ACM Beleidsregel Handhaving Besluit Eindapparaten

Ziggo DVB-C ontvanger specificatie

Versie 2.3 (2022-01)

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1 REFERENCES

Normative reference is a term covering separate documents referenced within this document and means that, unless otherwise stated, the most recent versions of the separate documents should be referenced.

[1] Staatscourant 2021, 36456 (2021-07-27 09:00), “ACM Beleidsregel Handhaving Besluit Eindapparaten (bepaling van het netwerkaansluitpunt en de vrije keuze van eindapparaten), Autoriteit Consument en Markt”.

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[4] CI+; CI Plus Device Interim License Agreement (2021-01), “CI Plus Device Interim License Agreement”.

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2 SCOPE

In line with the *ACM Beleidsregel Handhaving Besluit Eindapparaten* [1], this document describes a set of requirements related to DVB-C receivers such as (CI+) television sets and set-top boxes which will be installable on Ziggo network and offer the user access to linear broadcast services.

Although this document covers the minimum set of requirements for DVB-C receivers, it is not the intention to describe in detail the PSI/SI configuration of the current Ziggo DTV network. A more detailed PSI/SI overview, tables, descriptors and use cases can be found in annex *"VZ-E-NWS_DDV-SPC PSI_SI overview"*. Ziggo strongly recommends to review this documentation and support as much as possible the standard PSI/SI descriptors available in the network (e.g. standard descriptors present in PMT, TOT, NIT, SDT, EIT tables) in order to guarantee that basic DTV functionality is properly offered to customers (e.g. multiple audio tracks, subtitle tracks, EIT-P/F, EIT-S, local time offset and daylight saving time in TOT).

It needs to be acknowledged that this document only describes the minimal requirements for DVB-C receivers. It does not describe the requirements for a new CI+CAM module other than the CAM modules currently approved and in use for Ziggo.

In some cases the requirements are mandatory for passing inter-operability tests. The following phrases are used to identify what is mandatory or optional:

MUST	This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement.
MUST NOT	This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.
SHOULD	This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
SHOULD NOT	This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
MAY	This word, or the adjective "OPTIONAL", mean that an item is truly optional.

2.1 GENERAL FUNCTIONAL DESCRIPTION

The conceptual block diagram of a DVB-C receiver is shown in figure 1.

In summary, the DVB-C receiver needs to capture, descramble and decode TV signals and related program information transmitted over the Ziggo Network and present this on its output interfaces towards the TV display. Further it provides interaction capabilities with the customer by implementing a graphical user interface allowing interaction via a Remote Control Unit.

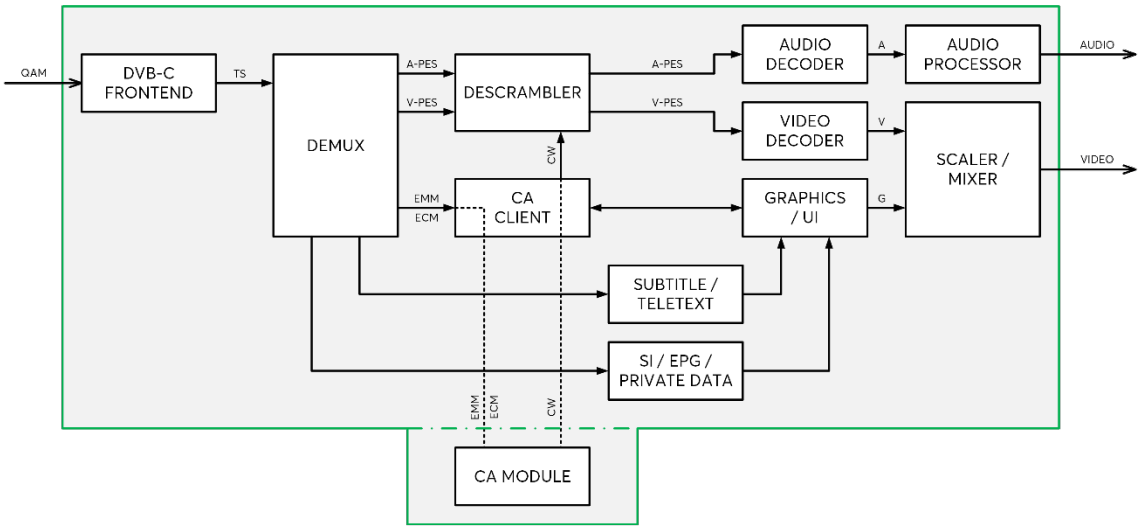

Figure 1: DVB-C receiver overview

A typical CA process consists of four key elements: the broadcast multiplexing equipment, the CA encryption system, the DVB-C receiver, and the CA security module. The broadcast multiplexing equipment (located in the Ziggo NHE) generates the encrypted program streams using encryption keys provided by the CA system. The program streams are transmitted to the customer DVB-C receiver within MPEG Transport Streams. The DVB-C receiver filters out the signals requested by the customer and pass them to the CA client. The CA security module then authorizes these programs for decryption if the customer has a subscription for the requested program. The programs are then decrypted in real time and sent back to the DVB-C receiver for display.

