

MHEG-5 Broadcast Profile

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Full standard:
<https://standards.iteh.ai/catalog/standards/sist/0aca7bbb-c9b4-42c5-aec5-f683a15d99a8/etsi-es-202-184-v2.1.1-2010-03>



EBU-UER



Reference

RES/JTC-020

Keywordsbroadcasting, data, digital, DVB, IP, MHEG,
MPEG, terrestrial, TV, video**ETSI**650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:

<http://www.etsi.org>

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at

<http://portal.etsi.org/tb/status/status.asp>

If you find errors in the present document, please send your comment to one of the following services:

http://portal.etsi.org/chaicor/ETSI_support.asp

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2010.

© European Broadcasting Union 2010.

All rights reserved.

DECTTM, **PLUGTESTS**TM, **UMTS**TM, **TIPHON**TM, the TIPHON logo and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members.

3GPPTM is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

LTETM is a Trade Mark of ETSI currently being registered for the benefit of its Members and of the 3GPP Organizational Partners.

GSM[®] and the GSM logo are Trade Marks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	17
Foreword.....	17
Introduction	17
1 Scope	18
1.1 Localizing the present document.....	18
1.1.1 Packages	18
1.1.1.1 Signalling package	18
1.1.1.2 Service Information package.....	18
1.1.2 Extensions.....	18
1.1.3 Allocation of codes	19
1.1.4 Duplicate services	19
2 References	19
2.1 Normative references	20
2.2 Informative references.....	22
3 Definitions and abbreviations.....	23
3.1 Definitions	23
3.2 Abbreviations	25
4 Conventions.....	26
5 Basic architecture	26
6 Transport protocols.....	28
7 Content formats	28
7.1 Static formats.....	28
7.1.1 Bitmap image formats.....	28
7.1.1.1 PNG.....	28
7.1.1.2 MPEG-2 I-frames.....	28
7.1.2 Monomedia formats for audio clips.....	28
7.1.3 Monomedia formats for text	28
7.2 Broadcast streaming formats	28
7.3 Resident fonts	29
7.4 Colour representation	29
8 Application model	29
8.1 Application lifecycle	29
8.1.1 Launching and terminating MHEG-5 applications.....	29
8.1.2 Preparing for launch.....	30
8.1.3 Auto boot broadcast application	30
8.1.3.1 How an auto-boot application is done.....	30
8.1.4 Auto kill application	30
8.1.5 Application context.....	30
8.1.5.1 Initial carousel.....	30
8.1.5.2 Current carousel	30
8.1.5.3 Current source	31
8.1.6 Accessible file systems	31
8.1.6.1 Broadcast applications	31
8.1.6.2 CI introduced applications	31
8.1.6.3 Interaction Channel	32
8.1.7 Keeping an application running across service tunes.....	32
8.1.7.1 Broadcast file system requests	32
8.1.7.2 Timers	32
8.1.7.3 Carousel Identity	32
8.1.7.4 Broadcast file system	33
8.1.7.5 Network and service boot info	33

