FREEVIEW PVR

DEVICE PROFILE 2020

Free to Air Digital broadcast and IP TV

Abstract

This document covers the PVR rules and is a supplement to the Freeview Specification 2020

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Freeview PVR Device Profile 2020

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Introduction

The Freeview PVR Device Profile is published as a supplement to the Freeview Specification 2020. PVRs must follow requirements from both documents. This device profile describes specific functions related to recording and CRID usage.

General

1.1 Document History

Version	Date	Description	Author
1.0	1 Oct 2019	Published version - PVR Device Profile 2020	Tim Diprose

1.2 Abbreviations

See Freeview Specification 2020

1.3 References

See Freeview Specification 2020

Device profile

1.4 PVR Recording

This section provides additional information for the use and interpretation of the content_identifier_descriptor and default_authority_descriptor used with the private data stream delivered in SI and over IP for recording of content by HbbTV enabled PVR devices.

Where a receiver is utilising the DVB SI EIT Schedule information in order to make programme or series bookings/recordings, then the receiver shall take advantage of the CRID information that accompanies the programme in order to allow the PVR to set accurate programme and series bookings.

1.4.1 Overview

Freeview NZ broadcasts its 8-day EPG data in three forms for receivers. A fully populated EIT schedule (Actual and Other), an HbbTV EPG, as well as an MHEG-5 EPG. The MHEG-5 EPG is a legacy broadcast and is not allowed for new devices. The HbbTV EPG data and application are delivered via IP packets to the receiver and is the preferred Guide to use.

SI continues to be used for the delivery of accurate timing information to the PVR. Each piece of programme content in the broadcast schedule is associated with a Content Reference Identifier (CRID). One or more CRID of type Programme or Series may be carried in each a Content Identifier Descriptor (CID), which are carried in the event loop of Event Information Tables.

- The CRIDs are not in human readable form since they are used at the system level only and are not presented to the viewer.
- The CRID value for each SI event or series of events is also associated with the viewer-facing EPG data delivered via IP.
- The CRID forms the primary key used to associate DSMCC and IP bound viewer-facing EPG data with SI bound accurate timing and schedule information.

All EPG data is delivered by SI using Huffman compression for programme names and synopsis. The data required to uniquely identify Programmes, and Series is broadcast in the EITschedule.

This PVR functionality has been achieved with minimal changes to existing core PVR functionality base (based on the UK playback specification).

A manufacturer may choose to implement the full Scheduled Recording APIs as per the OIPF-T1-R2 Specification Volume 5 Declarative Application Environment v2.3 as the Freeview NZ HbbTV EPG application will contain the Programme and Series ID CRIDs.

PVRs shall comply with SI EIT recording functions listed in D-book 8.7.2

1.4.2 HbbTV PVR devices

HbbTV PVR enabled devices shall implement the following

- Support +PVR function in OIPF DAE specification
- Shall support the PVR features listed in Table A.1 of TS 102 796, i.e. those features with status M-P.

1.4.3 PVR functional requirements

Item No.	Resources	Reference/Detail	Notes	
1	Programme bookings – DVB SI Resident EPG			
1.1	Book	The EPG shall handle the booking of a programme and send a 'PVR_make booking' instruction to the PVR. The PVR shall return a return code to the EPG according to the success or failure of the operation. This information may be used to inform the user of the outcome via the EPG.	Req	

Item No.	Resources	Reference/Detail	Notes	
1.2	Cancel	The EPG shall handle the cancellation of a previously booked programme by sending a 'PVR_cancel booking' instruction to the PVR. The PVR shall return a return code to the EPG according to the success or failure of the operation. This information may be used to inform the user of the outcome via the EPG.	Req	
1.3	List	A successful programme booking shall be listed in the Recording List until the time at which the programme has started or finished recording. At the time of recording the entry shall be removed automatically from the Recording List and an entry shall be made in the Playback List. Once in the Playback List all information about the programme shall be obtained from EIT p/f.	Req	
2	Programme bookings – HbbTV based EPG			
2.1	Book	The HbbTV EPG shall pass the following properties to the PVR engine via the HbbTV API when a programme is booked for recording: • startPadding • endPadding • name • description • startTime • duration • state • parentalRatings • channel	Req	