3 GENERAL FUNCTIONAL REQUIREMENTS

A DVB-C receiver can be a "Ziggo" certified integrated digital TV (with CI+ interface) or a STB (with CI+ interface). A CI+ certified receiver must comply with the requirements as described in industry standard *EICTA C-book* [2] (EICTA is currently known as DIGITALEUROPE), *CI Plus Specification v1.4.4* [3] and the *CI Plus Device Interim License Agreement* [4]. The CI Plus documentation can be found at http://www.ci-plus.com/documentation/ and the Ziggo specific EICTA C-book is under NDA rules.

It must be acknowledged that the "Ziggo" certification only applies to specific Conditional Access Modules (CI+CAM) in use by Ziggo (Irdeto/Nagra). CI+CAM modules other than those currently approved by VodafoneZiggo are NOT certified for use on the Ziggo network and may not be branded as "Ziggo certified".

NOTE: The development/manufacturing of a new CI+CAM is subject to security requirements from our CA vendors Nagra/Kudelski and Irdeto. The process for a new CI+CAM starts with contacting Nagra/Kudelski and/or Irdeto.

The following sections describe the requirements for a DVB-C receiver other than a "Ziggo" certified (CI+) digital television set. The requirements are similar to the *EICTA C-book* [2].

3.1 RECEIVER HARDWARE AND OS

Ziggo does not impose specific requirements on DVB-C receiver hardware (HW) and Operating System (OS), the Vendor is free to choose any type of DVB-C receiver HW or OS as long as the overall solution is compliant with the *ACM Beleidsregel Handhaving Besluit Eindapparaten* [1].

3.2 RECEIVER MIDDLEWARE

Ziggo does not impose specific requirements on middleware. The Vendor is free to choose any type of DVB-C receiver middleware. The overall solution shall be compliant with the *ACM Beleidsregel Handhaving Besluit Eindapparaten* [1].

3.3 RECEIVER USER INTERFACE LAYER

The User Interface Layer (UIL) defines the way the customer can interact via its Remote Control Unit (RCU) with the applications offered by the service. Ziggo does not impose specific requirements on the UIL. The Vendor is free to choose any type of UIL. The overall solution shall be compliant with the *ACM Beleidsregel Handhaving Besluit Eindapparaten* [1].

3.4 CONDITIONAL ACCESS (CA) SUBSYSTEM

The Vendor may offer CA in the DVB-C receiver. In case CA is implemented, this chapter is applicable. For DVB-C receivers without CA, chapter 3.4 may be skipped.

3.4.1 GENERAL

The primary purpose of a CA-system for digital broadcasting is to determine which individual DVB-C receiver must be able to decode and deliver particular program services / individual programs, to the viewers. Both smartcard-less and smartcard based solutions can be used for the CA system. Typically a DVB-C based CA system enables "simulcrypt", which allows several (but limited in total number) CA-systems to be present in parallel.

3.4.2 CAS SUBSYSTEM

For descrambling of encrypted channels the DVB-C receiver must be equipped with a CA security module that allows descrambling of encrypted MPTS transport streams and can handle CAS entitlement messages to add/remove rights to a given DVB-C receiver to access certain channels. It consists of following major sub-components:

- Descrambler
- CA security module (EMM/ECM handling)
- Smart Card (SC)

3.4.2.1 Descrambler

A conditional access system (CAS) uses a combination of scrambling and encryption to prevent unauthorized reception. Scrambling is the process of rendering the sound, pictures and data unintelligible. Encryption is the process of protecting the secret keys that have to be transmitted together with the scrambled signal in order for the descrambler to work. The responsibility of the descrambler module is de-scrambling the signals, to which the individual DVB-C receiver is properly entitled so that they can be viewed.

3.4.2.2 CA client and CA module

The EMM (Entitlement Management Message) allows a single decoder to view the programme material which is scrambled via a DVB 'common scrambling algorithm' by providing the key to the control word (CW) which is involved in the scrambling. The CW is sent via the ECM (Entitlement Control Message). The CA client passes the ECMs and EMMs to the CA module and smartcard. Only when authorised, the CA module passes CWs back to the Descrambler. Ziggo specifies a CI+ 1.4 CA module (CI+CAM).

3.4.2.3 Smartcard

Each CA system provides a security module that descrambles and decrypts data. This security module is either embedded within the receiver ("software" Smartcard) or is insertable in the form of a Smartcard. The Smartcard contains the subscriber's authorization codes required to descramble the signals and the EMM/ECM messages. Ziggo uses an insertable smartcard.

3.4.3 DVB-C NORMATIVE REFERENCES

The DVB-C receiver must at least be compliant with the following standards: *ETSI TS 101 197* [5], *ETSI TS 103 197* [6], *ETSI EN 300 468* [7], *ISO/IEC 13818-2* [8] and *ISO/IEC 13818-3* [9].

3.4.4 DVB-C SIMULCRYPT SPECIFICATIONS

Ziggo adheres to the latest DVB SimulCrypt specifications and as such no further specific requirements are applicable in this domain. Ziggo currently deploys card based and card-less (software based) CA systems concurrently in SimulCrypt mode.

