

Technical requirements for the reception of TV programs, with the exception for news and public affairs programs

Effective as of January 1st, 2022

The technical requirements for the reception of all TV programs in high definition (HD), Ultra high definition (UHD) and standard definition (SD), with the exception for programs intended for news and public affairs programs, are specified as follows.

- 1) The file based delivery is considered as preferred way of content delivery (according to file formats specified in Appendix 1).
- 2) The content have to be delivered in minimal resolution of HD (1920x1080). It is possible to deliver SD quality in justified cases. The recorded SD video signal follows the PAL 625/50 specification and must comply with the CCIR international recommendations.

The HD video signal must be recorded in the 1080i25 or 1080p50. The UHD video signals are only allowed in 2160p50. In case that source content has been already shot in 1080p25 or 2160p25 it is also possible to deliver in these formats, conversions from 25p to 50p (and vice versa) are prohibited!! Newly filmed shows in a progressive format are accepted exclusively in 1080p50 or 2160p50. If necessary, filming and delivery in 1080p25 format to achieve the motion effect must be done exclusively with the appropriate shutter. This process must be agreed by TV Nova s.r.o. in advance. Achieving a film motion effect in post-production by converting 1080i/25 material is not allowed!

- 3) In rare and justified cases, HDCAM, XDCAM HD 422, or Digital Betacam tape formats can be accepted. Even in these cases, materials must be delivered without defects and on the highest quality tape media available. Details of the tape delivery are given in the paragraph 9)
- 4) The arrangement of audio tracks and their possible combinations is shown in the table in paragraph (11) If the sound is delivered in the MONO version, the audio signal must be identical in both channels A1 and A2. The following order must be followed in the STEREO version:
A1 = L (Left channel); A2 = R (Right channel).
For two-channel recording the following applies:
A1 = primary audio modulation (Czech version)
A2 = secondary audio modulation (original version)

- 5) All materials supplied must comply with **EBU R128** Recommendation:
 - the audio signal shall generally be measured in its entirety, without emphasis on specific elements such as voice, music or sound effects
 - the measurement shall be made with a loudness meter compliant with both ITU-R BS.1770 and EBU Tech Doc 3341
 - the Program Loudness Level shall be normalized to a Target Level of -23 LUFs. The permitted deviation from the Target Level shall generally not exceed ± 1 LU for programs where an exact normalization to Target Level is not achievable practically.
 - maximum permitted True Peak Level is -1 dBTP
 - recommended Loudness Range (LRA) is less than 20 LU.

Exceptions include sports and other special shows, where peak signal levels must not exceed -9 dBFS

- 6) Programs consisting of both music and speech must respect the balanced physiological perception of sound, i.e. music and spoken word must be perceived at an equal volume level. (See EBU-R128)
- 7) The offset (time shift) between the picture and sound must be subjectively imperceptible, according to EBU-R37-1997 recommendations it must not exceed 40 ms if sound gains time and 60 ms if sound is delayed after image.
- 8) Preferred format of programs is 16:9 format, in HD or UHD definition, Figure 1a. In case that program is natively produced in UHD resolution, we prefer to provide UHD version according to specification described in Appendix 1.

In SD resolution, 16:9 anamorphic (Full Height Anamorphic) programs are accepted, Figure 1b. Inserting a 16:9 letterbox into a broadcast master is not permitted. The broadcast master must not contain areas with inserted black bars in the left and right parts of the image as a result of format conversion, not even in single cuts.

Film wide-screen formats (18:9 or 21:9) are preferentially accepted at 16:9 aspect ratio in HD or UHD resolution. In the SD resolution, they are accepted in a 16:9 anamorphic ratio. Black stripes at the top and bottom of the image are acceptable in these

cases, see Figure 2. In the case of an aspect ratio of 21:9, the image will be adjusted (if possible) according to EBU Recommendation R93-1998 to 18:9.

The recommended aspect ratio for commercial spots is 16:9 (for SD 16:9 FHA).

Any form of deformation as a result of format conversions is not permitted. Subsequent playout and distribution of the program will in principle avoid deformation or removal of parts of the image. The format of the image must be unchanged throughout post-production.

Captions and graphics must always be located only in the active part of the image signal. A safe area is specified in EBU Recommendation R95-2000. For 16:9 programs, it's 5% below the top or above the bottom edge, and 10% from the left or right edge. For 4:3 programs, a safe area of 10% from the edges must be maintained.



