



Technical specifications for the purchase of TV products in SD/HD/3D/UHD formats

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1. Introduction

This document describes the technical specifications for the supply to RAI of television products in Standard Definition, High Definition, 3D High Definition and Ultra High Definition (hereafter respectively identified with acronyms SDTV, HDTV, 3DTV and UHD TV).

Although many parts of these specifications have general validity, the reference context is limited to **fiction and cinema genres**.

Particular features of other program types will be considered in future versions.

In general, RAI assumes that all product production stages are carried out professionally using equipment in perfect working and maintenance conditions.

It is taken for granted that the main international technical standards for audio-video signals are well known and that if they are not mentioned in this document is consequently not an omission, it being understood that processing will be carried out in full compliance.

For convenience, Chapter 13 lists the references to standards and recommendations mentioned in these Technical Specifications.

2. Video Formats

The following paragraphs describe the main technical specifications for the television standards accepted by RAI.

2.1 *Standard Definition (SDTV)*

RAI accepts SDTV content generated in conformity with the ITU-R BT.601 Recommendation having the following characteristics:

- Resolution: 720x576 active pixels
- Aspect Ratio: 16:9 FHA (Full Height Anamorphic)
- Frame rate: 25 frames per second, interlaced scanning (50 semi-fields per second)
- Chroma sub-sampling scheme: 4:2:2

In case of a program is supplied originating from a 525 line, 30 frame per second, interlaced master, standard conversion must be performed out using converters with motion compensation algorithms¹

In case of content originates from SDTV masters with a 4:3 aspect ratio, the aspect ratio must be changed in accordance with paragraph 3.8 and delivery, after format conversion, should be in HDTV 1080i25 format.

¹In the literature, see "*motion compensation*" https://en.wikipedia.org/wiki/Motion_compensation

2.2 High Definition (HDTV)

RAI accepts HDTV contents generated with a production chain that, in terms of camera choice complies with EBU R118 v1.2 Recommendation (paragraph 2.4 "HD Tier 1") and that in terms of choice of compression algorithms and encoding bit-rates for subsequent processing stages ensure visually indistinguishable quality from the acquired signal.

RAI accepts HDTV content in the following formats:

HDTV **1080i25**² format

- Resolution: 1920x1080 pixels
- Aspect Ratio: 16:9
- Frame rate: 25 frames per second, interlaced scanning
- Chroma sub-sampling scheme: 4:2:2

HDTV **1080p25** format

- Resolution: 1920x1080 pixels
- Aspect Ratio: 16:9
- Frame rate: 25 frames per second, progressive scanning
- Chroma sub-sampling scheme: 4:2:2

HDTV **1080p50** format

- Resolution: 1920x1080 pixels
- Aspect Ratio: 16:9
- Frame rate: 50 frames per second, progressive scanning
- Chroma sub-sampling scheme: 4:2:2

Formats based on 1920 x 1080 pixel resolution must conform to ITU-R BT.709 Recommendation and SMPTE 274M standard.

Reference colorimetry for HDTV formats is specified in the ITU-R BT.709 Recommendation.

If the original acquisition involves film, Super 35 mm or higher quality film must be used preferably with an aspect ratio of 1.78 (16:9).

At every point of the production chain, material must be encoded with horizontal and vertical resolution equal or higher than that required by RAI. Exceptions are allowed only as indicated in paragraph 3.6.

²The 1080i25 format is also identified with the label 1080i50 referring to the frequency of semi-fields (50 Hz) rather than the frame rate (25 Hz). The 1080i25 notation is preferred in order to harmonise the description of progressive and interlaced formats.

