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Partie 4: Représentation de configuration codec

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This fourth edition cancels and replaces the third edition (ISO/IEC 23001-4:2014), which constitutes a minor revision with the following changes:

— addition of citations to Annexes G, H and J in the Introduction;

— addition of a citation to Annex E in Clause 4;

— improvement of the usage description of `rvc:port attribute` and addition of a citation to Annex F in Clause 6;

— improvement of the specification of RVC-BSDL in Annex C;

— addition of informative description of a generic bitstream parser in Annex I.

A list of all parts in the ISO/IEC 23001 series can be found on the ISO website.

Introduction

This document defines the methods capable of describing codec configurations in the reconfigurable video coding (RVC) framework. The objective of RVC is to offer a framework that is capable of configuring and specifying video codecs as a collection of "higher level" modules by using video coding tools. The video coding tools are defined in the video tool library. ISO/IEC 23002–4 defines the MPEG video tool library. The RVC framework principle could also support non-MPEG tool libraries, provided that their developers have taken care to obey the appropriate rules of operation.

For the purpose of framework deployment, an appropriate description is needed to describe configurations of decoders composed of or instantiated from a subset of video tools from either one or more libraries. As illustrated in Figure 1, the configuration information consists of

— bitstream syntax description, and

— network of functional units (FUs) description (also referred to as the decoder configuration)

that together constitute the entire decoder description (DD).

Bitstreams of existing MPEG standards are specified by specific syntax structures and decoders are composed of various coding tools. Therefore, RVC includes support for bitstream syntax descriptions, as well as video coding tools. As depicted in Figure 1, a typical RVC decoder requires two types of information, namely the decoder description and the encoded media (e.g. video bitstreams) data.

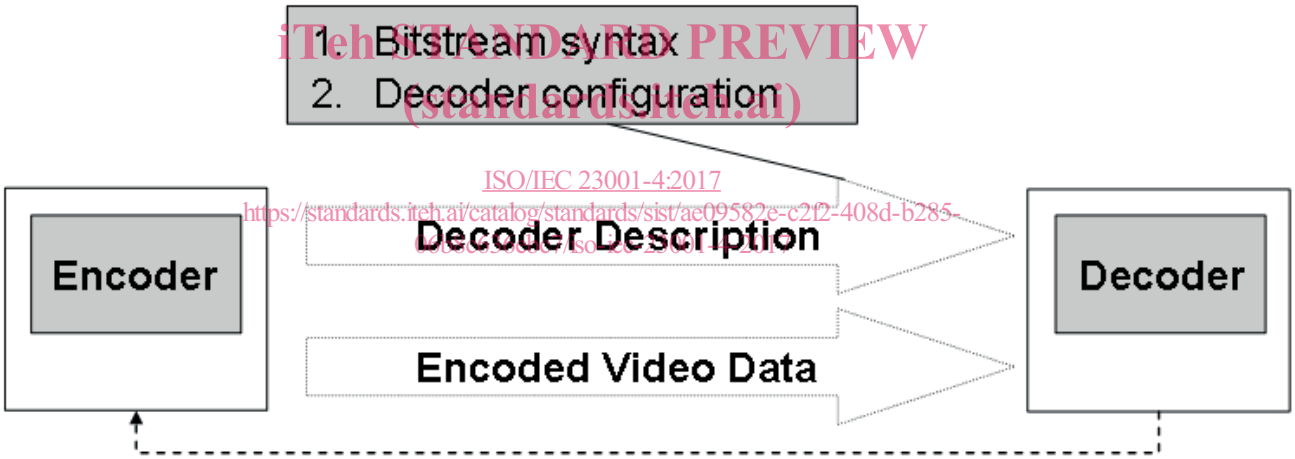

Figure 1 — Conceptual diagram of RVC

Figure 2 illustrates a more detailed description of the RVC decoder.