DVB SimulCrypt allows multiple DVB-C receivers, each using a different CA-system, to operate in parallel within the same DVB-C transmission system and to authorize and decode the programs for display. The different ECMs and EMMs required by each CA-system are transmitted simultaneously. Each STB recognizes and uses the appropriate ECM and EMM needed for authorization.

3.5 DIGITAL VIDEO BROADCAST - CABLE (DVB-C) SUBSYSTEM

3.5.1 GENERAL

Ziggo provides read access to DVB-C signalling information (NIT, TS Frequency Map, TS Service map,) in order to allow DVB-C receivers to "tune" into the correct MPTS and select the correct services for decoding by its end-user channel selections.

3.5.2 DVB-C FRONTEND

The DVB-C receiver must be equipped with a DVB-C front-end that allows "tuning" into DVB-C QAM modulated signals carrying Ziggo DTV signals. It consists of following major sub-components:

- QAM tuner module
- DEMUX module
- DVB-C PSI/SI signalling decoding module

The above three modules make sure the DVB-C receiver application and middleware software can get access to the necessary signalling data that it requires to present the services to the end-user and act upon its input via the remote control (RCU).

DVB-C signalling structures provide Digital TV “Table of contents” services such as: list of DTV transport streams, list of channels, language selection, Teletext, CA/Entitlement and Electronic Program Guide information.

3.5.2.1 QAM tuner module

The digital television audio and video signals are multiplexed in Multiple Program Transport Streams (MPTS). MPTSs are modulated, using a QAM (Quadrature Amplitude Modulation) scheme, to allow transport of the digital information over the ‘analogue’ HFC network. The QAM tuner module allows the DVB-C receiver to lock on the carrier frequency of the required transport stream, de-modulate the signals, and extract the transport stream data for feeding into the de-multiplexer module. Ziggo uses mainly 256QAM and some 64QAM modulated carriers.

3.5.2.2 DEMUX module

When a DVB-C receiver tunes into a MPTS, it will select the correct services for decoding in function of the end-user channel selection. For this purpose the DVB-C receiver must contain a de-multiplexer (demux) module. A demux selects only the relevant data streams out of many data streams, for further processing by the descrambler / decoders.

3.6 DVB-C PSI/SI SIGNALLING DECODING MODULE

DVB Service Information (SI) is an enhancement of MPEG PSI (Program Specific Information). It provides extra information which the receiver can use. Where there are several MPTSs available, in order to successfully de-multiplex a program (i.e. channel), the decoder must be notified of both transport stream id (to find the correct multiplex) and the program number of the service (to find the correct program within the multiplex).

3.6.1 DVB SIGNALLING

The Ziggo DVB-C signalling system is incorporated in the broadcast transmission streams of the digital television signals over the cable network. The base transmission system uses MPEG-2, AVC (MPEG-4) or HEVC family digital audio/digital video streams, amended with the accompanying signalling information transported in DVB-C multiplexers using 256QAM or 64QAM modulation with channel coding. The main signalling elements are explained in this chapter.

3.6.2 NIT SIGNALLING STRUCTURE

The NIT (Network Information Table) provides a grouping of Transport Streams and tuning information such as channel frequencies and modulation characteristics. The Ziggo network transmits the NIT_other on all transport streams of the DVB-C network. The NIT_actual MUST NOT be used.

The Ziggo network is divided into 38 regions with different RF frequency allocations and accompanying network_id's. Each region is identified by a unique NIT_other. The NIT structure consists of frequency, symbol rate, modulation, et cetera.

For ease of operation by the end-user, Ziggo replaces the National NIT table with localized versions in the Regional Center allowing the use of a uniform Network IDs (NID) like 5555 and 4444.

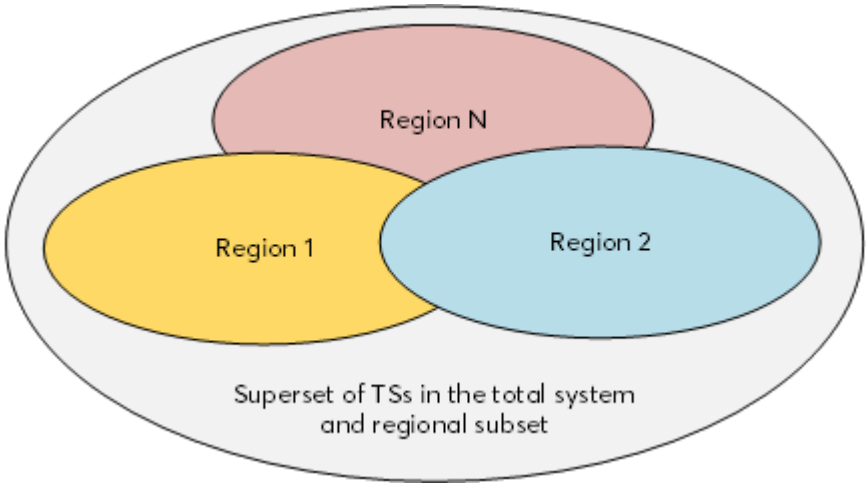

Figure 2: Graphical representation of Transport Streams available in different regions

3.6.3 PSI/SI SIGNALLING TABLES

DVB Service information (SI) is an enhancement of MPEG PSI (Program Specific Information). It provides extra information which the receiver can use to ease the decoding process. The primary link between DVB SI and MPEG is the PSI in MPEG and is contained primarily in the PAT (Program Association Table), PMT (Program Map Table) and CAT (Conditional Access Table) set of tables.