2.3 High definition 3D (3DTV)

The 3DTV format refers to a stereoscopic pair composed of 2 coherent signals in HDTV format respectively corresponding to the signals presented to the left and right eyes by a special reproduction chain. Therefore, each HDTV stream must satisfy the requirements defined in paragraph 2.2

RAI accepts 3DTV content in the following formats:

1080i25 format

- Resolution: 1920x1080 pixels
- Aspect Ratio: 16:9
- Frame rate: 25 frames per second, interlaced scanning
- Chroma sub-sampling scheme: 4:2:2

1080p25 format

- Resolution: 1920x1080 pixels
- Aspect Ratio: 16:9
- Frame rate: 25 frames per second, progressive scanning
- Chroma sub-sampling scheme: 4:2:2

In accordance with specific editorial requirements, special productions may also be made in the following formats:

- **HDTV 1080p50** (see paragraph 2.2)
- **UHDTV** (see paragraph 2.4)

Production must be implemented in accordance with the guidelines provided in the EBU R135 Recommendation.

At every point of the production chain, material must be encoded with horizontal and vertical resolution equal or higher than that required by RAI. Exceptions are allowed only as indicated in paragraph 3.6.

2.4 **Ultra High Definition Television (UHDTV)**

RAI accepts HDTV contents generated with a production chain that, in terms of camera choice complies with EBU R118 v1.2 Recommendation (paragraph 2.1 "**UHD-1 Tier 1**") that use RAW as the recording format³.

In stages after recording, the choice of compression algorithms and bit-rates must ensure the highest possible quality.

RAI accepts UHDTV content in the following formats:

2160p25 format

- Resolution: 3840x2160 pixel
- Aspect Ratio: 16:9
- Colour depth: 10 bit/sample or higher
- Frame rate: 25 frames per second, progressive scanning
- Chroma sub-sampling scheme: 4:2:2 or 4:4:4

2160p50 format

- Resolution: 3840x2160 pixel
- Aspect Ratio: 16:9
- Colour depth: 10 bit/sample or higher
- Frame rate: 50 frames per second, progressive scanning
- Chroma Sub-sampling scheme: 4:2:2 or 4:4:4

The reference standard for 3840x2160p25 and 3840x2160p50 formats is ITU-R BT.2020 Recommendation

If the original acquisition is on film, the Super 35mm or higher quality film must be used, while digital conversion must be performed with a state-of-the-art 4K film scanner.

At every point of the production chain, material must be encoded with horizontal and vertical resolution equal or higher than that required by RAI. Exceptions are allowed only as indicated in paragraph 3.6.

³The RAW format is the recording mode that directly stores the signal captured by the sensor, thereby minimising processing and compression (lossless compression or visually lossless)

3. Technical Specifications - Video

3.1 *Image quality requirements*

RAI requires “level 5” (optimal) image quality in accordance to the assessment scale described in the ITU-BT 500 Recommendation.

Bearing specific artistic and editorial needs in mind, RAI requires that:

- The image should be reasonably but not artificially sharp
- The image should be free of excessive noise, grain or artefacts caused by digital compression techniques
- The image should be as free as possible from defects caused by the optics used (e.g. reflections, monochromatic aberrations, chromatic aberrations, etc.)
- Camera movements should be reasonably soft and continuous
- The image should be free from excessive compression of low- and high-lights
- Highlight clipping must not cause visible artefacts
- Aliasing or jagged edges/lines should not be perceptible
- Colour shade yield, especially of skin tones, should be consistent throughout the program and realistic as regards the scene recorded unless deliberately altered to achieve a specific visual effect
- No digital processing artefacts should be perceptible (eg. contouring, banding, quantization noise) or spurious signals (eg. ringing, smear, echoes, overshoots, moiré, hum, crosstalk)

For 3DTV content, also refer to the following parameters:

- Residual vertical disparity. Vertical disparity denotes the vertical misalignment of two cameras while shooting. The absolute vertical disparity value at the centre of the program must be less than one pixel. A value of less than 1/100 of image height measured at the corners of the frame is acceptable
- Sensor rotation. Rotation indicates that the horizontal sensor axes of both cameras are not co-planar. Rotation must be nominally by null: a line placed along the horizontal axis of the sensors must visually align, i.e. give rise to vertical disparity having an absolute value of less than one pixels along the horizontal axis of the image
- Focal length. The focal length set on the lenses of the two cameras must be nominally identical, i.e. the lenses must have the same nominal optical configuration. A value of less than 3/1000 of image height measured horizontally and/or vertically at the corners of the frame is acceptable
- Focusing distance. The focusing distance set on the lenses of the two cameras must be nominally identical, i.e. the lenses must have the same nominal characteristics
- The recording system must be arranged in such a way as to minimise as far as possible the effects of non-linear distortions that may cause altered perception of the actual space