Item No.	Resources	Reference/Detail	Notes	
2.2	Book	Based upon the startTime and the channel data passed from the HbbTV EPG, the PVR should cross reference the DVB SI EIT/Schedule data and populate the recording list with the programme therein that has the corresponding startTime on that channel. This booking should be treated as per a normal DVB SI EIT/Schedule based recording.	Opt	If this is not implemented by the PVR, then the PVR should book a programme recording as a time based recording based upon the properties passed from the HbbTV EPG.
2.3	List	A successful programme booking shall be listed in the Recording List until the time at which the programme has started or finished recording. At the time of recording the entry shall be removed automatically from the Recording List and an entry shall be made in the Playback List. Once in the Playback List all information about the programme shall be obtained from EIT p/f.	Req	

Item No.	Resources	Reference/Detail	Notes	
3	Series bookings – DVB SI Resident EPG			
3.1	Book	The EPG shall handle the booking of a programme that is also part of a series. If the viewer books a programme that is also part of a series the EPG will present them with a dialog that will allow them to make the choice between recording the programme only and recording the series only. The EPG will then send a 'PVR_make booking' instruction to the PVR. The PVR shall return a return code to the EPG according to the success or failure of the operation. This information may be used to inform the user of the outcome via the EPG.	Req	If a programme that is part of a series has already been booked for recording (i.e. not as part of the series) and this is subsequently rebooked as a series the original programme booking shall be removed from the booking list automatically and the series used instead. This logic shall be handled entirely by the PVR meaning the EPG shall NOT need to send a Cancel Programme message before sending a Book Series message to the PVR. The process of booking the series shall automatically cancel the previously made programme booking. For the initial version of the profile each programme may be signaled as being in zero or one series only (i.e. a programme cannot be part of two different series). As specified in [DBook] section 8.7.2.1 Series Recording – the PVR is expected to store and track a series for up to 13 weeks between occurrences and then discard it.

Item No.	Resources	Reference/Detail	Notes	
3.2	Cancel	The EPG shall handle the cancellation of a previously booked series by sending a 'PVR_cancel booking' instruction to the PVR. This will cancel the series booking. The PVR shall return a return code to the EPG according to the success or failure of the operation, this information may be used to inform the user of the outcome via the EPG.	Req	The EPG shall display a "are you sure you want to cancel this series booking?" dialog before the 'cancel booking' instruction is sent.
3.3	Display	The display of programmes selected for recording shall include an indication if the programme is included as a consequence of being one programme or part of a series.	Req	
3.3	List	A successful series booking shall be listed in the Recording List and shall remain in the Recording List after each programme in the series is recorded. At the time of recording each programme in the series an entry shall be made in the Playback List for that programme and all programme information shall be obtained from EIT p/f. The Recording List entry for the series shall be removed automatically after a period of 13 weeks in which no programme from the series has been found.	Req	

Item No.	Resources	Reference/Detail	Notes	
4	Alternate Instance bookings			
4.1	Book	If a booking is made that causes a conflict, the requested booking shall be checked for alternate instances. If an alternate instance is available that enables the requested programme or series to be recorded at another time this shall be used instead of the selected instance of the programme or series. This shall occur subject to any device limitations (e.g. available space). Note: Previously booked programmes or series (that are causing the conflict) need not be checked for alternate instances. Alternate instance bookings shall be available for programme and series bookings.	Req	
4.2	Cancel	The cancellation of a previously booked programme that happens to have been booked as an alternate instance shall be handled the same as a programme booking cancellation.	Req	

