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Technical Specifications for
Digital Multimedia Broadcasting (DMB)
Radio Deployment in France

Context

In accordance with WorldDMB Receiver Profiles issued in September 2008 and with the updated signaling defined for DMB Radio (TS 102 428 [1] v1.2.1 (2009-04)) , the Technical Specification for DMB Radio deployment in France is updated.

History version:

Date	Comment
June 24, 2008	v1.0 initial release
March 17, 2009	v2.0 updated release: - 16 bits Service Identifier for DMB Radio - Added recommendation for DLS. - Updated audio object restriction in T-DMB audio profile 2 - AVC/H.264 not mandatory anymore but recommended - On air terminal update is cancelled - Cosmetics modifications
August 25, 2009	V2.01 - Reference editing

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1. Introduction

The purpose of this document is to propose the technical recommendations needed for the deployment of DMB¹ radio services in France. The intent is to focus on the specific parts of the T-DMB standard that will be used to build radio services in France so that radio receivers manufacturers can take full advantage of available digital radio features.

In this document, several words are used to signify technical recommendations. These words must be interpreted as follows:

- *MUST: This word, or the terms "REQUIRED" or "SHALL", mean that the recommendation is an absolute requirement. Receivers that do not follow this recommendation will offer an unacceptable service to customers and will not be suitable for receiving DMB Radio in France.*
- *SHOULD: This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore this recommendation, but DMB radio receiver manufacturers must understand and carefully weigh the full implications for the quality of the digital radio service on their device before choosing a different course. A DMB radio receiver which does not follow such a recommendation MUST be prepared to cope with T-DMB services featuring these RECOMMENDED options, though perhaps with reduced functionality or/and a degraded radio service quality.*
- *MAY: This word or the adjective "OPTIONAL", mean that a recommendation is optional. One DMB radio receiver manufacturer may choose to follow this recommendation because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may not follow this recommendation. A DMB radio receiver which does not support such an option MUST guaranty that the reception of a DMB radio service featuring this option will be properly handled as if the DMB radio service would not feature this option."*

2. Definitions

Two definitions have been introduced in the updated T-DMB specification (v1.2.1):

- **radio service:** DMB video service composed of (at least) one audio object, (at least) one auxiliary media object and one optional video object
- **television service:** DMB video service composed of one video object, (at least) one audio object associated with the video object and optional auxiliary media objects

The technical specifications of this document are based on DMB radio services to be deployed in France. The recommendations of this document therefore target DMB radio receivers.

3. T-DMB audio profiles

The T-DMB standard [1] currently defines two service profiles. Both T-DMB profiles are based on the same video encoding technique (MPEG-4 AVC/H.264) but offer two different audio encoding methods, both defined in Part 3 of the MPEG-4 standard [10].

¹ Digital Multimedia Broadcasting

Profile 1 uses the MPEG-4 BSAC² encoding method. In this profile, one or two channels are available per audio object. This profile is currently used in South Korea for personal mobile television and some radio programs. This profile won't be used in France.

Profile 2 uses the standardized HE-AAC³ v2 also selected for the DVB-H⁴[3], DRM⁵[4] and DAB+⁶[5] standards. This audio encoding method (using 1024 samples wide IMDCT in T-DMB) is described in the ISO/IEC 14496-3:2001/Amd.4 document. MPEG-Surround can additionally be proposed to provide 5+1 DMB radio services as defined in the DAB family. Please refer to Annex C for more information.

Parameter	Value
Sampling frequency	24 kHz; 32 kHz; 48 kHz
AAC core sampling rate	If SBR is used, the sampling rate of the AAC core must be half the output sampling rate. If SBR is not used, the sampling rate of the AAC core must be equal to the output sampling rate.
Number of channels	1, 2 (up to 5 + LFE using MPEG Surround)
Number of objects	1
Maximal bitrate	192kbps
IMDCT width	1024 samples
Allowed tools	Spectral Band Replication, Parametric Stereo, MPEG Surround

Table 1: Audio object restrictions for DMB Profile 2

Use of T-DMB profiles

Receivers MUST be able to decode the profile 2 of the DMB specification.

MPEG Surround

Receivers MAY decode MPEG Surround. When not supported, **receivers MUST at least decode the stereo components of the MPEG Surround signal.**

² Bit Sliced Arithmetic Coding

³ High Efficiency Advanced Audio Coding

⁴ Digital Video Broadcasting - Handheld

⁵ Digital Radio Mondiale

⁶ Digital Audio Broadcasting

Audio dynamic bitrate without AAC decoder reconfiguration

DMB Radio audio bitrate will be selected by broadcasters according to audio sources (voice only, voice and jingles, high quality music...) and desired associated data.

DMB radio receivers **MUST** dynamically adapt to bitrate changes.
The audio elementary stream (maxBitrate) and the required size of the decoding buffer (bufferSizeDB) will be signaled in the MPEG-4 audio object description (DecoderConfigDescriptor).

Dynamic AAC decoder reconfiguration

Digital Radio broadcasters may dynamically change the number of audio channels (e.g. stereo to mono) or the encoding parameters (e.g. stereo to MPEG Surround) according to audio sources (voice only, voice and jingles, high quality music...) and desired associated data.

Receivers SHOULD handle dynamic reconfiguration of AAC decoder.

Service including several audio components

Receivers MAY be able to decode radio services that include several audio components. The appropriate audio stream will be selected through activation mechanisms triggered automatically from the MPEG-4 scene through audio object references or by user action through the MPEG-4 graphic interface, as defined in the DMB standard.

If no MPEG-4 elementary stream selection mechanism is available, **receivers MUST consider the first audio stream defined in the PMT as the main audio stream.**

Audio signaling

HE-AAC v2 uses two optional tools: spectral band replication (SBR) and parametric stereo (PS). To ensure the best audio quality, **receiver MUST at least handle the explicit backward compatible signaling method** defined in paragraph 1.6.5 of ISO/IEC 14496-3 [10], to detect SBR data.

4. Associated visual data

In Digital Radio service based on T-DMB standard, two kinds of associated data will coexist:

- *DMB associated data* are tightly coupled with the audio stream. These data will be synchronized with the main audio stream and carried in the MPEG-2 transport stream of the DMB service.
- *Multiplex associated data* are common to the whole multiplex. This information might be loosely coupled with DMB service (e.g. EPG) or not (e.g. TPEG). They are carried by DAB transport layers.

