Specification	Name	Section	Checks
ETSI TS 103 285 V1.1.1 Digital Video Broadcasting (DVB); MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks	DASH Constraints, HTTP Support, and Synchronization	4.1	The URN for the profile (MPEG Interoperability Point) shall be "urn:dvb:dash:profile:dvb-dash:2014".
		4.2.1	The MPD shall conform to the constraints in clause 4.2 in addition to the rules for the MPD as defined in ISO/IEC 23001-9 [1], clause 7.3.
		4.2.2	The Period.SegmentList element shall not be present.
			If a Period element contains multiple Adaptation Sets with @contentType="video" then at least one Adaptation Set shall contain a Role element with @schemeIdUri="urn:mpeg:dash:role:2011" and @value="main".
			Each Period element shall conform to either clause 4.2.3 or 4.2.6.
		4.2.6	The Period.SegmentTemplate element shall not be present.
		4.3	Representations and segments shall comply with the formats defined in ISO/IEC 23009-1 [1], clause 7.3.
			In Media Segments, all Segment Index ('sidx') and Subsegment Index ('ssix') boxes, if present, shall be placed before any Movie Fragment ('moof') boxes.
			Subtitle segments shall be available at or before the time at which other media segments with which they are presented become available.
			All the initialization segments for Representations within an Adaptation Set shall have the same sample entry type (see ISO/IEC 14496-12 [6]).
			The movie fragment box ('moof') shall contain only one track fragment box ('traf').
			All Representations within an Adaptation Set shall have the same track_ID.
			Each Representation shall have only one Segment. This segment shall comply with the Self-Initializing Media Segment as defined in clause 6.3.5.2 of ISO/IEC 23009-1
			The segment shall contain only one single Segment Index box ('sidx') for the entire segment.
		4.4	For any Adaptation Sets with @contentType="video" the following attributes should be present: -@maxWidth (or @width if all Representations have the same width) -@maxHeight (or @height if all Representations have the same height) -@maxFrameRate (or @frameRate if all Representations have the same frame rate) -@par (Picture Aspect Ratio)
			For any Representation within an Adaptation Set with @contentType="video" the following attributes shall be present: -@width, if not present in the AdaptationSet element -@height, if not present in the AdaptationSet element -@frameRate, if not present in the AdaptationSet element -@scanType, if interlaced pictures are used within any Representation in the Adaptation Set
			For any Representation within an Adaptation Set with @contentType="video" the following attributes should be present or inherited from the Adaptation Set: -@sar (Sample Aspect Ratio)
		4.5	The MPD size before and after xlink resolution shall not exceed 256 Kbytes.
			The MPD has a maximum of 64 periods before and after xlink resolution.
			The MPD has a maximum of 16 adaptation sets per period.
			The MPD has a maximum of 16 representations per adaptation set.
			Segment duration shall be at least 1 second, except for the last segment of a Period which may be shorter.
			Subtitle segments shall have a maximum segment size of 512 kB.
			Where subsegments are not signalled, each video segment shall have a duration of not more than 15 seconds.
			Where subsegments are not signalled, each audio segment shall have a duration of not more than 15 seconds.
			Each video subsegment shall have a duration of not more than 15 seconds.
			Each audio subsegment shall have a duration of not more than 15 seconds.
		4.7.2	The MPD should contain at least one UTCTiming element with the @schemeIdURI attribute set to one of the following: -urn:mpeg:dash:utc:ntp:2014 -urn:mpeg:dash:utc:http-head:2014 -urn:mpeg:dash:utc:http-xsdate:2014 -urn:mpeg:dash:utc:http-iso:2014 -urn:mpeg:dash:utc:http-ntp:2014
			If the MPD does not contain any UTCTiming element then the segments shall be available at the latest at the announced segment availability time using a globally accurate timing source with a tolerance of at most 200 ms.
			If the MPD contains an UTCTiming element then: the segments shall be available at the latest at the announced segment availability time in the MPD for any device that uses one of announced time synchronization methods at the same time.
	deo	5.1.1	Video encoded with H.264/AVC shall comply with the limitations set out in ETSI TS 101 154 [3], clause 5.7.1 "Specifications common to all H.264/AVC HDTV IRDs and Bitstreams" and either clause 5.7.2 "25Hz H.264/AVC HDTV IRD and Bitstream" or clause 5.7.3 "30 Hz H.264/AVC HDTV IRD and Bitstream".