Figure 1: TV program in HD 16:9 format (a) and SD 16:9 anamorphic format (b)



Figure 2: Wide-screen film converted into HD 16:9 format (a) and SD 16:9 anamorphic format

9) Tape based (non-preferred) content delivery

- a) The Luminance Y signal must be within a range of - 1% (- 0,007 V) to 103% (0,721 V) relative to the black level. The color range must be within the valid RGB gamut, i.e. after decoding to RGB, all color components must fit within the legal range of - 5% to 105%. Signals in HD resolution must be kept in accordance ITU-R BT.709-5 Recommendation.
- b) All synchronization impulses, especially H and burst as well as chrominance signal, must remain in a consistent mutual time and phase relation. Extracting of lines or even absence of lines, and visible disturbances of modulation are unacceptable. The allowed shift (offset) of the picture against synchronization impulses is by 2 TV lines in vertical direction and by no more than 400 ns in horizontal direction against the blanking impulse.
- c) The cassette and its case must be marked by identical labels. The minimum scope of information on the labels must include:
 - name of the company that produced the program
 - name of the program (including number of the episode and the subhead)
 - start and end of the program in LTC
 - sound: mono, stereo, dual channel, Dolby Surround, Dolby E
 - format of the picture: 16:9, 16:9 FHA (anamorphic), 16:9 letterbox, 4:3

It is also necessary to supply accompanying documents that will contain, in addition to the above, the length of adjustment signals and their level (data in LTC).

- d) The time and control code must be recorded in LTC track, with a parallel use of VITC.
- e) The signals of the recording must be spread out as follows
 - Adjustments section
 - Duration 90 sec,
 - Picture – color bars PAL 100-0-75-0,

- Sound – reference tone according to clause 9f);
- Lead-in section
 - 30 sec with the signal of black burst in the picture and with no sound;
- Program section
 - beginning and ending of the program in LTC must be identical with the indication on the labeling of the program;
- Lead-out section
 - 30s after the end of the program with black burst in the picture and with no sound.

There must be continuous video signal in the sections black-program recording-black (b-c-d).

- f) For HDCam and Digital Betacam: Reference tone with the frequency of 1 kHz must be recorded in accordance with the level of –18 dBFS, i.e. A/D and D/A converters must be set up so the difference of levels between the full code of converters and the reference tone amounts to 18 dB. The values for modulation signal of the program measured by an analog peak indicator may exceed the reference level by + 6 dB. Extraordinary modulation peaks measured by a peak analog indicator may exceed the reference level by + 9 dB. Preemphasis must not be used.
- g) For XDCam HD 422: The same conditions apply as for the HDCam (see 9f) but the disk must be recorded with the continuous LTC (like a tape), file recording is not allowed. Commercials, sponsorship and teleshopping are not allowed to supply on the XDCAM media.

10) File based content delivery

- a) **Prior to delivery** of a program as file, the method of reception and interface must be individually specified with a supplier. Before regular content deliveries from a specific supplier, a test transfer must be performed following which the compatibility of files with technical equipment of CET 21 is agreed upon.
- b) Video and sound in the delivered file must meet all the above mentioned conditions for sound and video signal. The video sampling should be 4:2:2 or 4:4:4. The only acceptable compression method is MPEG-2 and H.264 (for XAVC formats). No other sampling in the sound than 48 kHz is allowed.
- c) All acceptable format types are defined in Appendix 1. For interlaced video formats, the field order must be Upper/Top Field First.
- d) Other acceptable formats for news and current affairs
For the purposes of news and current affairs, permissible also would be video sampling 4:2:0 and 4:1:1. In the case of compression method MPEG 2 the minimum bit rate is 10 Mbit/s (long GOP). Further, compression methods DV 25, H.264 (minimum bit rate 3 Mbit/s) are allowed for the SD definition and for the HD definition compression methods HDV, H.264 (minimum bit rate 7 Mbit/s and AVCintra (card P2) are accepted. The field order in all delivered video files must be Upper/Top Field First.

11) Allocation of audiotracks

In the delivered materials is necessary to comply with the prescribed order of audio tracks, which is shown in the following table. Other combinations of audio tracks are not allowed