4.1. DMB Associated data

There are several types of T-DMB visual data that may be associated with the audio stream. Three types of data are described in this section:

- Dynamic Label Segment (DLS) provided as Programme Associated Data (PAD) in MPEG-2 TS packet headers and synchronized with the audio stream. DLS provides limited text information which can be exploited by simple alphanumeric displays.
- BIFS data, made up of one or more MPEG-4 elementary streams which are synchronized with the audio stream. BIFS is responsible for the spatial and temporal composition of graphic primitives (e.g. rectangle and text) and media elements (e.g. images) into an interactive presentation. Recommendations concerning MPEG-4 BIFS only apply to radio receivers featuring a graphic display.
- Video data is an MPEG-4 elementary stream that is synchronized with the audio stream and allows displaying timed images. Only fixed logo or slideshows will be used for DMB radio.

Note:

All these DMB associated data are tightly related to the main audio stream, and will be precisely synchronized with it.

4.1.1. DLS (Dynamic Label Segment)

As defined in the DMB specification, TS 102 428 [1] v1.2.1 (2009-04), DLS data will be signaled in DMB radio services by the activation of the "private transport data" flag of a MPEG-2 TS packet header and included in PAD field transported in the "transport private data" field of this MPEG-2 TS packet header.

Display of DLS

**Receivers with a basic alphanumeric display MUST display DLS data.
In-car products a basic alphanumeric display SHOULD display DLS data.**

4.1.2. BIFS service descriptions

As planned by the government's decree concerning digital radio, DMB radio receivers should at least be compatible with the BIFS profiles [12] identified in the DMB standard [1] (see

Appendix A: MPEG-4 BIFS for additional information):

- **BIFS Core2D@Level1 profile for graphics elements (Graphics Profile)**, which specifies the BIFS graphics elements authorized in the MPEG-4 scene.

- **BIFS Core2D@Level1 profile for scene graph (Scene Graph Profile)**, which specifies the authorized structuring elements of an MPEG-4 scene.

BIFS engine

Digital Radio providers should have the possibility to produce their T-DMB services with the largest flexibility: rich interactive services with MPEG-4 BIFS only, video services with MPEG-4 AVC/H.264 (and minimal MPEG-4 BIFS) or a combination of both depending of application scenarios.

A BIFS engine MUST be included into T-DMB terminals featuring a graphic display.

Extension of BIFS Profile of DMB

The T-DMB⁷ [1] standard specifies the MPEG-4 BIFS profiles which define an interactive service that is synchronized with the audio stream. Indeed, sections 5.5.1 and 5.5.2 of the T-DMB standard directly refer to the Core2D@Level1 profiles for graphics elements and the scene graph.

In order to provide extension mechanisms to these interactive services, **T-DMB receivers SHOULD support multimedia services that contain multiple interactive services.** These advanced T-DMB services are composed of one or more basic MPEG-4 BIFS elementary streams with different profiles, one of which has to be the Core2D@Level1 profile for graphics elements and the Core2D@Level1 profile for the scene graph.

The various interactive services available for a given T-DMB multimedia service are listed in the Program Map Table that describes the MPEG-2 TS program by defining several IOD⁸s, (one IOD per interactive service). It is up to the terminal to select the interactive service whose profiles (as described in IOD according to the applicable standard) correspond to its MPEG-4 BIFS decoding capability (see Appendix B: MPEG-4 use on MPEG-2).

Note: Some advanced services produced by members of the GRN may have enhanced BIFS graphics features compared to the BIFS core2D component and will be properly signaled as BIFS profile extensions.

⁷ Terrestrial Digital Multimedia Broadcasting

⁸ Initial Object Descriptor

Dependencies between BIFS streams

The MPEG-4 Systems standard [15] allows to define dependencies between basic MPEG-4 streams (for additional information, refer to section 8.7.1.5). The T-DMB standard [1] allows to decompose an interactive BIFS service into several complementary streams: an independent stream and several enhancement streams that depend on the main stream.

In order to reduce the cost of the BIFS scene stream carousel, which should be less than 500ms according to the T-DMB standard [1], **T-DMB receivers MUST implement MPEG-4 streams dependency mechanisms, as specified by the MPEG-4 Systems standard for MPEG-4 BIFS streams.**

As per the MPEG-4 Systems standard, descriptions of basic MPEG-4 streams (ES_Descriptors) that are dependent (streamDependenceFlag=1) will be aggregated within a given OD and could be selected to build an alternate scene.

4.1.2.1. Fonts

Text rendering in BIFS is mainly based on the availability of character fonts on the T-DMB terminals. It is therefore possible to directly specify the font selected for a paragraph (Arial for example) in BIFS, or to specify a generic family such as *Serif* (Times New Roman for example), *Sans* (Helvetica) or *Typewriter* (Courier). The only requirement for MPEG-4 BIFS terminals is that the *Serif*, *Sans* and *Typewriter* families must be supported by allocating a font that supports requirements specified in section 7.10 of the MPEG-4 BIFS [12] standard.

Pre-installing fonts

In order to avoid the use of images to display textual contents, **a set of royalty-free fonts SHOULD be natively installed on digital radio terminals**, so that the text appears as desired by the content authors. This is critical for static page layout using tools available in BIFS Core2D@Level1.

Manufacturers who choose to install their own set of fonts shall therefore respect the metrics of the standard set of font defined above. To ensure the layout of the BIFS scene appears on the screen as designed, **the metric of custom fonts MUST matches the metric of the fonts chosen by the GRN.**

Note:

One limitation of MPEG-4 BIFS core2D@Level1 profile is that the layout is static. This induces that a text object with a size different than foreseen will break up the whole scene layout.

A pack of 3 royalty-free fonts (Iso-latin 1) should be pre-installed on receivers.

Deja Vu Serif has been chosen as one of the 3 fonts.

4.1.2.2. Images

The use of images in MPEG-4 BIFS presentations allows to include natural images as well as complex synthetic images (logos, for example). A frequent carousel of images displayed on the main part of the BIFS service is required to guarantee acceptable access times to the service, although it uses extensive bandwidth. These images can be displayed as soon as

received to build a slideshow but they can also be accessible through user's interaction or buffered.

Image formats

T-DMB receivers **MUST support JPEG and PNG** Image format. Additionally, **transparency as allowed by PNG MUST be supported.**

Image buffering

In order to offer fast navigation through a DMB Digital Radio broadcasted service, **receivers MUST buffer images Elementary Streams upon reception** even if some images may not be currently activated or visible in the MPEG-4 scene. This buffer will not exceed 100Ko and is essential to guarantee a comfortable access to interactive content without unacceptable delays when all main images are locally available on the DMB receiver.

Additionally, **DMB receivers MAY decode broadcasted images upon reception** even if they are not activated or visible in the current MPEG-4 scene to avoid decoding delays when browsing the BIFS service of a radio program.

DMB receivers **SHOULD allocate an image decoding buffer of at least 1Mo** in order to cache all decoded images of a T-DMB service and offer a comfortable navigation to the user.