8.1.7.6	Behaviour of stream decoders	33
8.1.7.7	Content management.....	34
8.1.7.8	Receiver keys	34
8.1.7.9	Interaction with resident programs.....	34
8.1.7.10	Interaction channel security	34
8.2	Application stacking.....	34
9	Signalling	35
9.1	Introduction to application lifecycle signalling	35
9.1.1	Application-level signalling.....	35
9.1.2	Service-level signalling.....	35
9.1.3	Network-level signalling.....	35
9.1.4	Scope	36
9.2	Void.....	36
9.3	PMT and ServiceGateway signalling package	36
9.3.1	Introduction.....	36
9.3.2	Identification of auto-boot application.....	36
9.3.2.1	data_broadcast_id_descriptor.....	36
9.3.2.2	Network boot info sub-descriptor	37
9.3.2.3	Service boot info sub-descriptor	38
9.3.3	Acquisition of the ServiceGateway object.....	38
9.3.3.1	carousel_id_descriptor	38
9.3.4	Acquisition of the auto-boot object.....	39
9.3.4.1	ServiceContextList.....	39
9.3.4.2	Locating the initial object.....	40
9.3.4.2.1	Explicit Initial Object Identified.....	40
9.3.4.2.2	No Explicit Initial Object Identified	40
9.3.4.2.3	Initial File System.....	41
9.3.4.2.4	Example.....	41
9.3.5	Example of steps required for auto-boot	41
9.3.6	Service-level application lifecycle signalling	42
9.3.7	Network-level application lifecycle signalling	42
9.3.7.1	Auto mount broadcast file system	42
9.3.7.2	network_boot_info	42
9.3.7.3	data_broadcast_id.....	43
9.3.7.4	carousel_id	43
9.3.7.5	Carousels moving components.....	43
9.3.7.6	Removal of service.....	43
10	Security.....	43
11	MHEG-5 engine profile.....	43
11.1	Basic specification.....	44
11.2	Object interchange format	44
11.3	Set of classes	44
11.4	Set of features.....	46
11.4.1	GetEngineSupport "feature" strings.....	46
11.4.1.1	VideoDecodeOffset.....	48
11.4.1.2	BitmapDecodeOffset.....	48
11.4.1.3	Engine identification strings.....	49
11.4.1.4	Audio stream decoders	49
11.5	Content data encoding	49
11.5.1	Use of negative hook values	50
11.5.2	Bitmap objects	50
11.5.2.1	Scaling.....	50
11.5.2.2	Tiling.....	50
11.5.2.3	Transparency.....	51
11.5.3	Stream "memory" formats	51
11.5.3.1	Audio.....	51
11.5.4	Non-linear stream formats	51
11.5.4.1	Video.....	51
11.5.4.2	Audio.....	51
11.5.4.3	Subtitles.....	51

11.6	User input	51
11.6.1	Base remote control functions	51
11.6.1.1	Receiver group	52
11.6.1.2	Register 3 group (see table 11.8).....	52
11.6.1.3	Register 4 group (see table 11.8).....	52
11.6.1.4	Register 5 group (see table 11.8).....	52
11.6.2	Extended remote control functions	53
11.6.2.1	Register 6 group (see table 11.9).....	53
11.6.3	UserInput registers	53
11.6.3.1	Base UserInput registers	53
11.6.3.2	Extended UserInput registers	54
11.6.4	Implementation of this interaction model	54
11.6.5	Interaction with broadcast-triggered native applications	54
11.7	Semantic constraints on MHEG-5 applications.....	54
11.8	EngineEvents.....	55
11.8.1	Object retrieval errors	56
11.8.2	Object retrieval errors - Interaction Channel	57
11.9	Protocol mapping and external interaction	57
11.10	ResidentPrograms.....	58
11.10.1	Typical use	59
11.10.2	Program names	59
11.10.3	Encoding of resident program names.....	59
11.10.3.1	Case sensitive names.....	59
11.10.4	Date and time functions	59
11.10.4.1	Day, date and time functions.....	59
11.10.4.2	GetCurrentDate	60
11.10.4.3	FormatDate.....	60
11.10.4.4	GetDayOfWeek.....	61
11.10.5	Random number function	61
11.10.5.1	Random	61
11.10.6	Type conversion functions.....	61
11.10.6.1	CastToContentRef.....	61
11.10.6.2	CastToObjectRef.....	62
11.10.6.3	CastToStringInt.....	62
11.10.7	String manipulation functions.....	62
11.10.7.1	Range of string index values	62
11.10.7.2	GetStringLength.....	63
11.10.7.3	GetSubString.....	63
11.10.7.4	SearchSubString	63
11.10.7.5	SearchAndExtractSubString.....	64
11.10.8	Service selection	64
11.10.8.1	SI_GetServiceIndex	64
11.10.8.2	SI_TuneIndex.....	65
11.10.8.3	SI_GetBasicSI.....	65
11.10.8.4	SI_TuneIndexInfo	66
11.10.8.4.1	Destructive service tune.....	68
11.10.8.4.2	Non-destructive service tune	68
11.10.9	Checking references.....	69
11.10.9.1	CheckContentRef.....	69
11.10.9.2	CheckGroupIDRef	70
11.10.10	Presentation information.....	70
11.10.10.1	VideoToGraphics	70
11.10.10.1.1	Informative note	71
11.10.10.2	SetWidescreenAlignment.....	72
11.10.10.3	GetDisplayAspectRatio.....	72
11.10.10.4	SetSubtitleMode.....	72
11.10.10.5	SetBroadcasterInterruptions	73
11.10.11	Common Interface	74
11.10.11.1	CI_SendMessage.....	74
11.10.12	Interaction channel.....	74
11.10.12.1	GetICStatus	74
11.10.12.2	ReturnData	75