Item No.	Resources	Reference/Detail	Notes	
5	Split Event bookings			
5.1	Book	A programme may consist of multiple events (for example, a movie divided into two parts by another programme). Split events shall be handled in the same way as standard programme bookings. No special message is required. All segments of the event shall be highlighted as being booked in the EPG.	Req	If a programme entry exists in the schedule twice as a complete programme and as a split event these shall be considered to be the same content and may be considered when conflict occurs and an alternate instance is available.
5.2	Cancel	The EPG shall handle the cancellation of a previously booked programme by sending a 'PVR_cancel booking' instruction to the PVR.	Req	The EPG shall display a "are you sure you want to cancel this programme booking?" dialog before the 'cancel booking' instruction is sent. For a successful cancelled booking the EPG shall indicate success by no longer displaying the programme as being to be recorded.
5.3	Playback	Split events when recorded may be stored as separate entries to enable the viewer to start watching the programme from the start of any part. If the split events are stored as one entity then a marker point is to be set at the beginning of the second event for quick access to the user. Each part shall be linked so that when the viewer plays them back in sequence they do not have to manually select the subsequent parts.	Req	

Item No.	Resources	Reference/Detail	Notes	
6	Conflict Resolution			
6.1	Back to back bookings	The PVR shall be able to record back-to-back programmes on the same service without registering this as a conflict.	Req	
6.2	Displaying a conflict	A conflict which is detected at the time of making a booking shall be indicated immediately, together with details of the cause, so that the user can take appropriate action.	Req	All conflict resolution shall be handled via the PVR GUI. The EPG shall therefore never receive a "conflict" return code as these must always be handled through the PVR by cancelling one or more bookings.
6.3	Default action	The default action taken by the PVR (with no user interaction) shall be made clear to the user in the manual. It is recommended that should the user not respond to a conflict resolution request that any scheduled recordings take precedence over viewing of a service or an OTR. There shall be a mechanism for informing the user of failed or incomplete recordings (in the playback list).	Req	

Item No.	Resources	Reference/Detail	Notes	
7	One Touch Recording (OTR)			
7.1	Record	The recorder shall incorporate a One-touch Recording (OTR) function which allows the user to start a recording, while watching live TV, with one button press on the remote control. The OTR button shall be the REC or ® - record button on the RCU.	Req	
7.2	Duration	The duration of the recording operation shall be based on EIT p/f, subject to any device limitations (e.g. available space).	Req	
7.3	Conflict	OTR shall not be delayed by further requests for user interaction unless to proceed would affect a recording that is either already underway or scheduled to start before the end of the OTR operation. If a conflict occurs when the OTR button is pressed a dialog shall be displayed in which the viewer may make the choice to cancel one of the conflicting programmes or partially record the OTR programme. If no choice is made the default action shall be to partially record the OTR programme. The same dialog shall be displayed if the OTR button is pressed and there is no immediate conflict but a schedule change means a conflict will now occur during the OTR period. The default action shall be to partially record the OTR programme stopping the OTR at the point at which the conflict occurs. The PVR shall indicate to the viewer the partially recorded state of OTR programme in the playback list. If an OTR event is a split event, each part of the split event shall be recorded separately.	Req	

Item No.	Resources	Reference/Detail	Notes	
7.4	Programme identification	The OTR function is event based and shall be controlled by EIT P/F. The 1st press of the OTR button records until the end of the current programme (including any end time off-set)	Req	
7.5	Continuous Recording	The OTR function may include an additional feature whereby a 2nd press gives 3 options – Record current service to: 1. End of present programme (display name) 2. End of following programme (display name) 3. After Hours and Minutes (user entry) Thereby providing the user with a simple mechanism to record the present and following programme of the current service.	Opt	

Item No.	Resources	Reference/Detail	Notes	
8	Pause and Rewind live TV			
8.1	Pause	The user shall be able to pause live TV. It shall be possible to pause for at least 30 minutes, subject to any device limitations (e.g. available space) or recording conflicts.	Req	

Item No.	Resources	Reference/Detail	Notes	
8.2	Rewind	The user shall be able to rewind live TV. It shall be possible to rewind at least 30 minutes (but preferably one hour) on the service that is currently tuned-in. Chase playback should then be possible – see 11.3	Opt	This implies that the PVR has a caching feature whereby the current service is constantly being recorded to the HDD in a 30 minute to one hour buffer. If the user changes services, then the buffer is emptied of the old service content and the new service starts caching.
8.3	On / Off	If 8.2 'caching' is implemented it is also suggested that the user should be able to switch this feature on or off.	Opt	If available the default should be set to 'on'.