			Segments shall start with SAP types 1 or 2.
			Content should be offered using Inband Storage for SPS/PPS i.e. sample entries 'avc3' and 'avc4'.

	DASH Specific Aspects for Vi	5.1.2	Content may be offered using either of the 'avc1' or 'avc2' sample entries. In this case, the Initialization Segment shall be common for all Representations within an Adaptation Set and the following shall hold: • For video Representations, the width and height values in the track header box shall have the nominal display size in square pixels after decoding, H.264/AVC cropping, and rescaling. • All information necessary to decode any Segment chosen from the Representations shall be provided in the Initialization Segment.
		5.1.3	The video codec profile, level and constraints should be signalled within the MPD using the @codecs attribute. If present, the value of the @codecs attribute shall be set in accordance with RFC 6381 [5], clause 3.3.
		5.2.3	Video encoded with HEVC shall comply with the limitations set out in ETSI TS 101 154 [3], clause 5.14.1 "Specifications Common to all HEVC IRDs and Bitstreams" and either clause 5.14.2 "HEVC HDTV IRDs and Bitstreams" or clause 5.14.3 "HEVC UHDTV IRDs and Bitstreams.
	DASH Specific Aspects for Audio	6.1.1	All audio Representations shall either define or inherit the elements and attributes shown in Table 3. • Role - Shall be common between all Representations in an Adaptation Set • @mimeType - Shall be common between all Representations in an Adaptation Set. • @codecs - Should be common between all Representations in an Adaptation Set to ensure seamless transitions (see note). • @audioSamplingRate - Should be common between all Representations in an Adaptation Set to ensure seamless transitions (see note). • AudioChannelConfiguration - Should be common between all Representations in an Adaptation Set to ensure seamless transitions (see note).
		6.1.2	Every audio Adaptation Set shall include at least one Role element using the scheme "urn:mpeg:dash:role:2011" as defined in ISO/IEC 23009-1 [1]. If there is more than one audio Adaptation Set in a DASH presentation then at least one of them shall be tagged with an @value set to "main". For receiver mixed Audio Description the associated audio stream shall use the @dependencyId attribute to indicate the dependency to the related Adaptation Set's Representations and hence also indicate that the associated audio stream shall not be provided as a Representation on its own.
		6.2	The content preparation shall ensure that each (Sub)Segment starts with a SAP type 1.
		6.3	For E-AC-3 and AC-4 the Audio Channel Configuration element shall use the "tag:dolby.com,2014:dash:audio_channel_configuration:2011" scheme URI. The @value attribute shall contain a four digit hexadecimal representation of the 16 bit field that describes the channel assignment as defined by Table E.5 in ETSI TS 102 366
		6.4	For all DTS audio formats, the Audio Channel Configuration shall use "tag:dts.com,2014:dash:audio_channel_configuration:2012" for the @schemeIdUri attribute In addition to the constraints listed above in Table 8, the audio frame duration shall also remain constant for all streams within a given Adaptation Set.
		6.5	The content preparation shall ensure that each (Sub)Segment starts with a SAP type 1.
		6.6.3	This descriptor shall have the @schemeIdUri attribute set to "urn:dvb:dash:fallback_adaptation_set:2014", and the @value attribute equal to the @id attribute of the Adaptation Set for which it supports the falling back operation. An additional low bit rate fallback Adaptation Set shall also be tagged with the same role as the Adaptation Set which it provides the fallback option for.
	DASH Specific Aspects for Subtitles		specified in EBU Tech 3380 [13] and encapsulated in ISO BMFF in accordance with Carriage of EBU-TT-D in
			signalled as described in clause 7.2.
		7.1.1	The @contentType attribute indicated for subtitles shall be "text".
		7.1.2	the language attribute shall be set on the Adaptation Set.
		7.2.1.1	This descriptor shall use the values for @schemeIdUri and @value specified in clause 7.2.1.2. The descriptor shall carry all the mandatory additional attributes defined in clause 7.2.1.3. A descriptor with these properties shall only be placed within an AdaptationSet containing subtitle Representations
		7.2.1.2	the @schemeIdUri attribute set to "urn:dvb:dash:fontdownload:2014" and the @value attribute set to 1.
			can make use of BaseURLs if desired).
			fontFamily: the fontFamily name used in EBU-TT-D documents, [13] and [14].