11.10.12.3	MeasureStreamPerformance	76
11.10.12.4	PromptForGuidance	76
11.10.13	Hybrid file system.....	77
11.10.13.1	SetHybridFileSystem	77
11.10.14	Developer utilities.....	78
11.10.14.1	WhoAmI	78
11.10.14.2	Debug	78
11.10.15	Access to application lifecycle signalling	79
11.10.15.1	GetBootInfo	79
11.10.16	Data exchange with ResidentPrograms.....	79
11.10.16.1	Memory spaces	79
11.10.16.2	On invocation.....	79
11.10.16.3	CallSucceeded/ForkSucceeded Values	80
11.10.16.4	During execution.....	80
11.10.16.5	On completion.....	80
11.10.17	Duration of effect of ResidentPrograms	80
11.11	Limitations on standard data-types.....	80
11.11.1	BooleanVariable	80
11.11.2	IntegerVariable	81
11.11.3	OctetString.....	81
11.11.4	ObjectNumber.....	81
11.11.5	GroupIdentifier and ContentReference.....	81
11.12	Extensions to the MHEG-5 language specification.....	81
11.12.1	Preamble	81
11.12.2	Changes to the Group class.....	81
11.12.2.1	Changes to "Own internal attributes"	82
11.12.2.2	Changes to "Events"	82
11.12.2.3	Changes to "Effect of MHEG-5 actions"	82
11.12.3	Changes to the Application class	82
11.12.3.1	Changes to "Own exchanged attributes"	82
11.12.3.2	Changes to "Own internal attributes"	83
11.12.3.3	Changes to "Effect of MHEG-5 actions"	83
11.12.4	Changes to the Scene class.....	83
11.12.4.1	Changes to "Own exchanged attributes"	84
11.12.4.2	Changes to "Own internal attributes"	84
11.12.4.3	Changes to "Events"	84
11.12.4.4	Changes to "Effect of MHEG-5 actions"	84
11.12.5	Changes to the TokenGroup class.....	85
11.12.5.1	Changes to "Effect of MHEG-5 actions"	85
11.12.6	Changes to the ListGroup class.....	85
11.12.6.1	Changes to "Own exchanged attributes"	85
11.12.6.2	Changes to "Own internal attributes"	85
11.12.6.3	Changes to "Effect of MHEG-5 actions"	85
11.12.7	Changes to the Bitmap class	86
11.12.7.1	Changes to "Own internal attributes"	86
11.12.7.2	Changes to "Effect of MHEG-5 actions"	86
11.12.8	Changes to the Text class.....	87
11.12.8.1	Changes to "Own exchanged attributes"	87
11.12.8.2	Changes to "Own internal attributes"	88
11.12.8.3	Changes to "Effect of MHEG-5 actions"	89
11.12.9	Changes to the Stream class.....	90
11.12.9.1	Changes to "Own exchanged attributes"	90
11.12.9.2	Changes to "Own internal attributes"	91
11.12.9.3	Changes to "Internal behaviours"	91
11.12.9.4	Changes to "Effect of MHEG-5 actions"	91
11.12.10	Changes to the Video class	92
11.12.10.1	Changes to "Own internal attributes"	92
11.12.10.2	Changes to "Effect of MHEG-5 actions"	92
11.12.11	Changes to the Slider class	96
11.12.11.1	Changes to "Own exchanged attributes"	96
11.12.11.2	Changes to "Own internal attributes"	96
11.12.11.3	Changes to "Events".....	96