A more detailed description of the RVC decoder is shown in Figure 2, where the decoder description is required for the configuration of an RVC decoder. The Bitstream Syntax Description (BSD) and FU Network Description (FND) (which compose the Decoder Description) are used to configure or compose an abstract decoder model (ADM) which is instantiated through the selection of FUs from tool libraries optionally with proper parameter assignment. Such an ADM constitutes the behavioural reference model used in setting up a decoding solution under the RVC framework. The process of yielding a decoding solution may vary depending on the technologies used for the desired implementations. Examples of the instantiation of an abstract decoder model and generation of proprietary decoding solutions are given in Annex I.

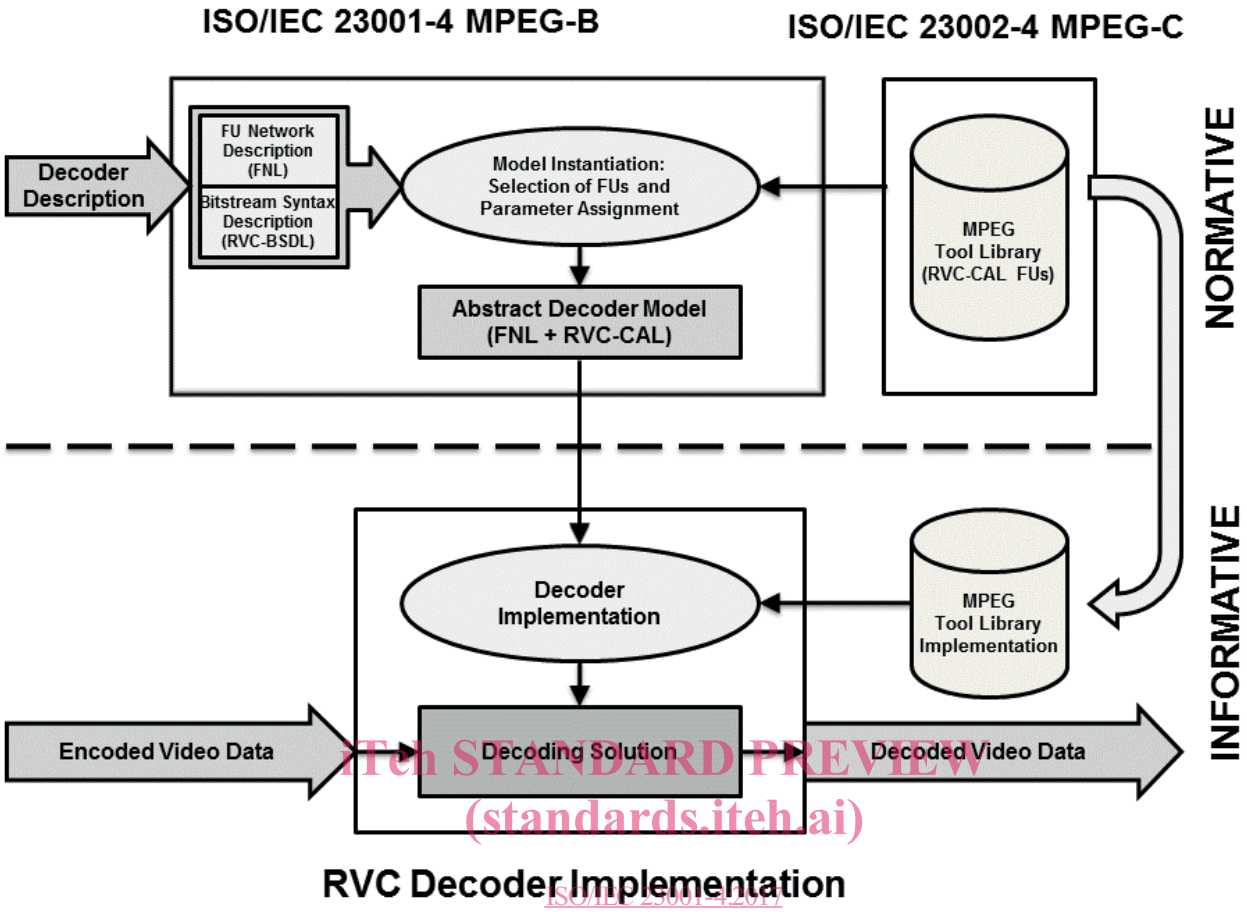

Figure 2 — Graphical representation of the instantiation process or decoder composition mechanism for the RVC normative ADM and for the non-normative proprietary compliant decoder implementation

