4(byte)	Ratio (original : modified)
Original	2D geometry	32	3,090	9,399	1
	Image object	1			
Adapted	2D geometry	1	203	6,476	0.69
	Image object	1			

5. Conclusion

This paper described the adaptive MPEG-4 contents authoring system. Moreover the adaptation mechanism for providing proper contents to various user terminals is also presented. These features enable to provide an efficient model for the transmission of MPEG-4 contents over various types of end terminals with a QoS guarantee.
In the future, we will give more efficient mechanism to adapt contents when huge number of streaming objects are participated in the transmitted content.

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