11.12.11.4	Changes to "Internal behaviour"	97
11.12.11.5	Changes to "Effect of MHEG-5 actions"	97
11.12.12	Changes to the HyperText class.....	98
11.12.12.1	Changes to "Own internal attributes"	98
11.12.12.2	Changes to "Events"	99
11.12.12.3	Changes to "Internal behaviours"	99
11.12.12.4	Changes to "Effect of MHEG-5 actions"	100
11.12.13	Changes to the LineArt class	101
11.12.13.1	Changes to "Own exchanged attributes"	101
11.12.13.2	Changes to "Effect of MHEG-5 actions"	101
11.13	Clarifications, restrictions and amendments.....	101
11.13.1	Additional semantics for the SetTimer action.....	101
11.13.2	CounterPosition attribute	101
11.13.3	Synchronous event processing.....	102
11.13.3.1	Preferred interpretation	102
11.13.3.2	Alternative interpretation	102
11.13.3.3	Explanation	102
11.13.4	Actions that generate more than one synchronous event	103
11.13.5	TransitionTo deactivation of shared=FALSE ingredients	103
11.13.6	Interactibles.....	103
11.13.7	Clarification of StreamPlaying and StreamStopped events	103
11.13.8	Use of NextScenes to preload content	104
11.13.9	Application defaults.....	104
11.13.10	Effect of SetData on Internal Attributes	104
11.13.11	Clarification of TransitionTo, Launch and Spawn behaviour.....	104
11.13.12	References to shared=FALSE ingredients	104
11.13.13	Restrictions on Link EventSource	104
11.13.14	Video Termination attribute.....	105
11.13.15	Clarification of Root object destruction behaviour.....	105
11.14	Service Information package	105
11.14.1	Service Information resident programs.....	105
11.14.1.1	SI_GetServiceInfo	106
11.14.1.2	SI_GetEventInfo	107
11.15	PVR extensions	108
11.15.1	PVR Implementation	108
11.15.2	CRID format	108
11.15.3	PVR extension resident programs.....	108
11.15.3.1	PVR_MakeBooking	109
11.15.3.2	PVR_CancelBooking	109
11.15.3.3	PVR_ListBooking.....	110
12	MHEG-5 engine graphics model.....	110
12.1	The graphics plane.....	110
12.2	The colour palette.....	110
12.2.1	Reservation for MHEG-5 applications	111
12.2.1.1	Fidelity of reproduction.....	111
12.2.1.2	Palette definition	111
12.2.2	Reservation for DVB subtitles	112
12.2.3	Subtitle priority for transparency	112
12.2.4	Reservation for manufacturer use	112
12.3	Colour representation	112
12.3.1	Colour space	112
12.3.2	Gamma.....	113
12.3.3	Direct/absolute colours	114
12.3.4	Approximation of transparency	114
12.3.5	PNG modes	114
12.4	Overlapping visibles.....	114
12.4.1	Transparency and overlapping visibles.....	114
12.4.1.1	Overlaying visibles.....	114
12.4.1.2	Rendering performance	115
12.5	LineArt and DynamicLineArt	115
12.5.1	Clarifications.....	115