Within the RVC framework, the decoder description describes a particular decoder configuration and consists of the FND and the BSD. The FND describes the connectivity of the network of FUs used to form a decoder whereas the parsing process for the bitstream syntax is implicitly described by the BSD. These two descriptions are specified using two standard XML-based languages or dialects:

— Functional Unit Network Language (FNL) is a language that describes the FND, known also as "network of FUs". The FNL specified normatively within the scope of the RVC framework is provided in this document;

— Bitstream Syntax Description Language (BSDL), standardized in ISO/IEC 23001-5 (MPEG-B Part 5), describes the bitstream syntax and the parsing rules. A pertinent subset of this BSDL named RVC-BSDL is defined within the scope of the current RVC framework. This RVC-BSDL also includes possibilities for further extensions, which are necessary to provide complete description of video bitstreams. RVC-BSDL specified normatively within the scope of the RVC framework is provided in this document.

The decoder configuration specified using FNL, together with the specification of the bitstream syntax using RVC-BSDL fully specifies the ADM and provides an "executable" model of the RVC decoder description.

The instantiated ADM includes the information about the selected FUs and how they should be connected. As already mentioned, the FND with the network connection information is expressed by using FNL. Furthermore, the RVC framework specifies and uses a dataflow-oriented language called

RVC-CAL for describing FUs' behaviour. The normative specification of RVC-CAL is provided in this document. The ADM is the behavioural model that should be referred to in order to implement any RVC conformant decoder. Any RVC compliant decoding solution/implementation can be achieved by using proprietary non-normative tools and mechanisms that yield decoders that behave equivalent to the RVC ADM.

The decoder description, the MPEG video tool library, and the associated instantiation of an ADM are normative. More precisely, the ADM is intended to be normative in terms of a behavioural model. In other words, what is normative is the input/output behaviour of the complete ADM, as well as the input/output behaviour of all the FUs that are included in the ADM.

This document also includes informative technical descriptions to facilitate implementation of the RVC framework. In Annex G, allocation of the decoder configuration data within MP4 file format is introduced. In Annex H, carriage of the decoder configuration over RTP is described. Finally, in Annex J, technical relation between the codec configuration representation and the MPEG multimedia middleware (M3W) is described.

Information technology — MPEG systems technologies —

Part 4:
Codec configuration representation

1 Scope

This document defines the methods and general principles capable of describing codec configurations in the reconfigurable video coding (RVC) framework. It primarily addresses reconfigurable video aspects and will only focus on the description of representation for video codec configurations within the RVC framework.

Within the scope of the RVC framework, two languages, namely FNL and RVC-BSDL, are specified normatively. FNL is a language that describes the FND, also known as "network of FUs". RVC-BSDL is a pertinent subset of BSDL defined in ISO/IEC 23001-5. This RVC-BSDL also includes possibilities for further extensions, which are necessary to provide complete description of video bitstreams.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14496-2:2004, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 14496-12, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 23001-5, *Information technology — MPEG systems technologies — Part 5: Bitstream Syntax Description Language (BSDL)*

ISO/IEC 23002-4, *Information technology — MPEG video technologies — Part 4: Video tool library*

IETF RFC 1889, *RTP A Transport Protocol for Real-Time Applications, H. Schulzrinne, et. al., January 1996*

IETF RFC 2327, *SDP: Session Description Protocol, M. Handley, April 1998*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
abstract decoder model
ADM
conceptual model of the instantiation of *functional units* (3.8) from the *video tool library* (3.16) and their connection according to the *FU network description* (3.9)

3.2
bitstream syntax description
BSD
description containing the bitstream syntax, its implicit parsing rules and possibly tables [e.g. VLD tables if not already existing in the *reconfigurable video coding* (3.13) *video tool library* (3.16)] to define the parser *functional unit* (3.8)

Note 1 to entry: The BSD is expressed using reconfigurable video coding-bitstream syntax description language (3.14).

3.3
bitstream syntax description language
BSDL
description of the bitstream syntax and the parsing rules

Note 1 to entry: Bitstream syntax description language (BSDL) is standardized by ISO/IEC 23001-5.