3.7 NETWORK SIGNALLING

All available networks with a designated frequency plan are signalled by the NIT_other tables. The DVB network_id entered by the end-user must be used during the installation to filter out one NIT_other to determine the network information. All other NIT actual/other tables must be ignored.

The NIT_other table must be used together with SDT_actual and SDT_other tables from the Home Transport Stream in order to build the channel list.

3.7.1 EPG (EIT) SIGNALLING

The EIT signalling information provides services such as Parental Rating and Electronic Program Guide (EPG) information. For character encoding see section Annex A.

3.7.2 CHANNEL NUMBERING

The DVB-C receiver software must understand and use the *EICTA C-book* [2] defined EACEM Logical Channel Descriptor during a network search. This descriptor is a private descriptor with descriptor tag 0x83. The DVB-C receiver must use only the Logical Channel Descriptor that is found in the NIT_other table used in the network installation.

The Logical Channel Descriptor must only be used by the DVB-C receiver software when it is preceded by a DVB private data specifier descriptor, with value 0x0028, and found in the NIT. The value 0x0028 is the EACEM private data specifier id, used in the private data specifier descriptor.

Only services that are flagged as visible with the visible_service_flag = '1' in the Logical Channel Descriptor must be placed in the list of accessible services of the DVB-C receiver:

- If services are not listed in the Logical Channel Descriptor in the NIT of installation, they must not be placed in the list of accessible services.
- If a service is flagged with logical_channel_number = '0', the service must not be placed in the list of accessible services, and the user must not be able to tune to or select the service.

To ensure all platforms understand the same Logical Channel Descriptor, the following descriptor definition must be used:

Syntax	Nr. of bits	Identifier
logical_channel_descriptor {		
descriptor_tag *0x83*	8	uimsbf
descriptor_length	8	uimsbf
for (i=0; i<N; i++) {		
service_id	16	uimsbf
visible_service_flag	1	bslbf
reserved	5	bslbf
logical_channel_number	10	uimsbf
}		
}		
NOTE: All bits in the reserved field are set to '1'		

Table 1: Syntax of logical_channel_descriptor

Additionally the EACEM HD simulcast descriptor (descriptor tag 0x88) is used by Ziggo. Its purpose is to override the EACEM Logical Channel Descriptor on advanced receivers. The channel number label defined by this descriptor overrides the channel number label assigned by the EACEM logical channel descriptor that is located in the same network_id. The rules for channel number labels are identical to the rules for the EACEM logical channel descriptor. This descriptor shall only be interpreted by receivers that are able to decode advanced codec HD digital television services (H.264/AVC).

3.7.3 PIN PROTECTION AND PARENTAL CONTROL

Children and young people must be able to watch content without harmful elements. Distributors of content are legally obligated to adhere the NICAM/Kijkwijzer regulations. Parental control must be offered to block inappropriate content for children.

Channel locking is a feature that allows the user to lock any service with a PIN code. The service can only be used after unlocking it with the PIN code.

Parental control is a PIN protection mechanism based on the DVB age rating system. The age rating of the content is compared to the user preference set in the TV menu (exact requirement below), so the service may be blocked. The user may unlock the content for viewing with the PIN code.

The DVB-C receiver software must implement the following mechanisms:

- channel locking mechanism that allows the user to specify which services are to be protected by means of a pin code.
- mechanism that allows the user to manage the pin code.
- parental control mechanism (maturity rating) based on the DVB standard parental rating descriptor as defined in standard *ETSI EN 300 468* [7]. This descriptor may be available in the EIT-P/F. In case no descriptor is present for the relevant event, the content must not be blocked.

The user must be able to modify the value of the parental control level, to determine which content should be protected by PIN.

Content must not be presented if the country specific age rating value + 3, provided by the DVB parental_rating_descriptor in the EIT-P/F, is higher than the <parental control level> configured on the DVB-C receiver. This includes DVB value 0x00. The content may be viewed after entering a PIN number.

3.7.4 SERVICE PLAN DYNAMIC UPDATES

It needs to be acknowledged that Ziggo will make changes to the PSI/SI tables on a regular base, without prior notice, other than changing the table versions. It is strongly advised that the DVB-C receiver software monitors versions updates for DVB tables and processes those changes real time.

The DVB-C receiver software must allow the user to perform a re-installation of the DTV services.
The locked channel and parental control settings must not be affected whenever the network operator makes changes to the service plan.