		7.2.1.3	mimeType: indicates the mime type of the resource available from the URL.
		7.2.2	The mime type used in the descriptor shall be the appropriate one from Table 13.
	Content Protection	8.3	All Representations in the same Adaptation Set shall be protected by the same license, and encrypted with the same key. That means all Representations shall have the same value of 'default_KID' in their 'tenc' boxes in their Initialization Segments. That also means that the ContentProtection descriptor shall be placed at the AdaptationSet level. In cases where HD and SD content are contained in one presentation and MPD, but different license rights are given for each resolution, then they shall be contained in different SD and HD Adaptation Sets, each with different ContentProtection descriptors in the Adaptation Set.
		8.4	Any Adaptation Set containing protected content shall contain one "mp4protection" ContentProtection descriptor as described in ISO/IEC 23009-1 [1], clause 5.8.5.2 first bullet with the following values: • @schemeIdUri = "urn:mpeg:dash:mp4protection:2011" • @value = "cenc" Furthermore, this "mp4protection" Content Protection descriptor should include the extension defined in ISO/IEC 23001-7 [7] clause 11.2: • @default_KID attribute under the "urn:mpeg:cenc:2013" namespace.

		8.5.0	For each DRM SystemID, if DRM specific data is present both within a 'pssh' box in the initialization segment and within a Content Protection descriptor in the MPD, the data within each should carry equivalent information.
		8.6.1	In order to ensure that the Player has access to the sample auxiliary information before it is needed to decrypt a sample, the offsets in any 'saio' box shall reference data that is stored after the start of, and before the end of, the 'moof' box that contains the 'traf' box that contains this 'saio' box.
	Carriage of Generic Streams and Events in DASH	9.1.2.1	Events associated with the @schemeIdUri attribute "urn:dvb:iptv:cpm:2014" and with @value attribute of "1" are defined as follows: • The presentation time (as indicated by the @presentationTime attribute of an MPD event or derived from the presentation_time_delta field of an inband event) shall be set to indicate a time at which the content programme metadata is applicable. • The value of the element (or the message_data field of an inband event) shall be as defined in Table 16.
		9.1.2.2	The format of the event payload carrying content programme metadata shall be one or more TV-Anytime BroadcastEvent elements that, when placed within the ProgramLocationTable element of the Default TVAMain fragment defined in Table 16, form a valid TVAnytime XML document. In order to carry XML structured data within the string value of an MPD Event element, the data shall be escaped or placed in a CDATA section in accordance with the XML specification 1.0 [26].
	Player Behaviour	10.4	Players shall support seamless switching between video Representations which differ only in any combination of the following properties: • Frame rate, providing the frame rate is within one of the following families: -25, 50 fps -30/1,001, 60/1,001 fps -30, 60 fps -24, 48 fps -24/1,001 fps • Bit rate • Profile and/or level • Resolution, subject to maintaining the same picture aspect ratio Players shall support seamless switching between audio Representations which differ only in any combination of the following properties: • Bit rate.
		10.5.2.2	If Adaptation Sets in two different Periods are associated, then the following parameters shall be identical for the two Adaptation Sets: • the language as described by the @lang attribute, • the media component type described by the @contentType attribute, • the picture aspect ratio as described by the @par attribute, • any role properties as described by the Role elements, • any accessibility property as described by the Accessibility elements, • any viewpoint property as described by the Viewpoint elements, • for audio Adaptation Sets, all values and presence of all attributes and elements listed in Table 3.
		10.5.2.3	All Representations in the Adaptation Set in the first Period shall share the same value EPT1 for the earliest presentation time. The Adaptation Sets with the value of their @id attribute set to AID in the first and subsequent Periods shall be associated as defined in clause 10.5.2.2.
		10.9.2	Where an MPD Anchor is used it should refer to a time which is currently available according to the times in the MPD.