3.4
connection
link from an output port to an input port of a *functional unit* (3.8) that enables token exchange between FUs

3.5
decoder configuration
conceptual configuration of a decoding solution

Note 1 to entry: Using the *MPEG video tool library* (3.12), decoder configuration can be designed as one of the following cases:

— a decoding solution of an existing MPEG standard at a specific profile and level;

— a new decoding solution built from tools of an existing MPEG standard;

— a new decoding solution built from tools of an existing MPEG standard and some new MPEG tools included in the MPEG video tool library;

— a new decoding solution that is composed of new MPEG tools included in the MPEG video tool library.

Note 2 to entry: In summary, an RVC decoder description essentially consists of a list of *functional units* (3.8) and of the specification of the FU connections [*FU network description* (3.9) expressed in *FU network language* (3.10)] plus the implicit specification of the parser in terms of *bitstream syntax description* (3.2) [BSD expressed in *reconfigurable video coding-bitstream syntax description language* (3.14)]. In order to be a complete behavioural model [i.e. *abstract decoder model* (3.1)] an RVC *decoder description* (3.6) needs to make reference to the behaviour of each FU that is provided in terms of I/O behaviour by the *MPEG video tool library* (3.12) specified in ISO/IEC 23002-4.

3.6
decoder description
DD
description of a particular decoder configuration, which consists of two parts: *FU network description* (3.9) and *bitstream syntax description* (3.2)

3.7
decoding solution
implementation of the *abstract decoder model* (3.1)

3.8
functional unit
FU
modular tool which consists of a processing unit characterized by the input/output behaviour

3.9
FU network description
FND
FU (3.8) connections used in forming a decoder which are modelled using *FU network language* (3.10)

3.10
FU network language
FNL
language that describes the *FU network description* (3.9), known also as a "network of FUs"

3.11
model instantiation
building of the *abstract decoder model* (3.1) from the *decoder description* (3.6) [consisting of the *bitstream syntax description* (3.2) and the *FU network description* (3.9)] and from *functional units* (3.8) from the *video tool library* (3.16)

Note 1 to entry: During the model instantiation, the parser FU is reconfigured according to the BSD or loaded from VTL.

3.12
MPEG video tool library
MPEG VTL
video tool library (3.16) that contains *functional units* (3.8) defined by MPEG, that is, drawn from existing MPEG International Standards

3.13
reconfigurable video coding
RVC
framework defined by MPEG to promote coding standards at tool-level while maintaining interoperability between solutions from different implementers

3.14
reconfigurable video coding-bitstream syntax description language
RVC-BSDL
pertinent subset of *bitstream syntax description language* (3.3), which is defined within the scope of the current *reconfigurable video coding* (3.13) framework

3.15
token
data entity exchanged between input and output among *functional units* (3.8)

3.16
video tool library
VTL
collection of *functional units* (3.8)

4 Functional unit network description

4.1 General

The FUs in MPEG RVC are specified by

— the textual description in ISO/IEC 23002-4, and

— the RVC-CAL reference software.

The RVC-CAL language is formally specified in Annex D, and the classification of FUs according to the dataflow computation model of RVC-CAL is informatively described in Annex E.

The Functional Unit Network Language (FNL) is specified in this subclause and is used to describe networks of FUs. FNL is derived from Extensible Markup Language (XML) which was in turn derived from SGML (ISO 8879). The ADM consists of a number of FUs with input and output ports, and the connections between those ports. In addition, the ADM may have input and output ports, which may be connected to the ports of FUs or to each other.

A decoder can be described as a network of a number of FUs or even only one FU (e.g. Figure 3).