The image ES buffer and/or the image decoding buffer management can be performed by monitoring the image ES deletions and/or updates in PMT, ISO/IEC14496 Sections headers or OD Insert/Update/Delete. This buffer allocation can also be complemented with the tracking of referenced images in the MPEG-4 scene.

4.1.2.3. Interaction modes

MPEG-4 BIFS scene graph (Core2D@Level1) offers two user interaction modes:

- TouchSensor: an event triggered by the interaction with a visual zone (via a mouse, touch-screen, etc.).
- InputSensor: an event triggered by the interactive device (keyboard, joystick, etc.).

The T-DMB terminal manufacturer is in charge of the link between the various keys on the interactive device (physical T-DMB terminal) and the events generated by an *InputSensor* (*keySensor*).

Navigation paradigm

In order to ensure navigation modes consistency between different digital radio services, **T-DMB terminal SHOULD offer a common navigation interface which will be used by all MPEG-4 BIFS services.** This common navigation interface is composed of 5 actions which triggers events at the scene level that are identified through hexadecimal codes:

Action	code
OK	0x0C
UP	0x11
DOWN	0x12
LEFT	0x13
RIGHT	0x14

Optionally, **additional actions MAY also be available through the terminal interface.** In that case, it is recommended to assign the following hexadecimal codes that will be used as interactivity extensions by content provider:

Action	code
Extension 1	0x01 or 0x31
Extension 2	0x02 or 0x32
Extension 3	0x03 or 0x33
Extension 4	0x04 or 0x34
Extension 5	0x05 or 0x35
Extension 6	0x06 or 0x36
Extension 7	0x07 or 0x37
Extension 8	0x08 or 0x38
Extension 9	0x09 or 0x39

Note: It is important that BIFS navigation does not interfere with other navigation modes at the DAB level: radio station switching, Transport Protocol Experts Group (TPEG), navigation in MP3 player mode...

4.1.3. Video service

A fixed logo or slideshow can be displayed by the video component of the DMB service [1] or by a BIFS component, using Image objects.

As described in the DMB standard, receivers should comply with MPEG-4 AVC/H.264 Baseline level 1.3 profile.

Receivers with graphic display

Video services in Digital Radio are used to broadcast fixed logo or image slideshow. The bitrate of these video services is therefore quite low.

DMB radio receivers featuring a graphic display SHOULD decode and display these low bitrates AVC/H.264 video streams.

DMB radio services without any video stream

Receivers MUST support DMB radio services without any video stream as described in TS 102 428 [1] v1.2.1 (2009-04). In that case, no video Elementary Stream is signaled either in the MPEG-4 scene (as exemplified in Section A.3.1 of the DMB standard [1]) nor in the Program Map Table (PMT).

Moreover, the T-DMB Digital Radio interactive services that do not use a video component will not reference a video object in the MPEG-4 scene. Therefore, **a video decoder SHOULD only be activated when a video object is defined in the MPEG-4 scene.**

DMB receivers SHOULD support the dynamic activation of a video stream that is properly signaled: updated PMT including the new video ES, OD update inserting a video object, BIFS update inserting a video object in the current MPEG-4 scene.

4.2. Multiplex Data Services

These are the services offered by the DAB which are not associated with a specific program. These services are usually carried using packet or MSC data sub-channels. This section describes the different services that will be broadcasted in France.

4.2.1. TPEG

TPEG broadcasting will follow TISA forum recommendation.

4.2.2. Electronic Program Guide

The Electronic Program Guide (EPG) used by the DAB standard is also used for DRM [4]. The EPG format is described in two standards [7] and [8].

The TS 102 818 standard [9] describes the format used to edit the electronic program guide content. This is based on XML language and can be used as an exchange format.

The other standard [9] describes the EPG binary conversion and transport process.

EPG is transmitted in one or more dedicated sub-channels which use the MOT directory transport mode. Maximum usable size is 128kbps.

Within a given sub-channel, each program group will use a separate MOT packet identifier.

For each program, the presence of an associated EPG will be as specified in the standard [9] via FIG 0/13.

Two receiver profiles have been defined:

Basic: designed for simple receivers; EPG size is reduced (receivers with 25KB memory), and compression cannot be used. The list of attributes available in this profile is defined in appendix A to the TS 102 371 standard [8].

Advanced: data compression is authorized and all attributes defined in the TS 102 371 standard [8] can be used.

Each multiplex will carry the EPG for all its programs.

Using the packet mode with FEC

In order to unify EPG and DMB service coverage areas, the EPG broadcast in a dedicated sub-channel may use the protection mechanism defined in the DAB packet mode [6].

This protection mechanism MAY be handled by T-DMB radio receivers.

Receiver MUST be able to decode EPG data even if the FEC is not supported.

EPG dimension

When EPG is present, the minimum information for one audio service are Current and Next.

The receiver MUST implement the Basic profile as defined into ETSI TS 102 818.

4.2.3. Date and time synchronization

Advanced features such as *back to start* or *scheduled recording* will be tightly coupled with precise timing information. For these services to work properly, the internal clock of the terminal should be synchronized with the multiplexer clock. In DAB, this synchronization is made possible by the use of the FIG 0/10.

Date and time Synchronization

T-DMB terminals SHOULD be able to keep their internal clock on time using FIG 0/10 facility.

5. DAB multiplex information

5.1. Multiplex organisation

Dynamic sub-channels bitrates

The bitrates of the different sub-channels could be dynamically modified. **The receivers SHOULD smoothly handle such dynamic changes.**

5.2. Network continuity

In France, T-DMB and FM networks will coexist for years. A complete coverage of the French population with T-DMB digital radio is expected by 2011. DMB receivers should preferably enable RDS FM reception and implement automatic program tracking. For a given program, receivers should favor digital service rather than analog service.

Continuity from a DMB service to an alternate network is defined in the DAB standard [6]. This standard allows to indicate alternate frequencies such as DMB, DAB, DAB+, FM, DRM or AM.

5.2.1. Signalisation of DMB-radio streams.

DMB radio service must be signaled as described in TS 102 428 [1] v1.2.1 (2009-04) using a 16bit Service Identifier.

Signaling DMB radio services with an 16 bits Sid

Receivers MUST support the utilization of a 16-bits Sid to signal a DMB radio as program service.

5.2.2. FM RDS to DMB

The signaling of DMB services with a 16 bits Sid (See paragraph 4.1) will ensure the use of RDS to declare DMB services as it is already possible for DAB services as described in document EN 301 700 [14].

5.2.3. DMB to FM RDS

Continuity from a DMB service to FM network is defined in the DAB standard [6]. This standard allows to indicate alternate frequencies.

Mapping table between PI RDS and FM frequencies

Alternative FM RDS services can be signaled in type 0/6 FIG. If 0/6 FIG is used and no additional information on frequency are provided in the multiplex (for instance using type 0/21 FIG), **receivers SHOULD build its own mapping table RDS PI to FM Frequencies** by scanning the FM band.