Item No.	Resources	Reference/Detail	Notes	
9	Accurate Recording			
9.1	Start / Stop	The PVR shall incorporate a default mechanism for controlling the starting and stopping of a recording based on the broadcast EIT p/f.	Req	The PVR shall also allow the user to specify start/stop time off-set periods – see 12.1.

Item No.	Resources	Reference/Detail	Notes	
9.2	Updated EIT p/f	The PVR shall track changes to the start time and end time of the event. The start of an event is indicated by its transition to the present event for the specified service. The end of an event is indicated by the event being replaced by a different event as the present event for that service. When the PVR is not in passive standby and a schedule change occurs, the affected programmes in the schedule of recordings and any recordings in progress shall be updated. In standby, the PVR shall monitor the EIT p/f sufficiently frequently and for sufficient duration to allow a programme to be recorded successfully even when the start time is brought forward by up to ten minutes and the schedule information is updated at least five minutes before the new start time.	Req	It is permissible for a recording to start before the start of an event and to finish after the event, but must not create unnecessary conflicts with the requirement for a back-to-back recording capability.

Item No.	Resources	Reference/Detail	Notes	
10	Schedule of Recordings			
10.1	Recording List	A mechanism for displaying programmes (and series) selected for recording shall be available, showing a minimum of scheduled date, programme (or series) title, service name, start time, and end time (or duration).	Req	
10.2	Modifications	The PVR shall allow the user to delete a programme (or series) from the Recording list.	Req	

Item No.	Resources	Reference/Detail	Notes	
10.3	Information source	Programme and series title and synopsis are sent across the API from the EPG at the time of booking. While the scheduled date, service name, start time, and end time (or duration) shall be obtained from EIT Schedule and SDT. For series bookings the time of the next programme in the series shall be displayed. This mechanism shall include a default message if there are no events in scope of the booked series within the current schedule. The PVR shall regularly check EIT schedule for any update to the date/time information associated with each event in the Recording List and update the list to reflect the schedule.	Req	
10.4	Content recorded	The PVR shall be able to record at least the following essential signal components: The video (if a TV service) The audio, as selected by the user The subtitles, as selected by the user Where the components above are recorded separately, the user shall be able to switch them on or off during playback.	Req	On-screen informational messages or menus generated by the recorder shall not be recorded with the programme content.
10.5	Recording in progress	The PVR shall indicate to the user when a recording is in progress via the front panel display of the PVR (not via OSD). The Recording list should also highlight a programme that is in the process of recording.	Opt	This is to ensure that the user knows that the PVR is actively recording.
10.6	Record and Replay	The PVR shall be capable of replaying and recording simultaneously.	Req	

Item No.	Resources	Reference/Detail	Notes	
11	Replay functions			
11.1	Playback list	All information about each programme recorded shall be obtained from EIT p/f at the time of recording. This allows details of individual programmes to be obtained as they are recorded even if they were booked via a series booking. A mechanism for displaying recorded programmes shall be available, showing a minimum of date, programme title, service name, start time, end time (or duration), and whether this programme is part of a series booking. The playback list shall be ordered by date (default) with the option to re-order by programme name or viewed state. The programme synopsis and parental rating shall also be available.	Req	
11.2	Information source	The playback list shall always obtain the above information from the EIT p/f at the time of recording thus enabling details for individual programmes to be obtained even if booked as a series.	Req	
11.3	Chase Playback	The user shall be able to start the playback of a programme for which the recording has not yet completed.	Req	