- To facilitate playback and testing of stereoscopic material, it should be optimised for 16:9 format display screens with a diagonal length in the 40"-60" range

3.2 Video Levels, gamut errors and forbidden signals

SDTV, HDTV and UHD TV signals will be respectively evaluated in accordance with ITU-R BT.601, ITU-R BT 709 and ITU-R BT.2020 Recommendations.

Video levels must fall within specific limits so that the program can be used without further processing.

Each signal outside the specified bounds is considered to be a *gamut error*⁴.

Using traditional representations where the nominal black level is shown as 0 mV (or 0%) and the nominal white level as 700 mV (or 100%), RGB components must comply with the EBU R 103 recommendation, namely:

- R, G and B components set between -35 mV and 735 mV (respectively -5% and 105%)
- The Luma component (Y) set between -7 mV 721 mV (respectively -1% and 103%)

Given the difficulties of controlling transients, a margin of error is allowed quantified as 1% of the number of pixels. Only frames having more than 1% of pixels outside the specified limits will be considered as gamut errors.

3.3 Moving titles and graphics

Moving titles and graphics should be inserted by working with the native format, ensuring that any subsequent conversion into interlaced formats or lower resolution retains legibility.

3.4 Anti-PSE

Flashes of light, intermittent lights and certain kinds of repetitive visual pattern can cause problems for viewers with PSE - PhotoSensitive Epilepsy. Televisions, by their very nature, are a source of intermittent light so one cannot completely eliminate the risk of causing such attacks in people suffering from this form of epilepsy. Nevertheless, some precautions are possible in order to reduce this risk. Consult the website of UK Independent Television Commission (www.ofcom.org.uk) for some basic guidelines in this regard.

3.5 Safe area

For products with SDTV, HDTV, 3DTV and UHD TV formats, a safe area⁵ must be maintained as prescribed in the EBU R95 rev. 1 Recommendation.

The EBU recommendation mandates that:

- the main action is contained in the central area up to 93% of height and 93% of width of the image
- titles and graphics are included in the central area up to 90% of height and 80% of width of the image.

⁴ <https://en.wikipedia.org/wiki/Gamut>

⁵ Consult https://en.wikipedia.org/wiki/Safe_area

While waiting specific recommendation or standard, it is also requested that UHDTV products comply with a safe area by applying the same percentages as indicated for HDTV products

3.6 Presence of material with not consistent features

The product may contain a portion of original material having a lower definition provided that it is required for editorial purposes.

In this case, the amount of original material having a lower definition should not exceed 25% of the duration of the program and should not be used for long and uninterrupted periods unless specifically agreed with RAI.

Original material having a lower definition must be converted using state of the art technology.

Similarly, in the event of precise editorial requirements, material may be present that has not previously been encoded using professional encoding algorithms.

For material having a native 16:9 format, conversion operation must not alter the geometric proportions.

Sequences in 4:3 format must be converted to 16:9 in a way conforming with editorial requirements without altering the geometric proportions of the content, making sure that the main native 4:3 content is retained (graphics, action).

3.7 Archive material

Any archive material included in the product supplied must meet all technical requirements specified in this document with the exception of the aspects described in the following paragraphs.

3.7.1 General quality

Archive material must be obtained from the best possible source; RAI expects that every reasonably feasible restoration or improvement activities will be implemented.

3.7.2 Aspect Ratio

Archive material should be processed so that, where possible, it fills the 16:9 frame without compromising image quality, its geometrical proportion and composition.

Alternatively, such material can be presented in *pillar-box*⁶ form (see paragraph 3.8) having the following characteristics:

- constant and intermediate aspect ratio between 4:3 and 16:9
- image centred in the 16:9 frame
- no geometric distortions should be visible
- sharp image edges and bars at black level

3.7.3 Captions and subtitles

Any subtitles or captions must remain inside the safe area (see paragraph 3.5).