5.2.4. FM / DMB audio matching

Audio delay

To limit audio delay for the end user, FM will be delayed. The overall network chain (encoder, interleaver, multiplexer and transport), is taken into consideration at transmitter side to arrange a **fixed 1 second delay** at receiver side (FM later than DMB).

Receivers MAY adapt their internal DMB/FM switching strategy according to this delay to avoid unacceptable mutes.

Audio fading

When the DMB signal is lost and if no alternate network is available, **the sound MAY be correctly cut by a fader of maximum 2 seconds, the display MAY indicate the program is going to be lost.** Then the receiver takes up his own defined backup strategy.

6. DRM (Digital Radio Mondiale)

DRM allows addressing a DMB program as specified in the DRM standard [4]

Appendix A: MPEG-4 BIFS Profiles

1. Description of MPEG-4 BIFS graphics elements

Basic Graphics Elements

The MPEG-4 BIFS standard includes a set of graphics primitives that can be used to:

- display synthetic visual elements (rectangles, for example)
- create texture surfaces (for natural media, for instance)
- define interactive areas (touch-sensitive links).

In BIFS, these graphic elements generally correspond to the geometry (*geometry* node) of a shape (*shape* node). Table 2 shows common graphic elements that are defined in the BIFS standard.

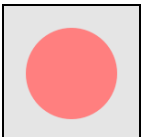
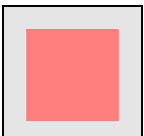

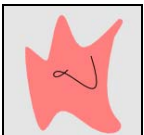
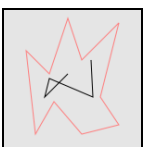

BIFS node	Visual description	
<i>Circle</i>		A circle is a closed surface whose geometric characteristics are defined by its radius
<i>Rectangle</i>		A rectangle is a closed surface whose characteristics are defined by its height and width.
<i>IndexedFaceSet2D</i>		<i>IndexedFaceSet2D</i> is a closed surface whose shape is defined by a list of points linked by segments (the first and the last points close the polygon).
<i>Curve2D</i>		<i>Curve2D</i> is a Bezier curve whose shape is determined by a list of points linked by different types of curves. The resulting polygon can be either closed or open.
<i>IndexedLineSet2D</i>		<i>IndexedLineSet2D</i> is a broken line whose shape is determined by a list of points linked by segments.
<i>Text</i>		The Text node describes a paragraph comprising a character string.
<i>Bitmap</i> geometry is based on the characteristics of shapes with a specific geometry (images, for example). In this case, the Bitmap node simply reproduces the texture by applying a zooming coefficient, if required.		

Table 2: Common BIFS Graphics Elements

Setting parameters for Graphics Elements

Graphics described in Table 2 can be parameterized by different BIFS tools which are applicable, or not, depending on the type of graphics element. Table 3 describes several features.


BIFS node	Visual characteristics
<i>FontStyle</i>	<p><i>FontStyle</i> defines the style of fonts used in a <i>Text</i> node:</p> <ul style="list-style-type: none"> • type of character font • font size • line alignment and spacing in a paragraph • etc. <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p style="text-align: justify;">Le Le Le texte texte texte en en en BIFS BIFS BIFS</p> <p style="font-size: small;">This text is justified according to the length attribute of the text node. This operation is applied on a line basis according to font characteristics (<i>FontStyle</i>)</p> </div>
<i>Coordinate2D</i>	<p><i>Coordinate2D</i> is a generic node, which is used to define a coordinate sequences. For example, it is used to define points in graphics nodes: <i>IndexedFaceSet2D</i>, <i>Curve2D</i>, <i>IndexedLineSet2D</i>.</p>
<i>Material2D</i>	<p><i>Material2D</i> defines a computer-based texture for closed basic graphics elements (rectangles, for example):</p> <ul style="list-style-type: none"> • filling (true or false) • filling color • transparency
<i>LineProperties</i>	<p><i>LineProperties</i> defines the contour of a primary graphics element:</p> <ul style="list-style-type: none"> • line thickness and color • line style (type of dotted line, for example) <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;">  </div>

Table 3: Graphics elements for BIFS parameter setting

2. Description of the MPEG-4 BIFS scene graph

The MPEG-4 BIFS standard includes tools for space, time and interactive composition of multimedia presentations. These elements of the scene graph can be used for:

- Space scene organization: *OrderedGroup, Transform2D*
- Navigation inside presentations: *Anchor, Conditional, Inline, Switch*
- Media insertion: *MovieTexture, ImageTexture, Sound2D, AudioSource*
- Time-based animations: *TimeSensor, ScalarInterpolator, PositionInterpolator2D, CoordinateInterpolator2D, ColorInterpolator, ROUTE*
- Interactivity: *TouchSensor, InputSensor*
- Advanced updates: *Node Update, Route Update, Scene Update*

3. MPEG-4 BIFS Profiles

Two types of profiles are defined for the BIFS standard.

- **The Graphics Profile**, which specifies the BIFS graphic elements authorized in the MPEG-4 scene. The T-DMB standard uses the **Core2D@Level1** profile for graphics elements (see Table 4 and Table 5).
- **The Scene Graph Profile**, which specifies the structuring elements authorized in a MPEG-4 scene. These elements enable description of the space and time organization, hierarchical dependencies and behavior of audiovisual objects. The DMB standard uses the **Core2D@Level1** profile for the scene graph (see Table 9 and et Table 10).

It should be noted that some BIFS tools, as defined in amendments to the MPEG-4 BIFS standard do not appear in any profile (as these profiles have been defined previously). For example, textures with gradients (*LinearGradient, RadialGradient*) exist in the MPEG-4 BIFS standard, but these tools are not yet included in any profile.

Table 4: BIFS Profiles of graphics elements

BIFS tools for graphics elements	Graphics Profiles					
	Simple 2D	Simple 2D + Text	Core 2D	Advanced 2D	Complete 2D	Complete
<i>Appearance</i>	X	X	X	X	X	X
<i>Background2D</i>		X	X	X	X	X
<i>Bitmap</i>	X	X	X	X	X	X
<i>Circle</i>			X	X	X	X
<i>Color</i>			X	X	X	X
<i>Coordinate2D</i>			X	X	X	X
<i>Curve2D</i>				X	X	X
<i>FontStyle</i>		X	X	X	X	X
<i>IndexedFaceSet2D</i>			X	X	X	X
<i>IndexedLineSet2D</i>				X	X	X
<i>LineProperties</i>				X	X	X
<i>Material2D</i>		X	X	X	X	X
<i>MaterialKey</i>				X		
<i>MatteTexture</i>				X		
<i>PixelTexture</i>			X	X	X	X
<i>PointSet2D</i>					X	X
<i>Rectangle</i>		X	X	X	X	X
<i>Shape</i>	X	X	X	X	X	X
<i>Text</i>		X	X	X	X	X
<i>TextureCoordinate</i>				X	X	X
<i>TextureTransform</i>				X	X	X

NOTE: audio3D profiles and 3D graphics elements do not appear in this table

The DMB standard[1] restricts the use of the Core2D profile to Level 1 for graphics elements (**Core2D@Level1**).