Item No.	Resources	Reference/Detail	Notes	
11.4	Fast Forward and Reverse	Fast playback at speeds up to at least x16 shall be possible in both forward and reverse directions. At all speeds, the user shall be presented with a series of images taken from the video stream as they are passed.	Req	PVR manufactures are discouraged from implementing a skip facility, however If there is a skip button available to the PVR remote, then a single skip interval, shall not be less than 600 seconds in the forward or reverse directions (e.g. provides a 10 minute chapter feature)
11.5	Parental Ratings	A parental rating shall be carried in EIT/Schedule. This shall be obtained by the PVR when populating details of a recording in the playback list unless the recording is being passed by the HbbTV engine in which case the parentalRating property will be used. This shall be used to enable content locking such that a pass-code should be entered before the content may be viewed if the user's Parental Rating setting is lower than the programmes Parental Rating value. This shall be based on pre-set user preferences for parental control based on parental ratings codes.	Req	Service locking must be a function of the PVR as no additional signalling other than parental rating descriptors at the event level will be provided to enable this.
11.6	Playback status	The playback list shall highlight if a programme has been viewed or not.	Req	

Item No.	Resources	Reference/Detail	Notes	
12	Manual time off-sets			
12.1	Start / Stop times	The PVR shall allow the user to set start and stop off-set time periods e.g. The default settings should be start 2 minutes before scheduled start time and stop 5 minutes after scheduled end time. The HbbTV engine shall also pass startPadding and endPadding API calls when a recording booking is passed from the HbbTV engine to the PVR engine. These padding values shall override the PVR off-set values.	Req	This feature is especially important as Freeview broadcasters are not currently interfacing their presentation automation systems (on-air schedules) to the Freeview SI/EPG system for accurate programme start and stop times. However as per the functional requirement for 'accurate recording' in 9.1 above, the PVR shall regularly monitor EIT p/f. In doing so it can use the 'following' (f) programme start time as the time from which it creates the start time off-set.

Item No.	Resources	Reference/Detail	Notes	
13	Recording Capacity			
13.1	Capacity information	The recorder shall be equipped with a means of indicating the available recording capacity. The basis for the indication shall be explained in the instruction manual and shall be in terms of percentage or time, based on a notional capacity requirement per hour of recording.	Req	

Item No.	Resources	Reference/Detail	Notes	
13.2 A	Capacity Management	Option A: If insufficient space is available on the HDD to record the scheduled programme the viewer shall be told to make space immediately before the scheduled time of recording. This may or may not coincide with the time the booking is made. If a split event is booked the required space shall be calculated at the start of the first segment. If the insufficient space on the HDD to record the schedule programme then the manufacture may choose either option 1) the booking is cancelled by the PVR and this shall then pass a "cancelled" message back to the EPG or option 2) the booking is continued and a message is displayed that indicates the program may not be completely recorded. In the play list this partial recorded programme should indicate that the recording is incomplete If this option is implemented the 'capacity warning' function at 13.3 must also be implemented.	Req	Option A or Option B is required (not both).

Item No.	Resources	Reference/Detail	Notes	
13.2 B	Capacity Management	Option B: If the HDD is full so that the next recording cannot be completed, the oldest recorded programme in the playback list shall be deleted to make space. This will continue until enough space has been made to record the next scheduled programme. If this option is implemented the 'keep function' at 13.4 must also be implemented.	Req	Option A or Option B is required (not both).
13.3	Capacity Warning	A 'capacity warning' function is required. This shall inform the user that they have reached 90% of the HDD available capacity or the remaining recording time is less than 10hours and "should consider deleting some recordings" to increase available space.	Req	If 13.2A above is implemented. For the calculation of recording time it should be assumed that for a HD or SD programme that the bandwidth is set to a minimum 12Mbps.
13.4	Keep function	The viewer shall have the option to flag programmes to be kept regardless of the age of the recording. If all content is flagged to be kept and the HDD runs out of space subsequent recordings will fail.	Req	If 13.2B above is implemented.