⁶ Consult <https://en.wikipedia.org/wiki/Pillarbox>

3.8 Conversion from other formats

For programs not produced in 16:9 aspect ratio, aspect conversion must in any case be carried out whilst retaining the main native content and without altering geometric proportions.

By way of example, the following figure shows conversions of certain formats (1.33:1, 1.66:1, 1.85:1 and 2.35:1) into 16:9 that simply involved adding black bars *without deleting any part of the original video image*.

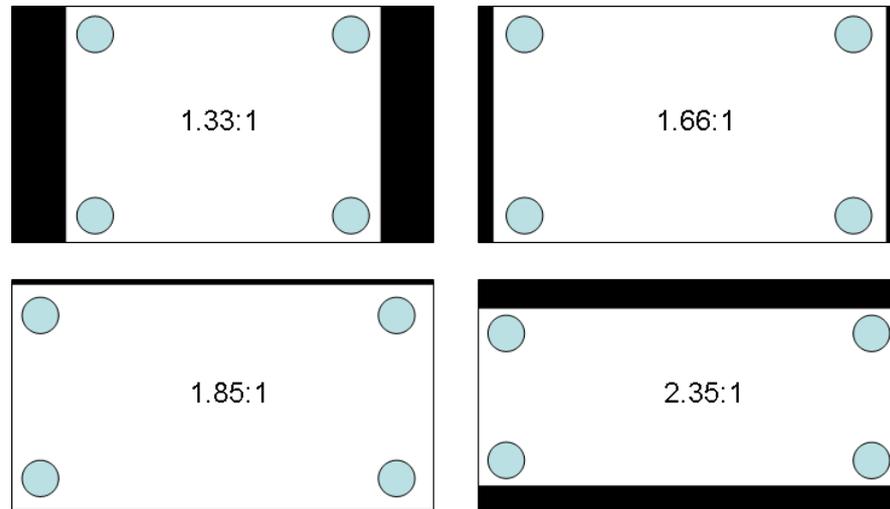


Fig. 1 - Format conversion examples

3.9 Vertical blanking of content in video media

The vertical blanking interval can be used to insert data, such as Teletext.

RAI reserves the use of the vertical blanking interval for these purposes, and does not accept, except in the case of special agreements, that the vertical blanking interval of video media supplied contain insertion signals (e.g. Video Index, Active Format Descriptor or Wide Screen Signalling).

If a timecode is inserted in the vertical blanking interval (VITC), it must match the longitudinal timecode (LTC).

3.10 Field dominance

In order to maintain correct display, cuts in material with interlaced scanning should always be made between field 2 and field 1.

Cuts in material with progressive scanning and interlaced transport (i.e. Progressive Segmented Frame) must always be made between field 2 and field 1.

4. Technical-Audio Specifications

4.1 *Quality requirements*

RAI requires that the audio part of the content supplied ensures a state-of-the-art quality meeting audio-visual industry standards.

Bearing specific artistic and editorial needs in mind, RAI requires that:

- Audio recording must be done with necessary precautions to prevent noise, radio-interference, interruptions or distortions
- Audio recording must be done with a minimum sampling rate of 48 kHz and a minimum audio bit depth of 24 bit.
- Audio tracks must not have dynamic alterations and/or frequency extension caused by noise reduction systems (or rustle) or encoding/decoding systems with an insufficient number of bits.
- Audio tracks must be free from spurious signals (e.g. click, noise, hum), analogue distortions and artefacts caused by digital compression systems
- Stereo or multi-channel audio tracks must reflect the spatial characteristics of images (left/right, front/back)
- Intelligibility of dialogue must be always assured, regardless of home sound system used
- Loudness effect must be consistent throughout the program and appropriate to the scene portrayed; sound dynamics must not be excessive to ensure use in the entire range of domestic listening conditions
- The sound front must be suitably balanced and free of phase differences that may cause evident deletions if stereo sound is listened to on mono systems or if multi-channel audio is listened to thanks to a down- mix process
- Mono audio tracks must be suitably converted to dual-mono so that they can be handled in exactly the same way as stereo tracks. The resulting dual-mono track must also meet all the requirements of the stereo track

Except for other editorial requirements, RAI recommends that:

- SDTV programs are produced with stereo audio (2.0)
- HDTV, 3DTV and UHDTV programs are produced with multi-channel audio (3/2 for ITU-R BS.775)

4.2 *Multi-channel audio*

The multi-channel audio track is broadcast in 5.1 format (code 3/2 for ITU-R BS.775).