4 SPECIFIC REQUIREMENTS

This section describes specific requirements for the DVB-C receiver to function on the Ziggo network. The requirements are defined for the RF interface (front-end), electromagnetic compatibility and audio/video processing. A 'pass' when testing these parameters during the DVB-C receiver interoperability test is a mandatory requirement for an allowed use of the DVB-C receiver on the Ziggo DVB-C network.

4.1 FRONT-END

In general the front-end must comply with the requirements as specified in the active version of standards *ETSI EN 60728-1* [10] and *ETSI EN 300 429* [11].

It needs to be acknowledged that Ziggo uses DVB-C only. At present there are no initiatives to adopt the DVB-C2 standard for higher modulation profiles. However, Ziggo may introduce DVB-C2 in the future when the available RF spectrum is not sufficient for the bandwidth demands as required for a long term content roadmap.

4.1.1 FREQUENCY RANGE

The DVB-C receiver must support an input frequency range of 240 to 1002 MHz, with center frequencies in the band 258 to 858 MHz. If the front-end is not capable to tune to 1002 MHz the minimum requirement for the highest frequency is 862 MHz. It needs to be acknowledged that the RF spectrum within the Ziggo network will be extended to 1002 MHz in the near future and to 1218 MHz in the foreseeable future.

NOTE: Ziggo only uses 8 MHz channel spacing for digital signals.

4.1.2 RF INPUT

4.1.2.1 Nominal operational RF level

The DVB-C receiver must support digital input signal levels as shown in table 2.

System	Modulation	Range	Minimum	Maximum	Noise Threshold
DVB-C	64QAM	VHF/UHF	-17 dBmV	+13 dBmV	≥ 26.5 dB
	256QAM	VHF/UHF	-13 dBmV	+17 dBmV	≥ 32.5 dB
NOTE:	Levels are specified for a C/N of 36 dB (BW coupling on) and symbol rates between 4.0 and 6.9 MS/s.				

Table 2: RF signal level requirements

4.1.2.2 Maximum operational RF level

The DVB-C receiver must be able to operate with a total input level up to +33 dBmV over 75 Ω, within the frequency range of 240 to 1002 MHz.

4.1.2.3 High-pass filter

It needs to be acknowledged that a Cable modem can transmit with level up to +60 dBmV in the upstream frequency range (5...204 MHz) which partially overlaps the frequency range of the RF tuner (85...862 MHz) and may exceed the permissible RF level.

It is strongly advised to integrate a configurable high-pass filter or diplexer (for 65 or 204 MHz upstream) in the RF-tuner section. The suppression for signals outside the passband must be greater than 40 dB. If this requirement cannot be met, a 250 MHz high-pass RF filter, with the same connector type as the DVB-C receiver RF connector, should be shipped within the same box.

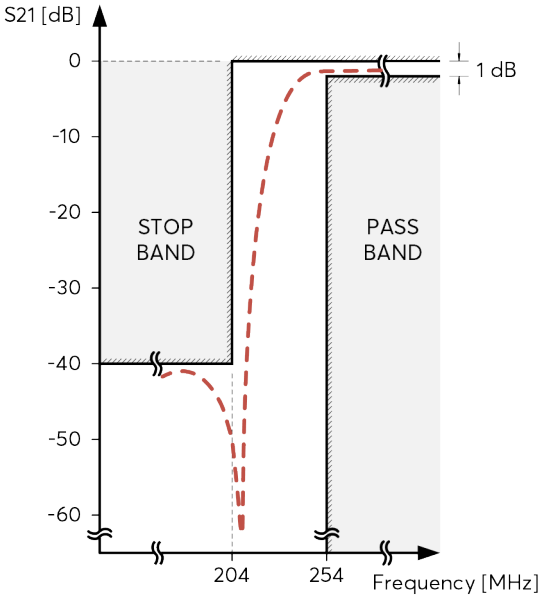

Figure 3: Tolerances for a 250 MHz High Pass Filter

4.1.2.4 Carrier to Noise

The DVB-C receiver must have a bit error rate (BER) performance better than 2 x 10^{-4} before Reed-Solomon error correction, for the following carrier to noise ratios (C/N):

Modulation	C/N	BER
64QAM	25.5 dB	≥ 2 x 10^{-4}
256QAM	31.5 dB	

Table 3: Carrier to Noise ratio requirements

4.1.2.5 Allowance on C/N performance for adjacent channel interference

The DVB-C receiver must perform as required in paragraph 4.1.2.4 plus an allowance in the following situations:

Adjacent channel type	Level	64QAM	256QAM
Digital signals	at nominal level	-	-
	10 dB above nominal	0.2 dB	1.0 dB
Analogue signals	10 dB above nominal	-	0.5 dB

Table 4: Allowance in C/N performance for adjacent channel situations

4.1.2.6 Carrier to Interference ratio

The DVB-C receiver must function without degradation under the following conditions:

Condition for flawless operation	C/N+I
subjected to co-channel interference of analogue signal within the channel bandwidth.	≥ 52 dB
subjected to composite second order (CSO) distortion for analogue modulated carriers	≥ 57 dB
subjected to composite triple beat (CTB) distortion for analogue modulated carriers	≥ 57 dB

Table 5: Interference robustness requirements

4.1.2.7 Noise figure

The DVB-C receiver must have a noise figure less than 8 dB

4.1.2.8 Return Loss

The DVB-C receiver must have a return loss better than or equal to 8 dB.