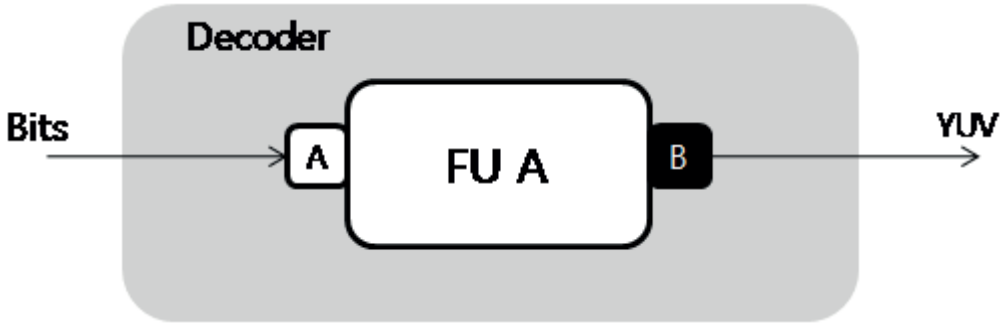

Figure 3 — FU network of one FU

A network of FUs is described in FND. An FND includes the list of selected FUs to form the decoder and the three types of connections: connections between FUs (type A), connections between decoder inputs and FU inputs (type B), and connections between FU outputs and decoder outputs (type C), which are illustrated in Figure 4.

The list of selected FUs (Figure 4) is described in FND according to Table 1. When selecting FUs from VTL, the IDs and names of FUs defined in ISO/IEC 23002-4 shall be used in the FND. The parameter assignments in the listed FUs are supported in the FND, but optional.


```
<Instance id="FU A">
        <Class name="Algo_Example1"/>
</Instance>
<Instance id="FU B">
        <Class name="Algo_Example2"/>
</Instance>
```

The connections (type A, type B, and type C shown in Figure 4) are described in FND as shown in Table 1.

Table 1 — Connection types

Type A	`<Connection src="FU A" src-port="B" dst="FU B" dst-port="D"/>` `<Connection src="FU A" src-port="C" dst="FU B" dst-port="E"/>`
Type B	`<input src="FU A" src-port="A"/>`
Type C	`<output src="FU B" src-port="F"/>`

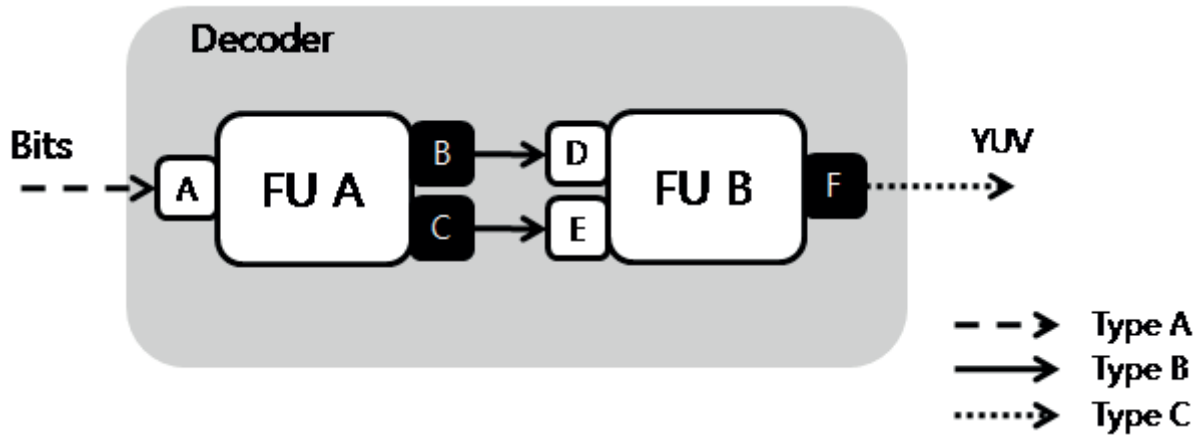

Figure 4 — Three types of connections in an FU network

Another example of FU networks with four FUs is illustrated in Figure 5. The textual description of Figure 5 in FND is described as follows.

```
<XDF name="Decoder">
<Instance id="Syntax parser">
   <Class name="syntax parser">
</Instance>
<Instance id="FU A">
   <Class name="Algo_ExamFU_A">
</Instance>
<Instance id="FU B">
   <Class name="Algo_ExamFU_B">
</Instance>
<Instance id="FU C">
   <Class name="Algo_ExamFU_C">
</Instance>
<Input src="Syntax Parser" src-port="A"/>
<Output src="FU C" src-port="R"/>
<Connection src="Syntax Parser" src-port="B" dst="FU A" dst-port="E"/>
<Connection src="Syntax Parser" src-port="C" dst="FU A" dst-port="F"/>
<Connection src="Syntax Parser" src-port="D" dst="FU B" dst-port="K"/>
<Connection src="FU A" src-port="H" dst="FU C" dst-port="O"/>
<Connection src="FU B" src-port="L" dst="FU C" dst-port="P"/>
<Connection src="FU B" src-port="M" dst="FU C" dst-port="Q"/>
</XDF>
```