The LFE (Low Frequency Effect) channel is optional. The use of the LFE channel must comply with the ITU-R BS.775 Recommendation

Special attention should be paid to the mix between the low-frequency components and LFE channel content, taking into account that the latter may be excluded during downmix processes⁷

Programs with a multi-channel audio track must always envisage the presence of a downmix stereo track.

If the stereo downmix track is generated automatically, the downmix coefficients used must match the associated down-mix metadata associated with the multi-channel track.

Regardless of the type of downmix used to generate the stereo track, it must still be normalized in terms of loudness in accordance with the requirements detailed in paragraph 4.6

In case of mono contents on the multi-channel track, it is important to maintain consistency of the sound front by avoiding switching between "Center Only" (content only available on the central channel) and "Phantom Center" (content only available on Left/Right channels)

If multi-channel audio is obtained through *upmixing*⁸ algorithms, such contents must be free from artifacts and cancellation phenomena when used by subsequent stereo or mono down-mix.

In case of multichannel track provided as discrete channels (i.e. using a 16 audio track configuration as described in paragraph 10.2), the metadata associated with such multichannel track should be provided in conformity with the SMPTE 2020-3 standard (Method B); while for track identification refer to paragraph 8.6.

4.3 **Assignment of audio tracks**

Chapter **Errore. L'origine riferimento non è stata trovata.** collects the different audio track allocation defined by RAI depending on the number of audio tracks supported.

In case of multichannel audio (MCA), audio tracks "number 1" and "number 2" of the media content must contain the stereo downmix or the balanced stereo mix (possibly encoded in Dolby Surround) for multichannel audio.

For 3DTV products, audio tracks must be present on media for left and right eyes alike. Audio content and track assignment must be the identical.

4.4 **Alignment tones and audio channel identification**

Alignment tones audio level (AL) must be of -18 dBFS (PPM4 on a PPM BBC – IEC type IIa instrument), with an amplitude tolerance not greater than ± 0.1 dB.

The alignment tone frequency must be 1 kHz ± 100 Hz for front channels L, C and R, and LS and RS for surround channels, and 80 Hz ± 5 Hz for the LFE channel.

If a program is created on a system with an alignment level of -20 dBFS, the program vendor must adapt the tone alignment level to -18 dBFS, as well as making sure that the program continues to comply with the requirements indicated in paragraphs 4.5 (Maximum audio level) and 4.6 (Program Loudness Level).

⁷ Downmix: A type of processing that allows the reproduction of a sound mix on a lesser number of loudspeakers

⁸ Upmix: Type of processing that simulates a wider sound front (i.e. from mono front to stereo front, from stereo front to surround)

Alignment tones must be sinusoidal, distortion-free and ensure phase consistency between channels.

Please note that alignment tone levels must be obtained with equipment working in PRESET⁹ configuration.

Channel identification must comply with EBU Tech 3304; on all channels, 3 seconds of 1 kHz tone are followed by 0.5 seconds of silence, after which the channels are identified in a clockwise direction starting from channel L. The identification signal is a 1 kHz tone lasting 0.5 seconds followed by 0.5 seconds of silence before the tone for the next channel; after a final pause of 0.5 seconds, the sequence is repeated from 3 seconds of continuous tone consistently on all channels.

The time needed for each identification sequence depends on the number of channels in the chosen format (for example, 6 seconds for 5.1 or 5.0 audio) and thereby indirectly detects the multi-channel format chosen.

The entire identification sequence must be repeated at least 4 times; in the interval between the end of the last sequence and the end of the colour bars, the 1 kHz tone must remain active on all the main channels.