4.1.3 DEMODULATION

The DVB receiver must at least support the following demodulation parameters:

Parameter	Value
Symbol rate	4.0 to 6.9 MSymbol/s
Modulation profile	64, 128 and 256QAM
Maximum bandwidth	62.5 Mbit/s
Spectral inversion	Normal and Inverted
NOTE: It is strongly advised that the DVB-C receiver is autosensing on Symbol rate, Modulation profile and Spectral inversion for aiding the end-user in the installation process	

Table 6: Demodulation requirements

4.2 ELECTROMAGNETIC COMPATIBILITY (EMC)

Mobile (terrestrial) operators occupy an increasing amount of the RF spectrum used by cable operators for distribution of radio- and television channels. Without proper RF shielding the risk of co-channel interference is imminent and can cause degradation or disruption of the offered service.

4.2.1 EMC NORMATIVE REFERENCES

The DVB-C receiver must be compliant to the following standards: *CENELEC EN 55032:2015* [12], *CENELEC EN 55035:2017* [13], *CENELEC EN 55020:2007* [14], *CENELEC EN 50083-2:2012* [15], *CENELEC EN 50083-8:2014* [16], *ISO/IEC 60728-2:2018* [17] and *ISO/IEC 60728-12:2017* [18]

4.2.2 PASSIVE AND ACTIVE IN-HOUSE MATERIALS

All passive and active in-house materials such as cables and connectors must comply with the requirements as described in *PVE Keurmerk 4.1* [19] also known as "Kabelkeur".

NOTE: The full set of requirements can be found on the website of the Keurmerkinstituut (https://keurmerk.nl/).

4.2.3 DVB-C RECEIVER

The DVB-C receiver must comply with all active regulations for immunization against EM radiation. The receiver must perform without errors under conditions as described below:

Frequency range	Field strength	Modulation	Performance criteria
80 to 1000 MHz	3 V/m	80% AM, 1 kHz	A
1400 to 2700 MHz	3 V/m	80% AM, 1 kHz	A
900 MHz	3 V/m	80% AM, 1 kHz, 1/8 duty cycle	A

Table 7: EMC immunity requirements

Frequency range	Field strength	Bandwidth	Performance criteria
5 to 2000 MHz	5 V/m	10 kHz to 10 MHz	A

Table 8: Out-of-band immunity requirements

Frequency range	Field strength	Bandwidth	Performance criteria
5 to 1000 MHz	5 V/m	10 kHz to 10 MHz	A

Table 9: In-band immunity requirements

4.3 AUDIO / VIDEO PROCESSING

4.3.1 VIDEO DECODER

The DVB-C receiver must be able to decode the video formats for SD and HD broadcasts as listed in table 10:

Encoding	Profile@Level
H.262 (MPEG-2)	SP@ML
	MP@LL, MP@ML and MP@HL
H.264/AVC	MP@L3 and MP@L4
	HP@L4
H.265/HEVC	MT@L3, MT@L4

Table 10: Mandatory video decoding requirements

The DVB-C receiver may be able to decode the video formats for UHD broadcasts as listed in table 11:

Encoding	Profile@Level
H.264/AVC	HP@L5
H.265/HEVC	MT@L5 and MT@L6
	MT@L6.2
NOTE 1:	Level 5 allows UHD 4K @ 25 (30) fps
NOTE 2:	Level 6 allows UHD 4K @ 100 (120) fps and UHD 8K @25 (30) fps
NOTE 3:	Level 6.2 allows UHD 4K @ 100 (120) fps and UHD 8K @ 100 (120) fps

Table 11: Optional video decoding requirements

4.3.2 AUDIO DECODER

The DVB-C receiver must be able to decode the audio formats as listed in table 12:

Encoding	Audio modes
MPEG-1 – Layer II	single channel, joint stereo, stereo
MPEG-2 – Layer II	single channel, joint stereo, stereo
AC-3	single channel, stereo, multichannel (5.1)

Table 12: Mandatory audio decoding requirements

The DVB-C receiver may be able to decode the audio formats as listed in table 13:

Encoding	Audio modes
MPEG-4 - AAC	level 1 - single channel, stereo
	level 3 - multichannel (5.1)
MPEG-4 – HE AAC	level 1 - single channel, stereo
	level 3 - multichannel (5.1)
E-AC-3	multichannel (5.1 and more)

Table 13: Optional audio decoding requirements

4.3.3 AUDIO/VIDEO SYNCHRONIZATION

The DVB-C receiver should not introduce more than -5 ms / +15 ms relative delay between the video and any audio component (relative to the times indicated by their respective PTSs). The accuracy of A/V synchronization at each stage should lie within the range of Audio 5 ms early (sound before picture) to 15 ms late (sound after picture) to comply with *EBU Recommendation R37-2007* [20].