Table 5: Level 1 Restrictions for BIFS Graphics Core2D profile

Nodes	Restrictions
<i>Appearance</i>	<i>textureTransform</i> is not supported
<i>Background2D</i>	Only 1 <i>Background2D</i> node per scene associated with a color or a background image. <i>set_bind</i> is not supported
<i>Bitmap</i>	No restriction
<i>Circle</i>	No texture mapping
<i>Color</i>	Not used at this level (by <i>IndexedFaceSet2D</i>)
<i>Coordinate2D</i>	4 points maximum
<i>FontStyle</i>	No restriction
<i>IndexedFaceSet2D</i>	15 nodes <i>IndexedFaceSet2D</i> maximum in the scene <i>color</i> , <i>colorIndex</i> , <i>colorPerVertex</i> , <i>texCoordIndex</i> are not supported
<i>Re jnot supported</i>	<i>lineProps</i> is not supported
<i>PixelTexture</i>	Maximum picture size: 32x32 8 <i>PixelTexture</i> nodes maximum in the scene
<i>Rectangle</i>	No restriction
<i>Shape</i>	No restriction
<i>Text</i>	<i>maxExtend</i> is not supported 6 480 characters maximum in the scene at a given time

Level 2 of Core2D profile (**Core2D@Level2**) for graphics elements reduces constraints for BIFS services changes with respect to BIFS Graphics Core2D@Level1 profile are described in Table 6. It should be noted that Level 2 in BIFS Graphics Core2D profile **is not** the level required by the DMB standard [1].

Table 6: Level 2 Restrictions for Graphics Core2D profile (vs Core2D@Level1)

Nodes	Restrictions
Color	255 colors maximum in the scene at a given time
Coordinate2D	255 points maximum in the scene at a given time
IndexedFaceSet2D	31 <i>IndexedFaceSet2D</i> nodes maximum in the scene <i>colorIndex</i> , <i>colorPerVertex</i> , <i>texCoordIndex</i> are not supported

The Advanced2D graphics elements profile comprises two levels (like the Core2D profile). The **Advanced2D@Level1** profile allows the use of new nodes and also reduces constraints for using the Core2D@Level2 profile. These differences are described in Table 7. It should be noted that the BIFS Graphics Advanced2D profile **is not** the profile required by the DMB standard [1].

Table 7: Level 1 Restrictions for Graphics Advanced2D profile (vs Core2D@Level1)

Nodes	Restrictions
<i>Appearance</i>	No restriction
<i>Background2D</i>	No restriction
<i>Circle</i>	No restriction
<i>Color</i>	65 535 colors maximum in the scene at a given time
<i>Coordinate2D</i>	65 535 points maximum in the scene at a given time
<i>Curve2D</i>	255 <i>Curve2D</i> nodes maximum in the scene
<i>IndexedFaceSet2D</i>	255 <i>IndexedFaceSet2D</i> nodes maximum in the scene
<i>IndexedLineSet2D</i>	255 <i>IndexedLineSet2D</i> nodes maximum in the scene
<i>LineProperties</i>	No restriction
<i>Material2D</i>	No restriction
<i>MaterialKey</i>	No restriction
<i>MatteTexture</i>	Only one <i>MatteTexture</i> per scene
<i>Text</i>	12 288 characters maximum in the scene at a given time
<i>TextureCoordinate</i>	65 535 coordinates maximum in the scene at a given time
<i>TextureTransform</i>	No restriction

Level 2 of the Advanced2D profile (**Advanced2D@Level2**) for graphics elements reduces constraints for BIFS services. Changes with respect to the BIFS Graphics Advanced2D@Level1 profile are described in Table 8; It should be noted that the BIFS Graphics Advanced2D profile **is not** the profile required by the DMB standard [1].

Table 8: Level 2 restrictions for Graphics Advanced2D profile (vs Adv.2D@Level1)

Nodes	Restrictions
<i>Curve2D</i>	32 767 <i>Curve2D</i> nodes maximum in the scene
<i>IndexedFaceSet2D</i>	32 767 <i>IndexedFaceSet2D</i> nodes maximum in the scene
<i>IndexedLineSet2D</i>	32 767 <i>IndexedLineSet2D</i> nodes maximum in the scene
<i>Text</i>	1 048 575 characters maximum in the scene at a given time

The DMB standard [1] uses the **Core2D** profile for the scene graph

Table 9: BIFS Profiles for Scene Graph

BIFS tools for scene graphs	Scene Graph Profiles						
	Basic 2D	Simple 2D	Core 2D	Main 2D	Advanced 2D	Complete 2D	Complete
AnimationStream					X	X	X
Anchor			X	X	X	X	X
AudioBuffer					X	X	X
AudioDelay						X	X
AudioFX						X	X
AudioMix						X	X
AudioSwitch					X	X	X
ColorInterpolator			X	X	X	X	X
CompositeTexture2D						X	X
Conditional			X	X	X	X	X
CoordinateInterpolator2D			X	X	X	X	X
DiscSensor				X	X	X	X
Form						X	X
Group					X	X	X
Inline			X	X	X		X
InputSensor			X	X	X	X	X
Layer2D				X	X	X	X
Layout						X	X
ListeningPoint						X	X
MediaBuffer					X		
MediaControl			X	X	X		
MediaSensor			X	X	X		
OrderedGroup	X	X	X	X	X	X	X
PlaneSensor2D				X	X	X	X
PositionInterpolator2D			X	X	X	X	X
ProximitySensor2D				X	X	X	X
QuantizationParameter			X	?	X	X	X
ScalarInterpolator			X	X	X	X	X
Script					X		X
Sound2D	X	X	X	X	X	X	X
ServerCommand			X	X	X		X
Switch			X	X	X	X	X
TemporalTransform				X	X		
TemporalGroup				X	X		
TermCap					X	X	X
TimeSensor			X	X	X	X	X
TouchSensor			X	X	X	X	X
Transform2D		X	X	X	X	X	X
Valuator			X	X	X	X	X
WorldInfo					X	X	X
Node Update			X	X	X	X	X
Route Update			X	X	X	X	X
Scene Update		X	X	X	X	X	X
ROUTE			X	X	X	X	X
PROTO					X		
PredictiveMF coding					X		

NOTE: Audio and audio3D profiles, as well as BIFS 3D graphics elements, do not appear in this table

The DMB standard[1] restricts the use of the Core2D profile to Level 1 for the BIFS scene graph (**Core2D@Level1**).