The 80 Hz tone on the LFE channel is continuous for the duration of the sequence. Although the tone is adjusted to the alignment level, by convention the LFE channel is reproduced at a level 10 dB higher compared to the main channels and consequently a certain degree of balance is maintained for perceived loudness.

4.5 *Maximum audio level*

Maximum audio level refers to the "True-Peak Audio Level" concept defined in recommendation ITU-R BS.1770.

The measurement of the Maximum True Peak Audio Level must be taken using an instrument that complies with the method defined in ITU-R BS.1770 Recommendation

The Maximum Audio Level True Peak allowed is -2.0 dBTP.

4.6 *Program Loudness Level*

The *Program Loudness Level* (average program loudness) is defined in recommendation EBU R128 and must be measured using instruments that conform to the measurement method described in ITU-R BS.1770 Recommendation.

Measurement of the *Program Loudness Level* must refer to the entire duration of the program starting from the first frame, excluding header and footer technical signals.

The *Program Loudness Level* measured must meet the Target Level of -23 LUFS +/-0.5 LU as required in EBU R128 Recommendation.

The same *Program Loudness Level* must be assured across the various soundtracks present (e.g. stereo soundtrack and multi-channel soundtrack)

4.7 *Audio/video synchronization*

The timing relationship between sound and image (sync) must not have any perceptible errors.

⁹The PRESET configuration implies a unity gain - 0 dB

Sound and image must be synchronized in accordance with recommendation EBU R37: sound must not be more than 5 milliseconds in advance or more than 15 milliseconds in delay compared to the image.

4.8 Dolby E Specifications

Dolby E is a proprietary audio compression format intended for professional use.

For multichannel audio content encoded in Dolby E, RAI requires that:

- The Dolby E track uses a 16 bit *word-size* (5.1 configuration transport). The 20 bit *word-size* is accepted only on specific agreement with RAI.
- If the stereo track is obtained through an automatic downmix process from the Dolby E track, this down-mix is automatically generated in the Lo/Ro mode¹⁰ using the downmix metadata on the Dolby E track
- The Dolby E track must be suitably anticipated to exactly compensate the Dolby E encoding delay of 40 milliseconds, consistently with the frame rate of the video formats specified in this document
- The Dolby E track must meet Dolby specifications as regards time alignment with the video signal, with special attention to guard band¹¹
- The metadata on the Dolby E track must be consistent with track content, especially as regards *Dialogue Level*
- Dolby metadata must remain constant for the entire duration of the program

Paragraph 9.3 lists the Dolby metadata required by RAI.

5. Subtitles

If subtitles in Italian and/or English are requested, they must be encoded in accordance with recommendation EBU Tech 3264. Generally speaking, the use of burn-in subtitles on the video is not encouraged. If they are present, their position must comply with the indications in paragraph 3.5 for the "safe area".

For 3DTV content, the subtitle should normally be perceived on the screen plane. The position in relation to the sense of depth must be closer to the viewer than the part of the image obscured by the subtitle. A reference standard in this regard is being investigated by various international bodies.

6. Program layout

RAI requires that the product supplied follows the layout summarised in **Table 1**

The content of each section is described in detail in the following paragraphs.

¹⁰The Lo/Ro downmix mode (Left Only/Right Only) is the sum of the Ls and Rs rear channels respectively with L and R front channels. The central channel C is divided equally between the two resulting channels. Any LFE channel is excluded.

¹¹ For more information <http://www.dolby.com/us/en/technologies/dolby-e-preferred-alignment.html>

RAI also requires that this structure is seamlessly maintained, i.e. that there are no interruptions between the various sections of the structure.

<u>Section</u>	<u>Duration (seconds)</u>	<u>Video</u>	<u>Audio</u>
protection tail ¹²	10" (minimum)	not recorded	not recorded
alignment tail	60" (minimum)	SMPTE colour bars at 75%	1 kHz at reference level
identification tail	5" (minimum) 15" (maximum)	visual program identification	sound or silence identification
start tail	10"	countdown	silence
Program	program duration	program video	program audio
end tail	30" (minimum)	black	silence

Table 1 - Program layout

6.1 Protection tail

Only for **video tape media** (e.g. Sony HDCAM-GR), the header of the program must have a minimum protection tail of 10 seconds with an unrecorded portion of tape.