		10.12.3.1	Where the DVB Metric reporting mechanism is indicated in a Reporting descriptor, it shall have the @reportingUrl attribute
		10.12.3.3	The attributes are defined as follows: • @reportingUrl An absolute HTTP or HTTPS URL. This shall be present when the scheme type is indicated as in clause 10.12.3.2. • @probability A positive integer between 0 and 1000
	Content Provider Guidelines (Informative)	11.1	All Representations that are intended to be decoded and presented by a DVB conformant Player should be such that they will be inferred to have an @profiles attribute that includes the profile name defined in clause 4.1, as well as either the one defined in clause 4.2.5 or the one defined in clause 4.2.8.
		11.2.2	as described in clauThe frame rates used have to be kept within the same families to enable seamless switching, as described in clause 10.4, and should be integer multiples of each other.
		11.3.0	If the service being delivered is a video service, then audio should be 20 % or less of the total stream bandwidth.
		11.6	The mixing of HEVC and H.264/AVC in the same adaptation set is not allowed (see clause 4.3).
		11.9.5	Where BaseURLs contain relative URLs, these should not include the @serviceLocation, @priority or @weight attributes.
ETSI TS 102 796 V1.4.1 Hybrid Broadcast Broadband TV	Annex E (normative): Profiles of MPEG DASH	E.2.1	The MPD shall indicate either or both of the following profiles: • the profile of DASH defined by DVB in the DVB DASH specification [45] ("urn:dvb:dash:profile:dvbdash:2014"); • "urn:hbbtv:dash:profile:isoff-live:2012" as used in previous versions of the present document. The profile specific MPD shall include at least one Adaptation Set encoded using the audio or video codecs defined in clause 7.3.1 of the present document.
		E.2.5	For E-AC-3 the Audio Channel Configuration shall use either the "tag:dolby.com,2014:dash:audio_channel_configuration:2011" (as defined in the DVB DASH specification [45]) or the legacy "urn:dolby:dash:audio_channel_configuration:2011" schemeURI.

HbbTV 1.5 Specification with Errata #3 Integrated	Requirements relating to the MPD		The size of a MPD shall not exceed 100 kbytes
			the content referenced by the profilespecific MPD shall only be encoded using the audio and video codecs defined in clause 7.3.1 of the present document
		E.2.1	The MPD must not contain an XML Document Type Definition (“<!DOCTYPE ...>”)
			There shall be no more than "Nper" Periods in an MPD that shall be temporally sequential
			There shall be no more than "Nadset" Adaptation Sets per Period in an MPD.
			If there is more than one video Adaptation Set, exactly one shall be labelled with a Role@value of "main" from the urn:mpeg:dash:role:2011 CS, to allow the terminal to identify the default adaptation set.
			Similarly if there is more than one audio Adaptation Set, exactly one shall be labelled with a Role@value of "main" to allow the terminal to identify the default adaptation set. There shall be at least one video Adaptation Set per Period in an MPD.
		E.2.2	There shall be no more than "Nrep" Representations per Adaptation Set in an MPD
		E.2.3	The profile-specific MPD shall provide the following information for all Representations, whether defined as part of the Representation or inherited. • For video Representations: @width, @height, @frameRate and @scanType • For audio Representations: @audioSamplingRate, AudioChannelConfiguration, @lang
		E.2.4	For receiver mix AD the associated audio stream shall use depdendencyId.
			For HE-AAC the Audio Channel Configuration shall use "urn:mpeg:dash:23003:3:audio_channel_configuration:2011" schemeURI with the value set to an integer number as defined in [3].
		E.2.5	For E-AC-3 the Audio Channel Configuration shall use either the "tag:dolby.com,2014:dash:audio_channel_configuration:2011" or the legacy "urn:dolby:dash:audio_channel_configuration:2011" schemeURI. The value element shall contain a four digit hexadecimal representation of the 16 bit field that describes the channel assignment as defined by table E.5 in TS 102 366 [15] where left channel is MSB.
		E.2.6	The MPD shall contain a ContentProtection element for each content protection system used. MPD URI definitions for ContentProtection elements shall conform to DASH [29] clause 5.8.5.2 "Content protection", whereby the method of the third scheme (in the third bullet text) in DASH [29] clause 5.8.5.2 shall be applied".
	Restrictions on Content	E.3.1.1	The following restrictions shall apply for content referenced from an profile-specific MPD and carried in the ISO base media file format as defined by ISO/IEC 14496-12 [31]: • The movie fragment box ('moof') shall contain only one track fragment box ('traf'). • The track run box ('trun') shall allow negative composition offsets (as defined in ISO 14496-12 [31]) in order to maintain audio visual presentation synchronization.