Table 10: Level 1 Restrictions for scene graph BIFS Core2D profile

Nodes	Restrictions
Anchor	<i>addChildren</i> and <i>removeChildren</i> are not supported 31 <i>children</i> maximum
AudioClip	<i>pitch</i> , <i>description</i> are ignored
AudioSource	<i>addChildren</i> , <i>removeChildren</i> , <i>children</i> , <i>pitch</i> , <i>speed</i> , <i>numChan</i> , <i>phaseGroup</i> are not supported (no <i>rewind</i> or <i>fast forward</i>)
ColorInterpolator	255 value pairs for <i>key</i>
CoordinateInterpolator2D	31 coordinates per <i>keyValue</i> 255 value pairs for <i>key</i>
ImageTexture	<i>repeatS</i> , <i>repeatT</i> are not supported
Inline	No restriction
Inputensor	Restriction for mice, keyboards and remote controls
MediaControl	<i>mediaSpeed</i> is not supported (no <i>rewind</i> nor <i>fast forward</i>) 31 <i>URLs</i> maximum
MediaSensor	<i>info</i> is ignored
MovieTexture	<i>speed</i> is ignored (no <i>rewind</i> or <i>fast forward</i>) <i>repeatS</i> , <i>repeat</i> are not supported
Node Update	<i>add</i> and <i>remove</i> commands are not authorized for <i>Children</i> fields
OrderedGroup	<i>addChildren</i> and <i>removeChildren</i> are not supported 31 <i>children</i> maximum
PositionInterpolator2D	255 value pairs for <i>key</i>
QuantizationParameter	No restriction
ROUTE	No restriction
ROUTE Update	No restriction
ScalarInterpolator	255 value pairs for <i>key</i>
Scene Update	No restriction
ServerCommand	No restriction
Sound2D	<i>intensity</i> , <i>spatialize</i> , <i>location</i> are not supported
Switch	No restriction
TimeSensor	Ignored if <i>cycleInterval</i> < 0.03 second
TouchSensor	No restriction
Transform2D	<i>addChildren</i> and <i>removeChildren</i> are not supported. <i>center</i> , <i>rotationAngle</i> , <i>scaleOrientation</i> are not supported (only translations and resizing are authorized) 31 <i>children</i> maximum. The negative <i>scale</i> parameter is prohibited
Valuator	No restriction
The maximum number of nodes authorized in a scene that respects the graphCore2D@Level1 scene profile is 8191, including all the instances of these nodes through DEF/USE mechanisms and integrated contents (inline).	

Appendix B: MPEG-4 use on MPEG-2

The initialization procedure for digital radio stations at MPEG-2 TS level can be described using the example given in Figure 1:

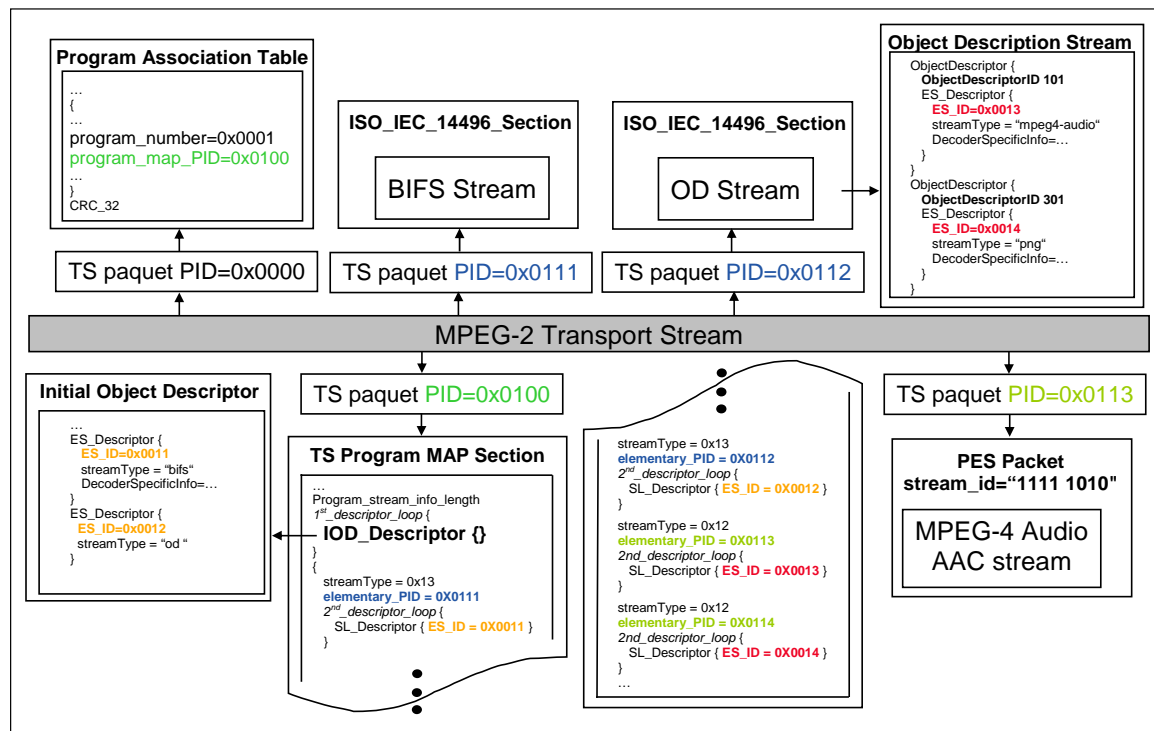


Figure 1: MPEG-2 TS including MPEG-4 data

1. For an MPEG-2 TS data stream, the Program Association Table (PAT) is obtained from the TS packets with PID 0x0000. Then, depending on the program number sought (an identifier that corresponds to a radio station), the PID of the table that describes that program (PMT) is identified.
2. The regular repetition of the PMT table in the MPEG-2 TS stream makes it possible to obtain the PMT associated with the selected program using the PID obtained at step 0 (PID=0x0100 in the example).
3. Within the PMT table, an *IOD_Descriptor* supplies the IOD that makes it possible to initialize the MPEG-4 service.
4. Within the IOD, *ES_Descriptors* supply the information related to the MPEG-4 scene description stream and the MPEG-4 object description stream.
5. MPEG-4 *ES_IDs* defined in the IOD are to be matched with *ES_IDs* defined in the PMT table *SL_descriptors* (*ES_ID*=0x0011 and *ES_ID*=0x0012 in the example)
6. Based on the correspondence between *ES_IDs* defined in the IOD and in the PMT, TS packets whose PIDs are identified can now be processed (PID=0x0111 for the BIFS stream and PID=0x0112 for the OD stream in the example).
7. The MPEG-4 scene description stream processing makes it possible to identify the *ObjectDescriptorIDs* which are used to compose the MPEG-4 service at a given time.
8. The OD stream processing makes it possible to link the *ObjectDescriptorIDs* referred to in the scene to the description of the associated MPEG-4 stream (an audio stream OD_ID=101 and an image stream ID_ID=301 in the example). Then, the associated PID is obtained as at step 5.
9. Processing of each stream referred to in the MPEG-4 scene enables the final composition of the multimedia service (PID=0x0113 for the audio stream, for example).