12.5.1.1	Lineart borders	115
12.5.1.2	"Fat" lines.....	115
12.5.1.2.1	"Fat" lines are centred.....	115
12.5.1.2.2	Clipping at box edge.....	116
12.5.1.3	Line ends.....	116
12.5.1.4	Bordered bounding box.....	116
12.5.1.5	DrawSector.....	116
12.5.1.6	Effect of pixel transparency	116
12.5.1.7	Co-ordinate system.....	117
12.5.2	Limitations	117
12.6	Text, EntryFields and HyperText	117
12.7	PNG bitmaps	117
12.7.1	Specification conformance.....	117
12.7.2	Colour encoding.....	118
12.7.3	Aspect ratio signalling	118
12.8	MPEG-2 stills.....	119
12.8.1	File format	119
12.8.2	Semantics.....	119
12.8.3	Presentation.....	119
12.9	MPEG video.....	119
12.10	Appearance of Visible objects during content retrieval.....	119
12.11	High definition graphics model	119
12.11.1	Resolution	119
12.11.1.1	HD resolution graphics plane.....	120
12.11.1.1.1	Resolution.....	120
12.11.1.1.2	Colour range	120
12.11.1.1.3	Direct/absolute colours.....	120
12.11.1.1.4	Text rendering	120
12.11.1.1.5	Bitmap format and resolution.....	120
12.11.2	Mapping the MHEG application co-ordinate system to the graphics plane.....	120
12.11.3	Intelligent rendering.....	121
12.11.3.1	Introduction.....	121
12.11.3.1.1	Co-ordinate transformation.....	121
12.11.3.2	Bounding box transformation.....	121
12.11.3.3	Visual appearance	122
12.11.3.3.1	Text.....	122
12.11.3.3.2	Images	123
12.11.3.3.3	Line Art	123
12.11.3.3.4	DynamicLineArt.....	123
12.12	JPEG bitmaps	124
12.13	H.264/AVC stills.....	124
12.13.1	File format	124
12.13.2	Semantics.....	125
12.13.3	Presentation.....	125
13	Text and interactibles	125
13.1	Text rendering overview	125
13.1.1	Non-presented text.....	125
13.2	Character encoding.....	125
13.2.1	UTF-8	125
13.2.2	Null characters	126
13.2.3	CharacterSet attribute	126
13.3	Fonts.....	126
13.3.1	Downloading.....	126
13.3.1.1	OpenType fonts.....	126
13.3.1.1.1	Profile of OpenType	126
13.3.1.1.2	Font parameters	127
13.3.1.1.3	Text Styles.....	127
13.3.1.2	Presentation	127
13.3.1.3	Defensive response.....	127
13.3.1.4	Font resource model.....	127
13.3.2	Embedded font.....	128

13.3.2.1	The DTG/RNIB font characteristics (informative)	128
13.3.2.2	Font version.....	128
13.3.2.3	Required sizes and styles	128
13.3.3	Invoking the font.....	128
13.4	Text object attributes	129
13.4.1	FontAttributes	129
13.4.1.1	Textual form.....	129
13.4.1.2	Short form	129
13.4.2	Control of text flow.....	130
13.4.2.1	Required flow modes	130
13.5	Text rendering	130
13.5.1	Philosophy	130
13.5.2	Font definition	131
13.5.2.1	Font bounds.....	131
13.5.2.2	"Physical" font data.....	132
13.5.3	Converting font metrics to display pixels	132
13.5.3.1	Vertical resolution.....	132
13.5.3.2	Horizontal resolution.....	132
13.5.4	Rendering within the limits of the Text object	133
13.5.4.1	Vertical limits.....	134
13.5.4.2	Horizontal limits	134
13.5.5	"logical" text width rules	134
13.5.5.1	Computing "logical" text width.....	135
13.5.5.1.1	Font sizes.....	135
13.5.5.1.2	Character widths	135
13.5.5.1.3	Kerning.....	135
13.5.5.1.4	Letter spacing	135
13.5.5.2	Logical text width	136
13.5.6	Line breaking	136
13.5.6.1	TextWrapping false.....	136
13.5.6.2	TextWrapping true	136
13.5.7	Positioning lines of text vertically within the Text object	137
13.5.7.1	Truncation	137
13.5.7.2	Positioning	137
13.5.7.3	Examples.....	139
13.5.8	Rendering lines of text horizontally.....	139
13.5.8.1	Truncation.....	139
13.5.8.2	Placement.....	139
13.5.8.3	Examples.....	140
13.5.8.4	Scaling for HD resolution graphics planes.....	140
13.5.9	Tabulation.....	140
13.5.10	Placing runs of characters and words.....	141
13.6	Text mark-up	141
13.6.1	White space characters.....	141
13.6.2	Marker characters	142
13.6.3	Non-printing characters	142
13.6.4	Format control mark-up	142
13.6.5	Future compatibility.....	143
13.7	EntryFields	143
13.7.1	Supported characters.....	143
13.7.2	Appearance	144
13.7.2.1	Receivers that do not implement InteractionChannelExtension.....	144
13.7.2.2	Receivers that implement InteractionChannelExtension.....	145
13.7.3	Behaviour.....	145
13.7.3.1	Character encoding.....	145
13.7.3.2	Semantics of EntryFieldFull and MaxLength	145
13.7.3.3	EntryPoint	145
13.7.3.4	Successive character entry	145
13.7.3.5	Only SetData when inactive.....	146
13.7.3.6	User input.....	146
13.7.3.7	Numerics of the EntryField.....	146
13.7.4	Non-numeric input.....	146