			Each Representation shall contain only one media component.
			All ISO BMFF Representations shall have the same track_ID in the track header box and track fragment header box.
			Initialization Segment shall be common for all Representations and the following shall hold: • For video Representations, width and height values in track header boxshall have the nominal display size in square pixels after decoding, AVC cropping, and rescaling. • All information necessary to decode any Segment chosen from Representations shall be provided in the Initialization Segment
			Each segment shall consists of a whole, self-contained movie fragment.
			Segments shall be at least 1s long, except for the last segment in of an MPD Period which may be shorter.
			Each video Segment shall have a duration of not more than fifteen seconds.
		E.3.2	Each audio Segment shall have a duration of not more than fifteen seconds.
HbbTV DASH Validation Requirements with DVB input			• Format of the output report: o Highlight in Orange / Red any minor / major problem points o Nice to have: • Show what is used / present in the presentation
			• Mode of use: o Standalone tool (via access to open source for tool, build instructions, from https://github.com/Dash-Industry-Forum/) o Allow user selection of profiles to check conformance against (to latest errata) * HbbTV 1.5 DASH profile * DVB-DASH profile * …?
			Live content capable (required – but some checks below may be more complex to implement in some areas)
			On-Demand content capable (using live profile and on-demand profile)
			Interactions between the MPD and the media , such as segment boundary positions, some checking that the required parameters e.g. decode time (signalled in tfdt) and SAP type are met, would be beneficial.
			DASH schema compliance after post processing to remove elements or attributes in the DASH namespace but not defined in the DASH schema.
			A valid (understood by the tool) profile exists - to check compliance against later
			For each profile listed in the MPD and which the tool understands, check that the MPD is conformant with the profile • Report any aspects that exceed the understood profile e.g. the various maximum numbers for Adaptation Sets, Representations

	Requirements		Report (informational) if an MPD element is scoped by other profiles (that the tool is not validating against)
			Report (error) if the MPD includes an element in a Representation or Adaptation Set that is declared with the profile being validated against but the MPD element is not part of that profile. • Eg. Features used in the DASH on-demand (and not in the live) profile included in an adaptation set declared with the HbbTV 1.5 urn
			Report if any media type that is present in the MPD (e.g. video) is missing once the MPD has been processed for a specific profile
		MPD	Warn on low values of minimumUpdatePeriod
		Init Segments	If avc1, check that it is common across representations. How many avcC and how many representations in AS?
			Check that there is no multiplexed A/V
			Check that other specific segment constraints from the HbbTV 1.5 and DVB DASH (and referenced) specifications are correctly observed.
			Report (error) if the segments include features that are not required by the profile being validated against • Eg. Those aspects of the sidx box that are profiled out of DVB-DASH
			Are the segment sizes (in bytes) and duration consistent with the representations bitrate? (report min / max / average / (Spread?))
			Are the start times within the segments consistent with the timing indicated by the MPD (including @presentationTimeOffset, if any)?
		Segments	Is the timing within the segments of a Representation such that there are no gaps?
		Periods	Does the accumulated duration of segments within a period match the period duration – how much are they out by?
			Do the adaptation sets contain a set of consistent representations • E.g. Highlight HEVC and AVC for different reps in same AS • E.g. Highlight 5.1 Audio & 2.0 Audio (this is a "should not", so error) • E.g. Highlight non-switchable audio codecs in same adaptation set
		Adaptation Sets	Report for information if there are combinations of representations in an Adaptation Set that conformant DVB DASH clients may not switch between due to the requirement to avoid non-seamless transitions . • For example, the specifications do not require AVC to HEVC transitions to be seamless .
			Do the codecs, profiles, levels, frame rates, video resolutions, audio channel configurations, etc. in the MPD match or correspond with the referenced init and media segments? (Note that in some cases an exact match is required, in others it is not but constraints still apply, e.g. resolution in common init segment)
			Are the codecs (in MPD and segments) actually supported by the specification. Are the profiles of the codecs correct and supported by the spec.
		Codec information	Resolutions: Report on any resolutions used that are not in the tables of resolutions in 10.3 of the DVB DASH specification [2].