6.2 Alignment tail

Reference signals must be recorded after the protection tail (only requested for tape media). The timecode track also starts at the start of the alignment tail.

The reference signals are:

- video: SMPTE colour bars at 75% saturation with apparatus in PRESET configuration
- Audio: see paragraph 4.4

6.3 Identification tail

The program must be identified by a static recorded image lasting max 15 seconds; the image must display essential programme information (in keeping with the information provided on the accompanying sheet and label). This essential information is listed in **Table2**:

¹² Present only for video tape media

Field	Notes
Name of producer	
Title	<i>For serials, also indicate the season number</i>
Subtitle and/or number of the season	<i>Indicated in the 1/N, 2/N etc. format, where N is the total number of parts in the program If the program is recorded on just one video media, the wording "1/1" should be included</i>
Number of video media	
Audio track structure	<i>Identifies the structure using the RAI-ID index coded in the tables in Section</i>
Video image format	
Original image format	
Duration	<i>Expressed in hh:mm:ss:ff</i>

Table2 - Content of Identification tail

6.4 Starting tail

The starting tail must last exactly 10 seconds and must contain the circular clock countdown. The countdown must be interrupted 2 seconds before the start of the program. The aspect format must be 1.78 (16:9). Audio should be silent for the entire duration of the tail. The timecode in harmony with the values of the previous parts must in any case be present.

6.5 End tail

After the program ending, there should be at least 30 seconds of black and silence with the timecode in any case present and in keeping with the program.

6.6 Timecode

All video media and files should be supplied with timecodes.

The timecode must be a continuous, increasing monotone without jumps or interruptions for the entire duration of the program.

The timecode signal must comply with the SMPTE 12M-1 standard.

The timecode for the first frame of the program must be 10:00:00:00

Table 3 Provides an example of timecode values for the first frame of the program with timecode 10:00:00:00. Refer to the recording structure described in Section 6.

<u>Timecode start</u>	<u>Section</u>	<u>Duration</u>
Support 1		
No timecode	Possible protection tail	10"
09:58:35:00	alignment tail	60"
09:59:35:00	identification tail	15"
09:59:50:00	start tail	10"
10:00:00:00	Program	90'
11:30:00:00	end tail	30"

Table 3 - Example of timecode for a program lasting 90 minutes

Different timecode values will be allowed only after prior arrangement with RAI.

In any case, the timecode throughout the program in individual media must be continuous, consistent and error-free and must never pass through zero at any point in the entire recording (including tails).

For **3DTV** content distributed on different media or files for left and right channels, the timecode must be the same on both to ensure correct alignment during playback.

7. Delivery formats

Material can be delivered on physical media as well as by sending the product via file transfer.

For physical media, use the professional video media envisaged by RAI or computer media containing files compliant with the specifications defined in paragraph 8.

The delivery mode will be indicated by RAI in the purchase agreement.

7.1 Delivery using professional video media

SDTV products must be delivered to RAI exclusively on re-writable *Sony Professional Disc XDCAM* optical media.

HDTV content delivered to RAI on re-writable *Sony Professional Disc XDCAM* optical media must be in **1080i25** format.

Following specific agreement with RAI, **HDTV 1080i25** and **1080p25** content can be delivered not only on re-writable *Sony Professional Disc XDCAM* optical media but also on Sony HDCAM-SR magnetic tape media.

3DTV content must be delivered to RAI using re-writable *Sony Professional Disc XDCAM* optical media respectively containing left and right eye signals (left channel and right channel), correctly identified by labels as described below and containing coherent timecode information.

UHDTV content may only be delivered by using files.

In any case, the delivered product must originate from the master in the highest possible quality, minimizing the number of encodings.

Video media must be in perfect condition (no abrasions, breakages or mechanical defects) and must be free from any imperfection that may cause a perceptual defect of audio/video content.