13.7.4.1	Introduction	146
13.7.4.2	Minimum requirements	147
13.7.4.3	SMS entry method	147
13.7.4.3.1	Basic Method.....	147
13.7.4.3.2	Timeout Period.....	147
13.7.4.3.3	Appearance during input	147
13.7.4.3.4	Character to key mappings	147
13.7.4.3.5	Character subsets	148
13.8	HyperText.....	148
13.8.1	HyperText anchors.....	149
13.8.2	Appearance	150
13.8.2.1	Visual appearance of anchors.....	150
13.8.2.2	Default anchor colours	150
13.8.2.3	Highlight	150
13.8.3	Behaviour.....	150
13.8.3.1	Anchor identification	150
13.8.3.2	Behaviour.....	150
13.8.3.3	Special behaviour at boundaries.....	151
13.9	Slider	151
13.9.1	Appearance	151
13.9.2	Behaviour.....	152
13.10	Text rendering example (informative).....	152
14	MHEG receiver requirements	154
14.1	Introduction	154
14.2	Management of stream decoders	154
14.2.1	Application killed by receiver.....	154
14.2.1.1	On change of service.....	154
14.2.2	Effect of lockscreen	154
14.2.3	Stream inheritance on Application object activation.....	154
14.2.4	Synchronizing stream decoder state.....	155
14.2.4.1	Graphics Plane	155
14.2.4.2	Stream component selection.....	155
14.2.5	Stream continuance on Application object deactivation.....	155
14.2.6	Locating components carried in Transport Streams.....	156
14.2.6.1	Multiplex references.....	156
14.2.6.1.1	DSM-CC Stream object.....	156
14.2.6.1.2	URL explicit format	156
14.2.6.1.3	URL inheritance formats	156
14.2.6.1.4	Interaction Channel format	157
14.2.6.1.5	Services in other transport streams	157
14.2.6.1.6	StreamEvent events	157
14.2.6.1.7	CounterTrigger events	157
14.2.6.1.8	Content management.....	157
14.2.6.2	Component references.....	157
14.2.7	Locating components carried in an Elementary Stream.....	157
14.2.8	Stream presentation errors	158
14.3	Application interaction with user control of linear content decoders	158
14.3.1	Video decoder.....	158
14.3.2	Audio decoder.....	158
14.3.3	Subtitle decode.....	159
14.4	Application impact on stream decoder specification.....	159
14.4.1	DVB subtitles.....	159
14.4.1.1	Flexibility of control	159
14.4.1.1.1	Subtitles are a facet of full-screen video.....	160
14.4.1.1.2	Subtitles have priority if enabled.....	160
14.4.2	Video decoder performance	160
14.4.3	Trick modes	160
14.4.3.1	Pause behaviour	160
14.4.3.2	Multiple stream objects	161
14.4.4	MPEG presentation.....	161
14.4.4.1	MPEG scaling reference model.....	161