Item No.	Resources	Reference/Detail	Notes	
14	Runaway Recordings			
14.1	EIT p/f	The recorder shall incorporate a mechanism for handling a runaway recording (e.g. as could occur if the EIT p/f transition fails because of a fault in the distribution network). If the EIT p/f now event extends for more than two hours beyond the scheduled duration then the recorder may terminate the recording at any time.	Req	
15	Manual Time based Recording			
15.1	Manual Record	The PVR may have a time based 'manual' record feature which the viewer can use to select a service, a start time, and an end time for a 'manual recording'. Manual recordings shall be added to the Recording List and Playback list in the same way as EIT / Guide based recordings.	Opt	As a backup or alternative to EIT / Guide based recording. It shall not be necessary for the EPG to display booking made though this manual, time based PVR interface.

1.4.4 Use of Service Information for PVR devices

The Service Information described in this section is based on the SI described in DBook chapter 7 & 8 as used in other PVR implementations. SI is used as a primary control for starting and stopping the recording of events. There are however subtle differences between the way SI is used in this and existing PVR implementations as described:-

- The Programme CRID is mandatory for every event as described within in SI.
- The Programme CRID is used instead of the Event ID as the primary key for tracking individual programme content in the schedule.

1.4.5 CRIDs

The Content Reference Identifier (CRID) is a unique identifier that shall be used to identify individual Programmes and Series. CRIDs that identify programme content are referred to as Programme CRIDs and those that identify Series are called Group CRIDs.

The CRID is defined in the Content Identifier Descriptor (CID), which is carried in the Event Loop of Event Information Table Present/Following (EIT P/F) and Event Information Table Schedule (EIT Schedule). The CRID type is defined in the CID so that each CID may be used to describe one or more CRID on each type.

1.4.5.1 CRID types

A content identifier descriptor can indicate the type of CRID that is carried therein. There are 2 types of CRID on the Freeview Network:-

- Series CRID – to group together a selection of content (e.g. a series)
- Programme CRID – to identify a specific piece of content (e.g. episode)

crid_type :-

- 0x31 DTG programme CRID (equivalent to type 0x01)
- 0x32 DTG series CRID (a restriction of type 0x02 to be used only for series)

PVRs should ignore all other CRID types.

1.4.5.2 Programme CRID

CRID Type 0x31

- Programme CRIDs are used to identify two or more EIT events as being the same programme and may not be used to represent other content defined by the same Authority. This prevents duplicate programmes being recorded from within the same series and also allows alternative programme instances to be recorded (or offered for recording) if a booking clash occurs. An EIT event can only be associated with a single programme CRID.

1.4.5.3 Series CRID

CRID TYPE 0x32

- Series CRIDs define groups of programmes linked by the series Concept. CID that describes a Series may contain multiple CRIDs; therefore, a Programme may be part of more than one Series. Where an event is associated with more than one series, an invitation to record programmes in the same series as this event would book to record all events in all series associated with the selected event. A PVR shall store and track series CRIDs for up to 13 weeks between occurrences in EIT schedule. To allow broadcasters to reuse a series CRID for a different editorial concept, receivers shall discard any series CRIDs not seen in EIT for 13 weeks.

1.4.5.4 Instance Metadata Identifier

A CRID in the CID shall be a programme CRID (crid type 0x31) with an IMI extension. Where two events have the same CRID and IMI value and the gap between each event is less than 3 hours (measured from the end of the preceding event to the start of the next event) then they shall be considered to be segments of a single item of content.

An item of content may be split across more than two events as long as the gap between each event remains less than 3 hours.

If the same event is repeated on another service (using the same CRID Authority and Content ID) within 3 hours and is also split, then a different IMI value will be used.

1.4.5.5 CID carriage

Each Programme described within the EIT P/F and EIT Schedule shall carry in the Event Loop at least one CID that shall contain one Programme CRID. Additional CIDs may also be carried in the same Event Loop to describe Groups. A CID that describes a Series may contain multiple CRIDs; therefore a Programme may be part of more than one Series.

CIDs shall be carried within EIT Schedule to provide a schedule of unique identifiers that represent programme content. CIDs shall also be carried in EIT P/F to provide a means of accurately signalling the start and end of each event. Additionally Short Event Descriptors and other informative descriptors may be carried within EIT P/F to enable instant access to "Now/Next" information on service change.