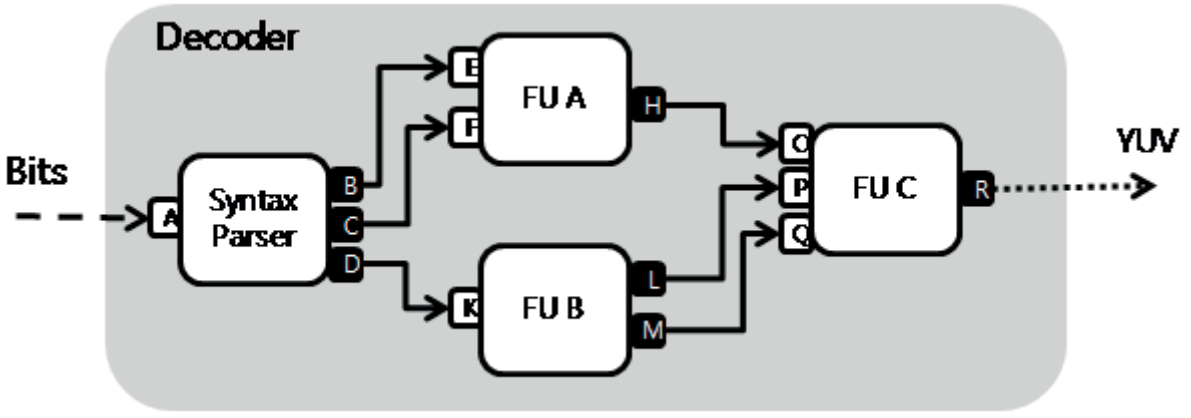

Figure 5 — Another example of FU networks

4.2 Specification of an FU network

The XML structures with names of elements, such as Decl, Network, Package, Expr, etc. are described in the specification of FNL in Annex A. In addition, attributes that direct an individual element's features are also introduced there. Attribute names will be prefixed with "@". For instance, common attribute names are @id, @name or @kind. In cases where an element name may be qualified by the value of an attribute, square brackets are used. For instance, in order to express the notion of an Expr element whose @kind attribute is the string "literal", Expr[@kind="literal"] is written.

By using the RVC-CAL model, FNL also allows FU networks and individual FUs to be parameterized. In particular, it is possible to pass bounded values for specific parameters into FU and FU networks. These values are represented by Expr and Decl syntax. Expr and Decl are the syntactical constructs describing a computation, which may, itself, be dependent upon the values of parameters which are either global or local variables.

5 Bitstream syntax description

The MPEG video tool library contains FUs that specify MPEG decoding tools. A new decoder configuration implies new bitstream syntax. The description of the bitstream syntax in RVC is provided using BSDL as specified in ISO/IEC 23001-5 and the BSDL schema. However, to facilitate the developments of synthesis tools that are able to generate parsers directly from a BSD (i.e. a BSDL schema), the RVC framework standardizes a version of BSDL called RVC-BSDL specified by including new RVC specific extensions and usage restrictions of standard BSDL in ISO/IEC 23001-5. Such extensions and restrictions versus the MPEG standard BSDL are defined in Annex C. RVC-BSDL contains all information necessary to parse any bitstream compliant with such syntax. The procedure to instantiate the parser capable of parsing and decoding any bitstream compliant with the syntax specified by the RVC-BSDL schema is not normative. Examples of such non-normative procedures are provided in Annex I.

6 Model instantiation

This clause describes the model instantiation process which consists of the selection of Functional Units (FUs) from the video tool library and instantiation of the FUs with the proper parameter assignments. The instantiation process requires the following information:

— video tool library;

— FU network description;

— bitstream syntax description.