The conventional syntax of IODs used in T-DMB is illustrated in Table 11.

Number of bits	Parameter description	Value example
InitialObjectDescriptor		
8	<i>InitialObjectDescriptor</i> identifier	0x02
16	Descriptor size	---
10	<i>ObjectDescriptorID</i>	0
1	<i>URL_Flag</i>	0
1	<i>includeInlineProfilesFlag</i>	0
4	<i>Reserved</i>	15
8	<i>ODProfileLevelIndication</i>	0x01
8	<i>sceneProfileLevelIndication</i>	0x0C
8	<i>audioProfileLevelIndication</i>	0x23
8	<i>visualProfileLevelIndication</i>	
8	<i>graphicsProfileLevelIndication</i>	0x04
ES_Descriptor (OD)		
8	<i>ES_Descriptor</i> identifier	0x03
8	Descriptor size	---
16	<i>ES_ID</i>	1
1	<i>streamDependenceFlag</i>	0
1	<i>URL_Flag</i>	0
1	<i>OCRstreamFlag</i>	0
5	<i>streamPriority</i>	0
<i>DecoderConfigDescriptor (OD)</i>		
<i>SLConfigDescriptor (OD)</i>		
ES_Descriptor (BIFS)		
8	<i>ES_Descriptor</i> identifier	0x03
8	Descriptor size	---
16	<i>ES_ID</i>	2
1	<i>streamDependenceFlag</i>	0
1	<i>URL_Flag</i>	0
1	<i>OCRstreamFlag</i>	0
5	<i>StreamPriority</i>	0
<i>DecoderConfigDescriptor (BIFS)</i>		
<i>SLConfigDescriptor (BIFS)</i>		

Table 11: InitialObjectDescriptor example

It should be noted in this example that the value of the *sceneProfileLevelIndication* (0x0C) parameter corresponds in the MPEG-4 BIFS standard to the BIFS Core2D@Level1 scene graph profile and that the value of the *graphicsProfileLevelIndication* (0x04) parameter corresponds in the MPEG-4 BIFS standard to the BIFS Core2D@Level1 graphics elements profile.

Appendix C: MPEG Surround function

MPEG Surround is standardized in ISO/IEC 23003-1:2007 and its technical corrigendum n°1 (Ref. No. ISO/IEC 23003-1:2007/Cor.1:2008)

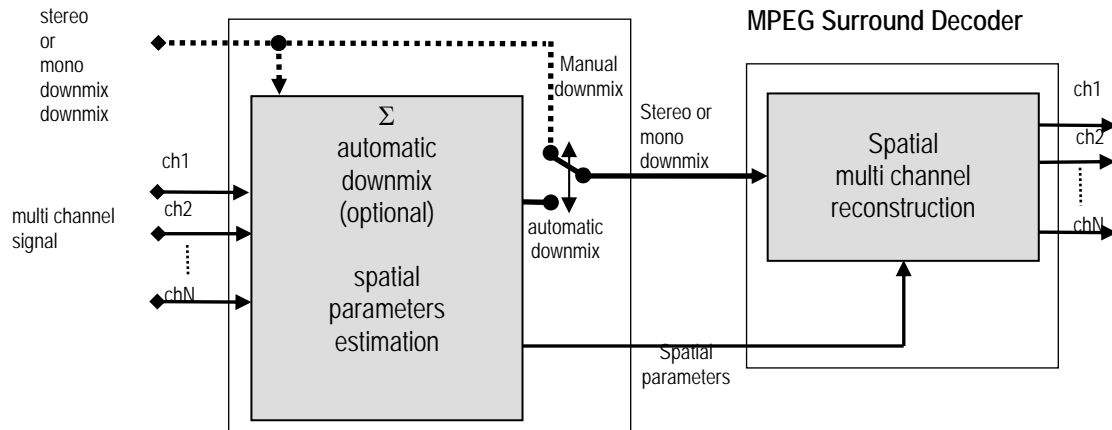


Figure 2 Principle of MPEG Surround

MPEG Surround adds multi channel capabilities to the HE-AACv2 audio codec. The system provides a set of new features such as full backward compatibility to stereo and mono equipment and a broad range of scalability in terms of bit rate used for describing the surround channels. Conventional audio receivers will decode a stereo or mono signal while a device supporting the MPEG Surround extension will provide a high quality multi channel signal.

So, a T-DMB radio service may use MPEG Surround on an optional basis.

In addition to the “normal mode” of operation in the “MPEG Surround Baseline Profile”, MPEG Surround supports an additional set of features such as :

- Binaural Decoding
- External Stereo Mix
- Enhanced Matrix Mode

Binaural Decoding utilizes the downmix, the spatial parameters, and HRTFs supplied to the decoder to create a “surround sound audio experience over headphones”.

In the External stereo mix mode, the MPEG Surround system supports external downmixes. The MPEG Surround encoder analyzes the difference between the internal downmix created by the MPEG Surround encoder and the external downmix. The difference is compensated for at the MPEG Surround decoder side. This allows the broadcaster to have full control of the sound of the transmitted mono or stereo mix.