14.4.4.2	Transparency of MPEG encoding	162
14.4.4.3	Quarter-screen MPEG	162
14.4.4.3.1	Subtitles and scaled video	162
14.4.4.4	BoxSize for MPEG images	162
14.4.4.5	Video / I-frame object placement	163
14.4.4.5.1	Restricted capability	163
14.5	Application control of aspect ratio	163
14.5.1	No active video object	163
14.5.2	I-frames	164
14.5.3	Quarter-screen video	164
14.5.4	Video greater than quarter-screen	164
14.5.5	Decision trees	165
14.6	Persistent storage	166
14.6.1	Storage of file names	167
14.7	Receiver resource model	167
14.7.1	Memory	167
14.7.2	Numbers of objects	168
14.7.2.1	Single PCR	168
14.7.3	Link recursion behaviour	168
14.7.4	Timer count and granularity	168
14.7.5	Timer duration	168
14.7.6	HD graphics bitmap requirements	169
14.8	Receiver process priority	169
14.8.1	OSD arbitration	169
14.8.2	Event handling whilst de-prioritized	170
14.8.2.1	Transparently	170
14.8.2.2	Non-transparently	170
14.9	Interaction with DVB Common Interface module system	170
14.9.1	Overview	170
14.9.2	Introduction of CI sourced file system	170
14.9.3	Guidelines for using Application MMI resource	171
14.9.3.1	Resource contention	171
14.9.3.2	RequestStart	171
14.9.3.2.1	Application Domain Identifier	171
14.9.3.2.2	Initial object	171
14.9.3.3	RequestStartAck	172
14.9.3.4	FileRequest	172
14.9.3.5	FileAcknowledge	172
14.9.3.6	AppAbortRequest	173
14.9.3.7	AppAbortAck	173
14.9.3.8	Asynchronous events	173
14.9.4	Application Info Resource "Enter_Menu"	173
15	File system profile	174
15.1	Introduction	174
15.1.1	Broadcast file system	174
15.1.2	Interaction channel	174
15.2	Object carousel profile	175
15.2.1	DSM-CC sections	175
15.2.1.1	Sections per TS packet	175
15.2.2	Data carousel	175
15.2.2.1	General	175
15.2.2.2	DownloadInfoIndication	176
15.2.2.3	DownloadServerInitiate	176
15.2.2.4	DownloadDataBlock	176
15.2.2.5	ModuleInfo	177
15.2.2.6	ServiceGatewayInfo	177
15.2.2.7	Download Cancel	178
15.2.3	The object carousel	178
15.2.3.1	BIOP Generic Object Message	178
15.2.3.2	CORBA strings	179
15.2.3.3	BIOP FileMessage	179

15.2.3.4	BIOP DirectoryMessage	180
15.2.3.5	BIOP ServiceGateway message	182
15.2.4	Streams and stream events	182
15.2.4.1	BIOP StreamMessage	182
15.2.4.2	BIOP StreamEventMessage	184
15.2.4.2.1	Stream event names and event ids	185
15.2.4.2.2	Generating MHEG-5 StreamEvents	186
15.2.4.2.3	Tap longevity	186
15.2.4.2.4	Stream event subscription longevity	186
15.2.4.3	Identifying services using StreamMessages and StreamEventMessages	186
15.2.4.3.1	BIOP_PROGRAM_USE tap	186
15.2.4.4	DSM-CC sections carrying stream descriptors	186
15.2.4.4.1	"do it now" events	186
15.2.4.4.2	Section number	186
15.2.4.4.3	Current_next_indicator	186
15.2.4.4.4	Stream event life time	186
15.2.4.4.5	Encoding of table id extension	187
15.2.4.4.6	Resources to monitor stream events "do it now" events	187
15.2.4.5	Stream descriptors	187
15.2.4.5.1	Stream event descriptor	187
15.2.4.5.2	NPT Reference descriptor	187
15.2.4.5.3	NPT Endpoint descriptor	187
15.2.4.5.4	Stream Mode descriptor	187
15.2.4.6	Mapping stream descriptors into the MHEG-5 domain	188
15.2.5	BIOP Interoperable Object References	188
15.2.5.1	BIOPProfileBody	189
15.2.5.2	LiteOptionsProfileBody	190
15.2.6	Assignment and use of transactionId values	192
15.2.6.1	Background (informative)	192
15.2.6.2	Use in the present document	192
15.2.7	Mapping of objects to modules	193
15.2.8	Compression of modules	193
15.3	AssociationTag mapping	194
15.3.1	Association tags in "taps"	194
15.3.2	Different uses of "taps"	194
15.3.3	Using an AssociationTag to reference a service	194
15.3.3.1	BIOP_PROGRAM_USE tap	194
15.3.3.2	deferred_association_tags_descriptor	195
15.3.3.2.1	Resolving a service	195
15.3.3.2.2	Default behaviour	195
15.3.3.2.3	Transport_stream_id field	195
15.3.3.3	Service association tag mapping decision tree	195
15.3.4	Using an association tag to reference an elementary stream	196
15.3.4.1	MHEG-5 ComponentTags to DSM-CC association tags	196
15.3.4.1.1	Tag vales for default components	196
15.3.4.1.2	Explicit component references	196
15.3.4.1.3	Mapping Errors	197
15.3.4.2	Mapping DSM-CC association_tags to DVB component_tags	197
15.3.4.2.1	stream_identifier_descriptor	197
15.3.4.2.2	association_tag descriptors	197
15.3.4.2.3	Elementary stream matching using the deferred_association_tags_descriptor	197
15.3.4.2.4	PMT changes	197
15.3.4.3	Elementary stream mapping pseudo code and decision tree	198
15.4	Caching	199
15.4.1	Transparent cache model	199
15.4.2	Determining file version	199
15.4.2.1	Module acquisition	199
15.4.3	Content cache priority	200
15.4.4	Group cache priority	200
15.4.5	Cache validity	200
15.4.6	Dynamic carousel structure	201
15.5	Receiver demultiplexer resources	201

