BFlavor: a new bitstream structure description language

Davy Van Deursen

Supervisor(s): Rik Van de Walle

Abstract— **Bitstream structure description languages are able to automatically create textual descriptions containing information about the high-level structure of binary multimedia resources. Such a description can easily be transformed into an adapted description. The adapted description is then used to create an adapted version of the original resource. BFlavor, a new bitstream structure description language, is a combination of two existing bitstream structure description languages: MPEG-21 BSDL and XFlavor. Both languages are able to translate the structure of a multimedia resource into an XML document. The intention of BFlavor is to combine the advantages of both languages, and to eliminate their disadvantages. In this paper, we will discuss the motivation behind the creation of BFlavor and its working. A comparison between BFlavor, XFlavor, and MPEG-21 BSDL is presented as well.**

Keywords—**BFlavor, XFlavor, MPEG-21 BSDL**

I. Introduction

TODAY , in the world of multimedia, there is a huge variety of different end user devices. The devices differ in characteristics such as screen size, processing power, battery life, ... Therefore, multiple versions of the same multimedia resource are needed. This can be realized by using scalable bitstreams in combination with a transparent bitstream adaptation system. A language for describing the structure of scalable bitstreams on a high level can be used in such a generic bitstream adaptation system.

Bitstream structure description languages are able to translate the structure of a binary multimedia resource into a textual format. Mostly, this textual format will be eXtensible Markup Language (XML). Using XML as textual format allows the usage of many already existing tools for manipulating XML documents, as well as a straightforward integration with other metadata standards. This way, the transformation is done at a higher level. Hence, only a limited knowledge about the structure of the bitstream is needed during the transformation. The transformed description can then be used to obtain an adapted version of the binary multimedia resource. This makes that bitstream structure description languages can be used in a transparent bitstream adaptation system.

II. BFlavor

BFlavor is a combination of two existing bitstream structure description languages: MPEG-21 BSDL (Bitstream Syntax Description Language) [1] and XFlavor (Formal Language for Audio-Visual Object Representation) [2]. In this section, a short overview of MPEG-21 BSDL and XFlavor is presented, together with the motivation to create BFlavor. The working of BFlavor will be discussed as well.

D. Van Deursen is with Multimedia Lab, ELIS Department, Ghent University - IBBT, Ghent, Belgium. E-mail: davy.vandeursen@ugent.be.

A. MPEG-21 BSDL and XFlavor

MPEG-21 BSDL is a tool of part 7 (Digital Item Adaptation, DIA) of the MPEG-21 specification. It is built on top of W3C XML Schema, and is able to (partially) describe the structure of a (scalable) bitstream. MPEG-21 BSDL is designed to assist in customizing scalable bitstreams.

XFlavor is an extension of C++ and Java and is able to describe the bitstream syntax on a bit-per-bit basis. XFlavor was initially designed to simplify and speed up the development of software that processes audiovisual bitstreams by automatically generating a parser for these bitstreams. This parser is able to generate an XML description of the bitstream syntax. XFlavor comes with a tool (i.e., `bitgen`) for the generation of the adapted bitstream. This makes that XFlavor can be used for the adaptation of (scalable) bitstreams.

In Table I, some experimental results are presented. A comparison between MPEG-21 BSDL and XFlavor is given in terms of execution time, memory usage and description size. We will use these results for motivating the creation of BFlavor. In this table, ET and MC respectively stand for Execution Time and Memory Consumption.

TABLE I

Simulation results for MPEG-21 BSDL, XFlavor, and BFlavor.

# H.264/ AVC slices	MPEG-21 BSDL			XFlavor			BFlavor		
	ET (s)	MC (MB)	BSD size (KB)	ET (s)	MC (MB)	BSD size (KB)	ET (s)	MC (MB)	BSD size (KB)
49	34.6	2.6	114.5	0.4	1.9	478.9	0.2	1.9	144.8
97	104.8	3.8	225.6	0.6	1.9	960.8	0.3	1.9	291.4
201	390.9	6.2	466.7	0.9	1.9	2149.8	0.4	1.9	609.1
297	808.2	8.5	688.2	1.0	1.9	2869.4	0.5	1.9	903.0
1800	>24h	na	na	5.0	1.9	17358.6	2.1	1.9	5480.2
5400	>24h	na	na	14.0	1.9	52168.0	5.2	1.9	16501.6
9000	>24h	na	na	23.1	1.9	87414.4	8.4	1.9	27526.8

MPEG-21 BSDL generates a (partial) description of the bitstream. Hence, it is possible to describe the bitstream with a high-level granularity and thus generate a compact bitstream syntax description (BSD). On the contrary, XFlavor generates very large BSDs. This is due to the fact that XFlavor cannot refer to the original bitstream. Hence, all the information of the bitstream has to be written in the BSD, which makes the description unacceptably large.

A disadvantage of MPEG-21 BSDL is the `BintoBSD` tool (v. 1.1.3), whose execution speed is very poor. This is due to the XPath evaluation mechanism, used for getting access to context information (i.e., information already retrieved from the bitstream). Also the memory usage of the `BintoBSD` tool is unacceptably high due to the fact that the entire description of the bitstream structure is kept in the system memory in order to al-

low the evaluation of arbitrary XPath 1.0 expressions. The generated parser of XFlavor is, in comparison with the `BintoBSD` tool of MPEG-21 BSDL, very fast. The memory consumption of XFlavor is low and constant.