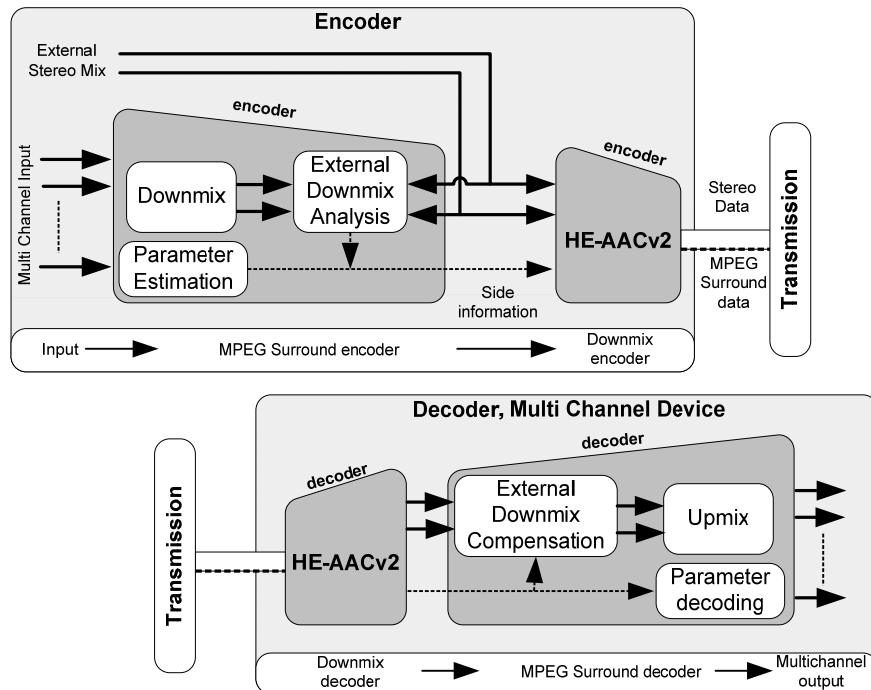


Figure 3 MPEG Surround support for external stereo mix

The **Enhanced Matrixed mode** generate a multi-channel signal based on the downmix without the transmission of MPEG Surround side information. This option can be combined with Binaural Decoding.

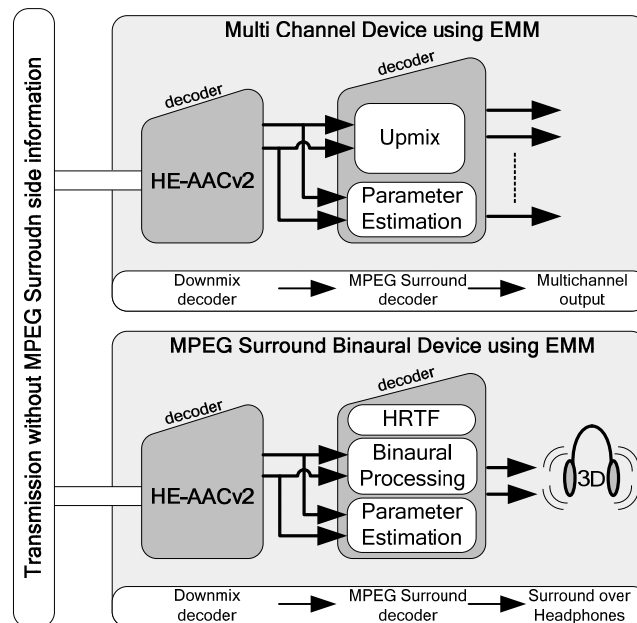


Figure 4 Enhance Matrix Mode decoding

Information regarding the use of MPEG surround in the DAB family (overview, requirements for MPEG Surround encoders and decoders) is provided in ETSI TS 102 563, clause 5.3.

Operational aspects of broadcasting:

It is not mandated that MPEG Surround is used for the lifetime of the service component. When MPEG Surround is used, all audio access units shall contain an extension payload of type EXT_SAC_DATA and the SpatialSpecificConfig() shall be broadcast at least every 500 ms. EXT_SAC_DATA payloads shall be broadcast only when MPEG Surround is used. When MPEG Surround is enabled or its configuration is changed, the first audio access unit of the new configuration shall contain the SpatialSpecificConfig() to allow seamless continuation of audio playback. Changes of the MPEG Surround configuration shall not happen more frequently than each 500ms.

Note: it is assumed that an MPEG Surround configuration is valid for the entirety of a programme item.

Receiver implementation aspects:

A receiver that is capable of decoding MPEG Surround shall probe each audio access unit for the existence of an extension payload of type EXT_SAC_DATA. If an EXT_SAC_DATA extension payload was found, it shall be prepared to decode MPEG Surround.

If EXT_SAC_DATA extension payloads are received, an MPEG Surround capable receiver shall not delay playback for more than 500ms. If it has not received a SpatialSpecificConfig() by then, it shall start decoding and playback of the HE AAC v2 payload, but shall continuously check for the availability of a SpatialSpecificConfig() and then reconfigure itself for the decoding of MPEG Surround.

It is not mandated that an MPEG Surround payload is transmitted for the lifetime of the service component and hence a receiver shall support a change of the MPEG Surround configuration. Depending on the implementation, this may result in a receiver that can reconfigure the audio output or a receiver that always produces multichannel sound output.

In the latter case, the MPEG Surround enhanced matrix mode can be used to generate the multichannel output if no MPEG Surround payload is transmitted.

If a receiver is currently decoding MPEG Surround and an audio access unit with no EXT_SAC_DATA extension payload is received, then the receiver shall assume that MPEG Surround is no longer used and appropriately reconfigure itself.

A receiver shall assume that each reconfiguration is valid at least for the equivalent of 500ms output audio data, hence it shall not reconfigure itself more than two times per second. The receiver must be able to detect and correctly handle changes in the SpatialSpecificConfig().

For the MPEG-Surround restitution with a domestic device (such as a HiFi tuner or a Home Cinema amplifier), manufacturers may provide on their devices 6 external analog outputs and/or an multi channel digital audio stream output (via a S/PDIF or a HDMI interface) re encoded in DTS or Dolby AC3.

Appendix D: List of applicable standards

- [1] ETSI TS 102 428: Digital Audio Broadcasting (DAB); DMB video service; User Application Specification
- [2] ETSI TS 102 427: Digital Audio Broadcasting (DAB); Data Broadcasting - MPEG-2 TS streaming
- [3] ETSI EN 302 304: Digital Video Broadcasting (DVB); Transmission System for Handheld Terminals (DVB-H)
- [4] ETSI ES 201 980: Digital Radio Mondiale (DRM); System Specification
- [5] ETSI TS 102 563: Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio
- [6] ETSI EN 300 401: Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers
- [7] ETSI TS 102 818: Digital Audio Broadcasting (DAB); Digital Radio Mondiale (DRM); XML Specification for DAB Electronic Program Guide (EPG)
- [8] ETSI TS 102 371: Digital Audio Broadcasting (DAB); Digital Radio Mondiale (DRM); Transportation and Binary Encoding Specification for Electronic Program Guide (EPG)
- [9] EBU BPN 027-1 to 6 Transport Protocol Experts Group (TPEG) TPEG Specifications
- [10] ISO/IEC 14496-3 Information technology — Coding of audio-visual objects —Part 3:Audio
- [11] ISO/IEC 23003-1: 2007 Technologies de l'information -- Technologies audio MPEG -- Partie 1: Ambiance MPEG
- [12] ISO/IEC 14496-11:2005 Information technology - Coding of audio-visual objects – Part 11: Scene description and application engine
- [13] ISO/IEC 14496-18:2004 Information technology – Coding of audio-visual objects – Part 18: Font compression and streaming
- [14] ETSI EN 301 700: cross-referencing to simulcast DAB services by RDS-ODA 147
- [15] ISO/IEC 14496-1:2004 Information technology - Coding of audio-visual objects – Part1: Systems