4.3.4 COPY PROTECTION

Ziggo is bound to restrictions on content distribution enforced by the owner of the intellectual rights of the content. Therefore copy-protection is a mandatory requirement.

The DVB-C receiver must have a system for protection against unauthorized copying of the video outputs when required by the owners of the content rights, such as WSS, Macrovision and HDCP.

The default mode of operation is “copy protection off”. The DVB-C receiver must provide copy protection on marked content on the following interfaces:

Interface	Protection
Analog output (AV/Scart)	WSS, Macrovision (specification 7.1.S1 [21])
HDMI output	HDMI 1.4b with HDCP 1.4b

The copy protection must be active when signalled by the CI_protection_descriptor in the SDT table.

NOTE: The descriptor is defined for CI plus content protection. However, the content protection offered by a CI+CAM may also be implemented in the DVB-C receiver in another form.

ANNEX A CHARACTER ENCODING

Ziggo uses multiple types of character encoding in general, but for all texts in the PSI/SI two character code tables are used. In this Chapter the signalling of these tables and the tables themselves are given.

A.1 CONTROL CODES

Text fields can optionally start with non-spacing, non-displayed data which specifies the alternative character table to be used for the remainder of the text item. The following table lists these codes.

First byte value	Character code table	Table description
0x00	*ISO/IEC 6937* [22]	Code table 00 - Latin Alphabet
0x01 to 0x04	NOT used by Ziggo DVB-C receivers	
0x05	*ISO/IEC 8859-9* [23]	Code table 05 - Latin/Turkish Alphabet
0x05 to 0x0B	NOT used by Ziggo DVB-C receivers	
0x0C to 0x0F	Reserved for future use by DVB	
0x10 to 0x15	NOT used by Ziggo DVB-C receivers	
0x16 to 0x1F	Reserved for future use by DVB	

Table 14: Character encoding - first byte values

Ziggo CPE devices support Table 00 and 05 provided in chapter A.2. If the first byte value is 0x20 to 0xFF, the default Latin alphabet table is used, Table 00.

A.2 CHARACTER CODE TABLES

Colour coding is used to indicate the general glyph category:

Colour	Description
light orange	letters of the Latin alphabet which are compatible with 7-bit US-ASCII encoding
light red	numbers of the Latin alphabet which are compatible with 7-bit US-ASCII encoding
light blue	blue marks, punctuation, symbols, and separators
light pink	non-spacing symbols (diacritical marks)
light green	region-specific alphabet symbols

Non-printing characters use the following mnemonics:

Mnemonic	Description
SPC	space
NBSP	no-break space
SHY	soft hyphen
LRM	left-to-right mark
RLM	right-to-left mark

Character code table 00 (Latin alphabet with Unicode equivalents) is shown in table 15 and code table 05 (Latin/Turkish alphabet with Unicode equivalents) is shown in table 16.

First Nibble	Second Nibble -0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F
0-																
1-																
2-	SPC 0020	! 0021	" 0022	# 0023	$ 0024	% 0025	& 0026	' 0027	(0028	) 0029	* 002A	+ 002B	, 002C	- 002D	. 002E	/ 002F
3-	0 0030	1 0031	2 0032	3 0033	4 0034	5 0035	6 0036	7 0037	8 0038	9 0039	: 003A	; 003B	< 003C	= 003D	> 003E	? 003F
4-	@ 0040	A 0041	B 0042	C 0043	D 0044	E 0045	F 0046	G 0047	H 0048	I 0049	J 004A	K 004B	L 004C	M 004D	N 004E	O 004F
5-	P 0050	Q 0051	R 0052	S 0053	T 0054	U 0055	V 0056	W 0057	X 0058	Y 0059	Z 005A	[005B	\ 005C	] 005D	^ 005E	_ 005F
6-	` 0060	a 0061	b 0062	c 0063	d 0064	e 0065	f 0066	g 0067	h 0068	i 0069	j 006A	k 006B	l 006C	m 006D	n 006E	o 006F
7-	p 0070	q 0071	r 0072	s 0073	t 0074	u 0075	v 0076	w 0077	x 0078	y 0079	z 007A	{ 007B	| 007C	} 007D	~ 007E	
8-																
9-																
A-	NBSP 00A0	¡ 00A1	¢ 00A2	£ 00A3	€ 20AC	¥ 00A5		§ 00A7	¤ 00A4	‘ 2018	“ 201C	« 00AB	← 2190	↑ 2191	→ 2192	↓ 2193
B-	° 00B0	± 00B1	² 00B2	³ 00B3	× 00D7	µ 00B5	¶ 00B6	· 00B7	÷ 00F7	’ 2019	” 201D	» 00BB	¼ 00BC	½ 00BD	¾ 00BE	¿ 00BF
C-		̀ 0300	́ 0301	̂ 0302	̃ 0303	̄ 0304	̆ 0306	̇ 0307	̈ 0308		̓ 030A	̛ 0327		̋ 030B	̨ 0328	̌ 030C
D-	— 2015	¹ 00B9	® 00AE	© 00A9	™ 2122	♪ 266A	¬ 00AC	¦ 00A6					⅛ 215B	⅜ 215C	⅝ 215D	⅞ 215E
E-	Ω 2126	Æ 00C6	Đ 0110	ª 00AA	Ħ 0126		Ĳ 0132	Ŀ 013F	Ł 0141	Ø 00D8	Œ 0152	º 00BA	Þ 00DE	Ŧ 0166	Ŋ 014A	ŉ 0149
F-	ĸ 0138	æ 00E6	đ 0111	ð 00F0	ħ 0127	ı 0131	ĳ 0133	ŀ 0140	ł 0142	ø 00F8	œ 0153	ß 00DF	þ 00FE	ŧ 0167	ŋ 014B	SHY 00AD
	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F