Regarding the language aspects, XFlavor has a small advantage in terms of control flow. Where XFlavor can use the constructions of C++ and Java (`if`, `else`, `while`, `for`, ...), MPEG-21 BSDL has to use the BSDL-specific attributes `bs2:if`, `bs2:ifNext`, `bs2:ifUnion` and `bs2:nOccurs`. Especially for the creation of loops, XFlavor has more intuitive provisions.

As we can see, both languages are characterized by some complementary properties. BFlavor, a combination of the two technologies, is designed to harmonize the advantages and avoid the disadvantages of the two languages.

B. Working of BFlavor

BFlavor is built on top of XFlavor. Hence, the syntax of the BFlavor description is still an extension of C++ and Java. In Fig. 1, we can see the BFlavor adaptation chain. We start with the BFlavor description, which contains a high-level description of the structure of a particular coding format. This description will be translated by the `bflavorc` translator which results in a set of Java classes and an MPEG-21 BSDL schema. The Java classes are compiled to a coding format specific parser, that can generate a BSD which is compatible with BSDL-1 specification of MPEG-21. The BSD can be transformed with techniques such as eXtensible Stylesheet Language Transformation (XSLT), Streaming Transformations for XML (STX), ... `BSDtoBin` uses the customized BSD together with an MPEG-21 BSDL schema to produce a customized bitstream. Because of the fact that the `BSDtoBin` tool needs a BSDL schema, it is necessary that the `bflavorc` tool can generate an MPEG-21 BSDL schema from the BFlavor description.

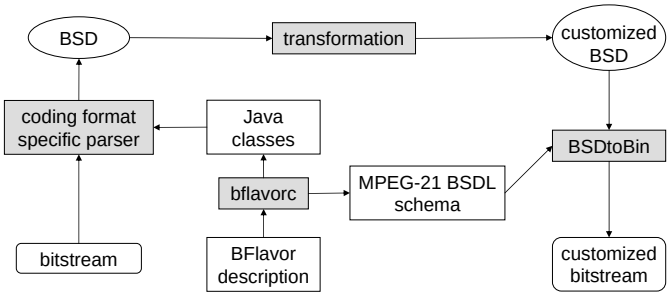

Fig. 1. Adaptation chain of BFlavor

III. Comparison between BFlavor, XFlavor and MPEG-21 BSDL

In Table II, an overview of the characteristics of MPEG-21 BSDL, XFlavor, and BFlavor is given. BFlavor has the same constructions for flow control as XFlavor. This way, we avoid the more difficult constructions of MPEG-21 BSDL. In terms of execution time, BFlavor even performs better than XFlavor when we look at Table I. This is because BFlavor generates a smaller BSD than XFlavor, which results in less time spent to

TABLE II
Overview of the characteristics of MPEG-21 BSDL, XFlavor, and BFlavor.

Criterion	MPEG-21 BSDL	XFlavor	BFlavor
Foundation	W3C XML Schema (restrictions, extensions)	C++/Java (restrictions, extensions)	XFlavor (restrictions, extensions)
Flow control	BSDL-specific attributes	C++/Java-based flow	C++/Java-based flow
Context access	XPath (BSDL-2 variables)	parsable and non-parsable variables, often used as class arguments	parsable variables, often used as class arguments
Processing speed	slow	fast	fast
Memory usage	high	low	low
Granularity	high-level	low-level	high-level

Input/Output (I/O) operations. BFlavor solves the major disadvantage of XFlavor, namely the low-level granularity and hereby the large size of the BSD. BFlavor makes it possible to refer to the original bitstream, which results in a high-level granularity of the language. Hence, the size of the BSD generated by BFlavor comes close to the size of the BSD generated by MPEG-21 BSDL. The memory consumption of BFlavor is the same as the one of XFlavor. Thus, we avoid the inefficient memory usage of the `BintoBSD` tool.

A disadvantage of the joined approach is the possibility to obtain context information. In BSDL, this can be achieved by using the XPath evaluation mechanism, while XFlavor uses (non-)parsable variables. The use of non-parsable variables is forbidden in BFlavor (for the compatibility with MPEG-21 BSDL), which makes it more difficult to retrieve context information.

IV. Conclusions

In this overview paper, a new bitstream structure description language was presented. BFlavor, a modification of XFlavor that is compatible with MPEG-21 BSDL was designed to combine the strengths and to avoid the weaknesses of XFlavor and MPEG-21 BSDL. The execution time of BFlavor is even better than XFlavor. BFlavor maintains the low memory consumption of XFlavor. With the possibility to refer to the original bitstream, BFlavor has a high-level granularity, similar to the granularity of MPEG-21 BSDL. Experimental results have shown that the joined approach outperforms the two techniques as separate tools.

Acknowledgments

The research activities that have been described in this paper were funded by Ghent University, the Interdisciplinary Institute for Broadband Technology (IBBT), the Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT), the Fund for Scientific Research-Flanders (FWO-Flanders), the Belgian Federal Science Policy Office (BFSPO), and the European Union.

References

[1] ISO/IEC JTC 1 *Information Technology Multimedia framework (MPEG-21) Part 7: Digital Item Adaptation*, October, 2004.

[2] A. Eleftheriadis and D. Hong, *Flavor: A Formal Language for Audio-Visual Object Representation*, Proceedings, ACM Int'l Conf. on Multimedia, New York, NY, USA, October 2004.