Number of audio tracks	Audio label	Audio tracks order
2 audio tracks	Mono	A1: CZ Mono, A2: CZ Mono
	Stereo	A1, A2: CZ Stereo
	Dual	A1: CZ Mono; A2: Orig Mono
4 audio tracks	Stereo CZ + Mix without music	A1, A2: CZ Stereo, A3, A4: Mix without music
	Stereo CZ + Orig.	A1, A2: CZ Stereo, A3, A4: Orig Stereo
	Stereo CZ + M&E	A1, A2: CZ Stereo, A3, A4: M&E
	Stereo CZ + Stereo CZ	A1, A2: CZ Stereo, A3, A4: CZ Stereo
	Stereo CZ + Dolby E	A1, A2: CZ Stereo, A3, A4: Dolby E data
6 audio tracks	Stereo CZ + M&E + Mix without music	A1, A2: CZ Stereo, A3, A4: M&E, A5, A6: Mix without music
8 audio tracks	Stereo CZ + Dolby E + Orig + M&E	A1, A2: CZ Stereo, A3, A4: Dolby E data; A5, A6: Orig; A7, A8: M&E
	Stereo CZ + Dolby E + Orig	A1, A2: CZ Stereo, A3, A4: Dolby E data; A5, A6: Orig; A7, A8: empty
	Stereo CZ + Dolby E + M&E	A1, A2: CZ Stereo, A3, A4: Dolby E data; A5, A6: empty ; A7, A8: M&E
	Stereo CZ + Orig + M&E	A1, A2: CZ Stereo, A3, A4: empty ; A5, A6: Orig; A7, A8: M&E
	Stereo CZ + Audio 5.1	A1, A2: CZ Stereo, A3-A8: Audio 5.1

	Stereo CZ + Orig + M&E + CZ Dialogs	A1, A2: CZ Stereo, A3, A4: Orig; A5, A6: M&E; A7,A8: CZ Dialogs
16 audio tracks	Stereo CZ + Audio 5.1 CZ + Mix without music + M&E 5.1	A1, A2: CZ Stereo, A3-A8: Audio 5.1 A9,A10: Mix without music, A11-A16: M&E 5.1

Channels order for surround sound (Audio 5.1)

audio 5.1						
channels order	1	2	3	4	5	6
audio track	left	right	center	LFE	left surround	right surround

Channels order for DolbyE signal

Dolby E								
channels order	1	2	3	4	5	6	7	8
audio track	left	right	center	LFE	left surround	right surround	stereo left	stereo right

Appendix 1 – Acceptable types of files for file-based delivery

Detailed Technical Specifications

accepted formats

Specification	Profile SD (Interlaced)	Profile HD (Interlaced)	Profile HD (Progressive or Interlaced)	Profile UHD (Progressive)
General				
Profile Name/description	SD IMX50	XDCAM HD 422	XAVC HD	XAVC UHD
Main viewing environment	TV	TV	TV	TV
File Container	MXF OP1a	MXF OP1a	MXF OP1a	MXF OP1a
Preferred Encoder/Transcoder software or hardware	Telestream	Telestream	Telestream	Telestream
Can audio be received separately?	no	no	no	no
Video				
Video Codec	MPEG-2 (D10)	MPEG-2	H.264	H.264
Video Bitrate in Mbps	50 Mbps	50 Mbps	<i>Long GoP</i> 50 Mbps (1080p/25, 1080i/25) 100 Mbps (1080p/50) <i>I-Frame only</i> 100 Mbps (1080p/25, 1080i/25) 200Mbps (1080p/50)	<i>Long GoP</i> 200 Mbps (2160p/25) 250Mbps (2160p/50) <i>I-Frame only</i> 250 Mbps (2160p/25) 500Mbps (2160p/50)
CBR or VBR?	CBR	CBR	CBR	CBR
Keyframe	I-Frame only	GOP (M=3,N=12)	I-Frame only or GOP	I-Frame only or GOP
Open or Closed GOP	-	closed	closed	closed

Aspect Ratio	16:9FHA / 4:3	16:9 / 4:3PB *1	16:9 *1	16:9 *1
3840 X 2160				x
1920 X 1080		x	x	
720 X 608 (16X9)	x			
16 X 9 anamorphic flag	yes	-	-	-
If letterbox, remove black bars? (results in lower vertical resolution)	yes	-	-	-
Color sampling	4:2:2	4:2:2	4:2:2	4:2:2, 4:4:4
Time code	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00
Frame rate (fps)	25	25	25/50	25/50
Interlaced	yes	yes	- / yes	-
Field Order (for interlaced content)	Top Field First	Top Field First	- / Top Field First	-
Overlays	No	No	-	-

Notes:

*1 we also accept 18:9 and 21:9 aspect ratio (if possible, 21:9 will be modified to 18:9 according to EBU R93-1998 Recommendation)

Specification	Profile 1	Profile 2	Profile 3	Profile 4
Audio				
Multiple Audio streams	yes	yes	yes	yes
Audio Container	AES3	AES3	AES3	AES3
Audio Codec	PCM (EBU) DolbyE	PCM (EBU) DolbyE	PCM (EBU) DolbyE	PCM (EBU) DolbyE
Number of Channels and Layout	as described in section 11)			
Bit depth	16/24	16/24	16/24	16/24
Sample rate in KHz	48	48	48	48