Table 15: Character code table 00 - Latin alphabet with Unicode equivalents

NOTE: This table is a superset of *ISO/IEC 6937* [22] with addition of the Euro symbol (0x20AC).

First Nibble	Second Nibble -0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F
0-																
1-																
2-	SPC 0020	! 0021	" 0022	# 0023	$ 0024	% 0025	& 0026	' 0027	(0028	) 0029	* 002A	+ 002B	, 002C	- 002D	. 002E	/ 002F
3-	0 0030	1 0031	2 0032	3 0033	4 0034	5 0035	6 0036	7 0037	8 0038	9 0039	: 003A	; 003B	< 003C	= 003D	> 003E	? 003F
4-	@ 0040	A 0041	B 0042	C 0043	D 0044	E 0045	F 0046	G 0047	H 0048	I 0049	J 004A	K 004B	L 004C	M 004D	N 004E	O 004F
5-	P 0050	Q 0051	R 0052	S 0053	T 0054	U 0055	V 0056	W 0057	X 0058	Y 0059	Z 005A	[005B	\ 005C	] 005D	^ 005E	_ 005F
6-	` 0060	a 0061	b 0062	c 0063	d 0064	e 0065	f 0066	g 0067	h 0068	i 0069	j 006A	k 006B	l 006C	m 006D	n 006E	o 006F
7-	p 0070	q 0071	r 0072	s 0073	t 0074	u 0075	v 0076	w 0077	x 0078	y 0079	z 007A	{ 007B	| 007C	} 007D	~ 007E	
8-																
9-																
A-	NBSP 00A0	¡ 00A1	¢ 00A2	£ 00A3	¤ 00A4	¥ 00A5	¦ 00A6	§ 00A7	¨ 00A8	© 00A9	ª 00AA	« 00AB	¬ 00AC	SHY 00AD	® 00AE	¯ 00AF
B-	° 00B0	± 00B1	² 00B2	³ 00B3	´ 00B4	µ 00B5	¶ 00B6	· 00B7	¸ 00B8	¹ 00B9	º 00BA	» 00BB	¼ 00BC	½ 00BD	¾ 00BE	¿ 00BF
C-	À 00C0	Á 00C1	Â 00C2	Ã 00C3	Ä 00C4	Å 00C5	Æ 00C6	Ç 00C7	È 00C8	É 00C9	Ê 00CA	Ë 00CB	Ì 00CC	Í 00CD	Î 00CE	Ï 00CF
D-	Ğ 011E	Ñ 00D1	Ò 00D2	Ó 00D3	Ô 00D4	Õ 00D5	Ö 00D6	× 00D7	Ø 00D8	Ù 00D9	Ú 00DA	Û 00DB	Ü 00DC	İ 0130	Ş 015E	ß 00DF
E-	à 00E0	á 00E1	â 00E2	ã 00E3	ä 00E4	å 00E5	æ 00E6	ç 00E7	è 00E8	é 00E9	ê 00EA	ë 00EB	ì 00EC	í 00ED	î 00EE	ï 00EF
F-	ğ 011F	ñ 00F1	ò 00F2	ó 00F3	ô 00F4	õ 00F5	ö 00F6	÷ 00F7	ø 00F8	ù 00F9	ú 00FA	û 00FB	ü 00FC	ı 0131	ş 015F	ÿ 00FF
	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F

Table 16: Character code table 05 - Latin/Turkish alphabet with Unicode equivalents

NOTE: This is compatible with *ISO/IEC 8859-9* [23]

ANNEX B PROPRIETARY LANGUAGE CODES

Ziggo uses some ISO 639 language codes for alternate use and/or backward compatibility. The proprietary language codes are listed in table 17.

639-2	Language	Stream	Purpose/Comment
ang	Old English	Audio	Legacy use. Placeholder for primary Dutch audiotrack
nld	Dutch	Audio	Legacy use. To be replaced by "dut" in near future
ina	Interlingua	Audio	Auxilary language
gos*	--	Audio	Descriptive audio for the vision impaired people
mis	--	Audio	Uncoded languages
mul	--	Audio	Multiple languages
888	--	Subtitles	Equivalent to "pagina 888" teletext subtitles
NOTE:	Language codes marked with an asterix (*) are proprietary language codes.		

Table 17: Proprietary ISO 639-2 language codes used by Ziggo