			Some measure on the variance of actual segment durations would be informative. • For example, what is the min / max duration of the (non-final) segments? What is the spread of the segment durations (perhaps presented as a histogram)? Is the average duration consistent with that of the duration information in the MPD?
		Duration Self consistency	Are segment durations within bounds of our specs.
			Are segment durations consistent with duration advertised in MPD?
			For Live: warn if no UTCTiming element using one of the schemes required in DVB DASH is present.
			Check that new segments are becoming available by their indicated availability time according to each clock described by a supported UTCTiming element (or by 200ms before the time according to UTC, if no supported UTCTiming element is present)
		Window of availability	Are the segments (of all reps) that lie within the window of availability actually present • NOTE: Maybe just check the extremes of the window, rather than the whole lot but must always check the first and last available segment in both on-demand and live cases. The checks must be made against each clock described by a supported UTCTiming element (or by 200ms before the time according to UTC, if no supported UTCTiming element is present)
			Check that no xlink:actuate attribute is set to "onRequest"
		xlink	Check that any xlink:href attribute is a valid URL that returns an XML element appropriate to the context in which it appears (or in permitted cases, an empty document)
		TLS	If segments are delivered over TLS, is there a set of representations that meet the HbbTV TLS bitrate constraint? Report on combinations of representations that would exceed this.
			In any AdaptationSet that contains more than one HE-AAC Representation, check that the SBR header (and in the case of HE-AAV v2 the PS header) is present in the first frame of each segment
			Significant effort should be made to validate the roles, accessibility and other attributes of the audio adaptation sets (HIGH)
		Audio	Validate the audio Fallback operation (6.6.3 of [2]) with the descriptor @schemeIdUri attribute set to "urn:dvb:dash:fallback_adaptation_set:2014", and the @value attribute equal to the @id attribute of the Adaptation Set for which it supports the falling back operation. (LOW)
			Check that subtitle segments contain ISO BMFF packaged EBU-TT-D (and not some other profile of TTML such as SMPTE-TT).

		Subtitles	Check that timings of subtitles in a segment are relative to the start of the stream (as opposed to the start of the segment). This could be achieved by warning if the timings of all the subtitles in a segment lie completely outside the time period of that segment.
			Check for correct sample entry type (stpp XMLSubtitleSampleEntry)
			Check that namespaces are listed in sample entry
			Check handler type in Init Segment is 'subt'
			Check 7.2 of [2] downloadable fonts (HIGH)
			Check for @lang, Role and Accessibility elements for subtitles as described in section 7 of [2] (HIGH)
			Check the subtitle codec attribute is set correctly(HIGH)
			Check the ISO BMFF is according to EBU 3381 [4], at a simple level (HIGH)
		DRM	Check that a ContentProtection descriptor is present with schemeIdUri = urn:mpeg:dash:mp4protection:2011 for each AdaptationSet whose content is encrypted
			Signalled in MPD – report what the DRM(s) in use are
			Signalled in PSSH – report what the DRM(s) in use are
			o If both MPD and PSSH, check they are consistent with each other (same DRM systems use same 'data') *Flag if present in both and highlight of inconsistent (where possible by DRM info available)
			Warn if there is no PSSH in the MPD or Init Segment for a key ID that's used in the Media Segments
			Confirm that the 'cenc' encryption scheme is being used: *Check the value attribute of the Content Protection element (for schemeIdUri="urn:mpeg:dash:mp4protection:2011) in the MPD is set to 'cenc' *Check the scheme_type field of the 'schm' box has the value 'cenc' (1 day)
			Check key rotation (LOW)
			Nice to have: *Summarise which representations are encrypted and summarise which key_ids are used for that rep over the presentation (if VOD).
		DVB DASH Specifics	Frame rates should be part of families in Section 10.4 and that the frame rates are /2 or /4 or the one in section 10.4 (LOW)
			There should be a check for content offering with multiple periods (10.5.2) (HIGH)
			MPD Anchors should be considered to be part of the checks (LOW)
			Verifying the DVB Metric Reporting Mechanism should also be considered (LOW)
	Validation & Acceptance		Supplier shall provide a report of sample content validated against the HbbTV, DVB_DASH profiles – both that demonstrates validator has passed correctly material that should have passed, and failed correctly material that should have failed.