The instantiation process consists of attaching the source code corresponding to the FUs identified in the FND in order to build a complete model that can be simulated. The video tool library is a library of source code of all FUs standardized in ISO/IEC 23002-4. The FND contains only the references (names of the FUs) to the pieces of code in the VTL. The process outputs the ADM. Figure 6 illustrates the model instantiation process.

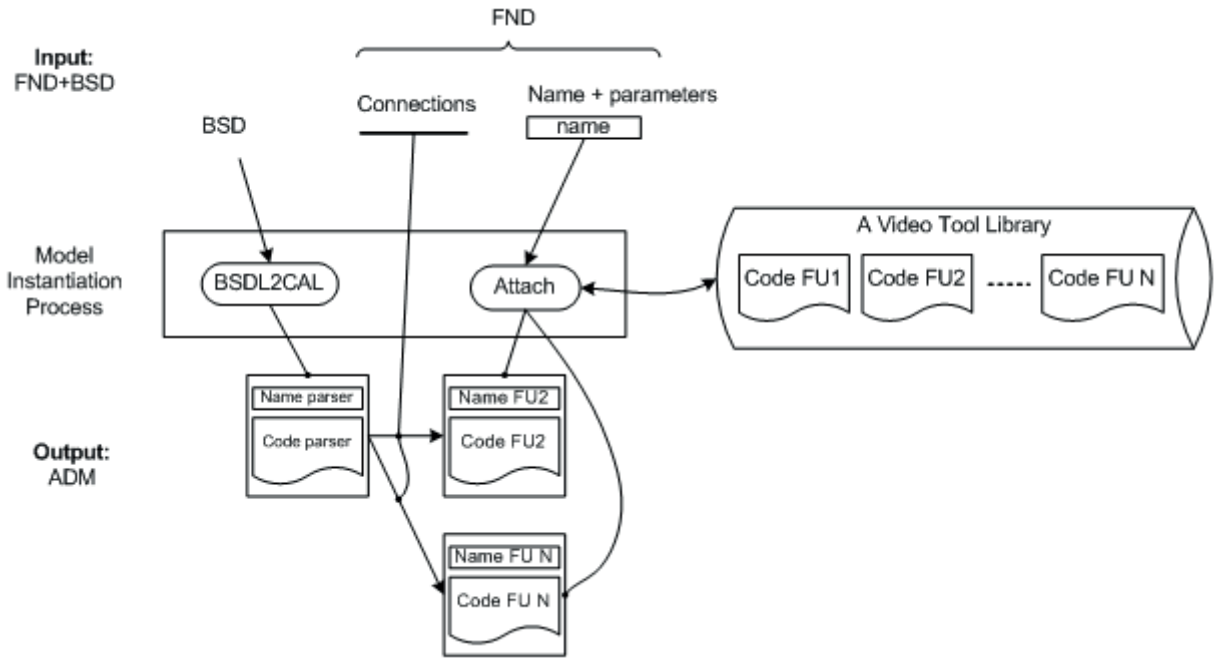

Figure 6 — Description of the model instantiation process

The FU Network Description (FND) provides the structure of the decoder by giving the names of the FUs composing the decoder and their respective connections among them. The name of the instance of the FU in the ADM is contained in the tag `<instance id="...">`. For instance, the attribute `rvc:port` (See C.4.4.5) indicates the name of the instance of the FU into the ADM to which this element of syntax is sent. The tag `<parameter>` provides the values of the parameters, which shall be used for the instantiation of the FU in the ADM.

The Bitstream Syntax Description (BSD) provides the structure of the bitstream. The parser is generated automatically from the BSD. Informative examples are provided in Annex I for building the parser. The syntax parser FU of the ADM might use other FUs to parse the bitstream. Thus, a clear link between identifiers inside the BSD and the FND shall be established. The tag `<rvc port="...">` indicates the name of the instance of the FU into the ADM to which this element of syntax is sent.

NOTE The FND could include instances of FUs that represent input and output to/from the network. Informative technical descriptions for the input/output FUs can be found in Annex F.