1.4.5.6 CRID encoding

A CRID contained within a Content Identifier Descriptor shall be encoded according to the following rules; -

The CRID must be a compliant URI as defined in ETSI TS 102 822-4 section 8. The CRID is further restricted to only contain characters encoded over the range from ISO 6937 0x20 to 0x7F.

The length of the CRID plus IMI (if any) shall not exceed 64 characters. The maximum lengths of the separate parts of the CRID are as follows: -

- authority 32 characters (excluding leading „crid://‟)
- data 29 characters (including leading „/‟)
- instance metadata id 3 characters (including „#‟ separator)

The CRIDs are not intended to be human readable and shall not be displayed on-screen.

The CRID is split into a number of separate parts ;-

Given the CRID, **crid://tvnz.co.nz/0123ABF#A1**

Scheme:	crid://	The Scheme describes the format of the rest of the CRID and shall always be “crid://”.
Authority	tvnz.co.nz	The Authority is a registered domain used to represent the source of the content and may be taken from the producer of the content, the broadcaster or other body.
Content	/0123ABF	The Content Identifier uniquely identifies the content within the scope of the current Authority
Instance Identifier	#A1	The Instance Identifier is an optional part that shall be used when a single piece of content has been split into more than one part.

The complete CRID including Scheme, Authority, Content Identifier and Instance Identifier shall be case-insensitive.

1.4.5.7 Default Authority Descriptor

To further reduce bandwidth usage within DVB SI a Default Authority Descriptor (DAD) is defined that describes the Scheme and Authority parts for any number of CRIDs that share the defined Authority. The single but not necessary unique DAD is located in the service loop of the SDT on each service referenced in the SDT. For services which may offer alternative instances of the same programme the DAD in each services SDT may be the same.

For each CRID carried in a CID that shares the Authority defined by the DAD, the Unique Content Identifier and Instance Identifier parts need be defined only.

1.4.5.8 Booking Timing

The CRID for each Programme and Series in the scope of the current schedule shall be carried within the HbbTV application alongside any viewer-facing data that describes the content. The CRID shall be treated as the primary key that shall be used to make the connection between a description of an event in the EPG with the accurate timing information as described in EIT P/F.

Where an HbbTV PVR is unable to handle the CRID data carried in the EPG data stream, the HbbTV engine will pass the timing information of the booking to the PVR via the Scheduled Recording APIs as defined in Annex A of the TS 102 796 V1.4.1 specification. The PVR will then enter a recording booking into its PVR engine according to this data.

1.4.5.9 The booking process

To book the recording of an event the viewer shall have the means to select from the EPG the content they wish to be booked for recording. This content may be an individual Programme, a Series.

An API call shall be made to send from the Broadcast API Engine to the PVR Engine the CRID and CRID Type that represents the requested booking. Viewer facing data shall also be sent from the Broadcast API Engine to the PVR Engine at this time. This data may be used to aid management of recorded content by the viewer after a successful recording has been made.

When a booking is made using a Programme CRID a look-up within the CRIDs delivered via DVB SI shall be performed to query the existence of the selected Programme CRID. If a successful booking request is made the Programme CRID and the viewer-facing data sent from the Broadcast API Engine to the PVR Engine shall be stored on the PVR local storage.

When a booking is made using a Series CRID this shall be resolved at the time of booking into a list of Programme CRIDs using a DVB SI look-up. The list of Programme CRIDs represents the actual Programmes to be recorded by the PVR Engine. For a booking request to be successful at least one Programme within the Group must exist within the scope of the current schedule. If a successful booking request is made the Series CRID and the viewer-facing data sent from the Broadcast API Engine to the PVR Engine shall be stored on the PVR local storage.

The Series CRID sent during the booking process from the Broadcast API Engine to the PVR Engine remains the primary key for the recording of any events within that Group. By this method it shall be possible to book for recording additional Programme events that are not yet in scope of the current EPG. By the method described it shall be possible to check at the time of booking, which individual Programmes within a Group should be booked for subsequent recording. The actual list of Programmes to record will be determined by Programme CRIDs carried in DVB SI and on the list of Programme CRIDs representing Programme content previously recorded and stored on the PVR.