15.6	IC file system	201
15.7	MHEG profile of HTTP	201
15.7.1	Protocol parameters	201
15.7.2	Methods	202
15.7.3	Response status codes	202
15.7.4	Header fields	202
15.7.4.1	Request header fields	202
15.7.4.1.1	User agent string	203
15.7.4.2	Response header fields	203
15.7.4.3	General header fields	203
15.7.4.4	Entity header fields	204
15.7.5	Cookie support	204
15.8	Connection setup	204
15.9	Multiple connections	204
15.10	HTTP caching	205
15.11	Timeouts	205
15.12	Hybrid file system	205
15.12.1	Introduction	205
15.12.2	Resolution of References	206
15.12.3	Resolution Example	206
15.12.4	Hybrid file system caching	207
15.12.5	Synchronous file loading	207
15.12.6	Size of mapping table	207
15.12.7	Configure mapping table	207
15.12.8	Interaction with security (informative)	207
15.13	Authentication of applications	208
15.13.1	Overview (informative)	208
15.13.2	Authentication levels	209
15.13.3	Hash files	209
15.13.4	Signatures	210
15.13.5	Application signing certificates	210
15.13.6	Authentication process	211
15.13.6.1	Hash file verification	211
15.13.6.2	Signature verification	211
15.13.6.3	Optimizations	212
15.13.6.4	Certificate caching	212
15.13.6.5	Handling race conditions	212
15.13.7	Authentication file formats	212
15.13.7.1	Hash file	212
15.13.7.1.1	Hash file pathname matching	214
15.13.7.1.2	Hash file location and naming conventions	214
15.13.7.1.3	Digest value computation rules	214
15.13.7.1.4	Special authentication rules	215
15.13.7.2	Signature file	215
15.13.7.2.1	Description	215
15.13.7.2.2	Signature file location and naming conventions	216
15.13.7.2.3	Supported algorithms	216
15.13.7.3	Certificate file	217
15.13.7.3.1	Description	217
15.13.7.3.2	ASN.1 encoding	217
15.13.7.3.3	Supported algorithms	217
15.13.7.3.4	Name matching	217
15.13.7.3.5	Certificate file location and naming conventions	218
15.13.7.3.6	Authentication rules	218
15.13.8	Example of creating an application that can be authenticated	218
15.13.8.1	Scenario (informative)	218
15.13.8.2	Hash and signature computations	219
15.13.8.2.1	Computation of the hashes of the app1 directory	219
15.13.8.2.2	Computation of the hashes of the app1/data1 directory	220
15.13.8.2.3	Computation of the hashes of the app1/data2 directory	220
15.13.8.2.4	Computation of the signatures	220
15.14	Controlling access to Internet servers	220