Where a PVR has not been able to use the CRID for the booking of a Programme or Series then the PVR shall use the static timing data presented by the HbbTV EPG to the PVR Engine via the API as defined in the ETSI EN 102 796 v1.4.1 specification.

If a PVR is utilising its own firmware based EPG service to allow the viewer to book recordings, then this will be populated by the EIT information present in the EIT Schedule and the PVR engine will interact directly with the DVB SI EIT data including the CRIDs for Programmes and Series as defined above.

1.4.6 The recording process

1.4.6.1 Programmes

The PVR Engine shall on a continuous basis check EIT P/F and EIT Schedule for the existence of the booked Programme CRID.

When the schedule is such that booked Programme CRID is described in the Event Loop of the EIT P/F as the Present event and has a Running Status of Running the PVR Engine shall start the recording process on the service indicated by the EIT P/F table. The PVR Engine shall take into account any resource management latencies and off-set buffer values (since broadcasters are currently not provisioning accurate start/stop triggers) in order to start the recording in a timely manner.

The recorded content shall be stored alongside the pre-stored Programme CRID and viewer-facing data in a format defined by the receiver manufacturer. The Programme CRID shall be obtained from the CID carried in DVB-SI. The viewer-facing data shall be obtained from data sent from the Broadcast API Engine to the PVR Engine at the time of booking.

The Event Loop of the active EIT P/F shall be monitored until the booked CRID is no longer the present event or is no longer signalled with a Running Status of Running after including the extra off-set time buffer (if set) at which point the recording shall be stopped. If the CRID does not include an Instance Identifier the recording shall be marked as complete and the Programme CRID shall be removed from the PVR list of CRIDs to monitor for recording.

1.4.6.2 Series

To record Programme content booked via a Group CRID the Group CRID must be continually resolved into a list of Programme CRIDs via DVB-SI look-ups. The Group CRID shall be used as the primary key when monitoring DVB-SI. However the Programme CRID shall be used for the actual recording. The recording shall be started at the time at which the Programme CRID enters the EIT P/F table as the Present event with a Running Status of Running including any pre-set buffer time. The recording shall be stopped when the Programme CRID is no longer described in the EIT P/F as the Present event or if the Running Status is no longer described as Running and the off-set buffer time (if set) has lapsed.

The programme shall be recorded only if the PVR logic states that this Programme in the Group shall be recorded. The actual list of Programmes to record shall be determined by Programme CRIDs carried in DVB SI and on the list of Programme CRIDs representing content previously stored on the PVR local storage.

Series CRIDs shall not include Instance Identifiers. However, at the point at which a Programme in a Group is recorded it shall be treated as a Programme since the recording is based on the now resolved Programme CRID. The Programme may therefore be described by a CRID that includes an Instance Identifier and may therefore be a single programme event broadcast in more than one part.

The recorded programme content shall be stored alongside the Programme and Group CRIDs that describe the content. If available, viewer-facing data describing the group shall also be stored at this time in a format defined by the receiver manufacturer. The Programme CRID shall be obtained from the CID carried in DVB-SI.

The viewer-facing data shall be obtained from data sent from the Broadcast API Engine to the PVR Engine at the time of booking.

Any viewer-facing data sent along with the request to book content is likely to be relevant to the Group rather than the Programme within the Group. It may therefore not always be possible to obtain data that describes individual Programmes within a Group when booked for recording via a Series CRID. Therefore viewer-facing data shall also be obtained from the Short Event Descriptor carried via EIT P/F at the time of recording.

Each Programme that is recorded as part of a Group shall be marked as complete according to the logic described in section 7.5. The Series CRID shall continue to be monitored for further events in the same Group. The Series CRID shall be removed from the PVR list of monitored CRIDs only if the CRID is not seen in the broadcast schedule for a defined period. This period is defined as 13 weeks by D-BOOK 10.