7.2 Delivery using IT media - file naming convention

RAI only accepts Hard Disk Drives with USB 3 interface formatted with the NTFS file system¹³.

Files delivered using Hard Disk Drives must be readable without errors, i.e. the MD5¹⁴ hash¹⁵ calculated by reading each file received must match the MD5 hash listed by vendors in files with a “.MD5” extension

RAI requires that files delivered using Hard Disk Drives comply with the following nomenclature:

<Title>_s<SeasonNum>_ep<EpisodeNumber>_<EpisodeTitle1>_<FORMAT>

¹³ <https://en.wikipedia.org/wiki/NTFS>

¹⁴ <https://en.wikipedia.org/wiki/Md5sum>

¹⁵ https://en.wikipedia.org/wiki/Hash_function

Where <FORMAT>, in harmony with the file profile, may have one of the following values: **1080i25, 1080p25, 1080p50, 2160p25, 2160p50**

Examples:

- *LoremIpsum_s09_ep001_DolorSitAmet_1080i25.MXF*
- *LoremIpsum_s09_ep001_DolorSitAmet_2160p25.MXF*

For delivery of 3DTV products, the delivered files must use the following nomenclature:

<Title>_s<SeasonNum>_ep<EpisodeNum>_<EpisodeTitle>_<FORMAT>_<LH|RH>

Example:

- *LoremIpsum_s09_ep001_DolorSitAmet_1080i25_LH.MXF*
- *LoremIpsum_s09_ep001_DolorSitAmet_1080i25_RH.MXF*

At the specific request of RAI, files may be delivered that contain multiple episodes ("assembled files").

In this case, the nomenclature of delivered files must be:

<Title>_s<SeasonNum>_ep<EpisodeNum>_<EpTitle1>_<EpTitle2>_<FORMAT>

Example:

- *LoremIpsum_s09_ep001_DolorSitAmet_ConsecteturAdipisciElit_1080i25.MXF*

For delivery of 3DTV products, files containing several episodes must use the following nomenclature:

<Title>_s<SeasonNum>_ep<EpisodeNum>_<EpTitle1>_<EpTitle2>_<FORMAT>_<LH|RH>

Example:

- *LoremIpsum_s09_ep001_DolorSitAmet_ConsecteturAdipisciElit_1080i25_LH.MXF*
- *LoremIpsum_s09_ep001_DolorSitAmet_ConsecteturAdipisciElit_1080i25_RH.MXF*

7.3 Delivery using IT media - file organisation

The organisation of files on IT media must use of folders.

It is required that each audio/video file, even if delivered in different technical versions, should be contained in a specific folder having the same file name (without extension), with the exception of 3DTV products which must have 2 audio/video files and respective MD5 hash files.

The same folder must also include:

- The data sheet in XML format
- the MD5 hash file

Example:

→ **<LoremIpsum_s09_ep001_DolorSitAmet_1080i25> (folder)**

→ *LoremIpsum_s09_ep001_DolorSitAmet_1080i25.MXF (audio/video file)*

→ *LoremIpsum_s09_ep001_DolorSitAmet_1080i25.XML*(technical electronic card)

→ *LoremIpsum_s09_ep001_DolorSitAmet_1080i25.MD5* (hash file)

For delivery of 3DTV products, RAI requires:

- delivery of pairs of files respectively containing left and right eye signals (left channel and right channel). For file nomenclature, the reference paragraph is 7.2
- both files should comply with standards for material having identical formats (e.g. HDTV, UHDTV) contained in these specifications
- both files should contain the same audio track in sync with the video track.

7.4 Delivery by IT transfer

Delivery of the product by IT transfer can take place as follows:

- Web services and FTP
- RAI Web App and file handling system

For both modes of delivery, the process involves the following steps:

- Indication of contract number with RAI by the vendor to the delivery system
- Selection of the program file to be delivered among those associated with the purchase contract displayed by the delivery system
- Issuing of a ticket (code) identifying the delivery
- Sending of a single file with reference to the ticket issued as per the previous point.

After notifying the vendor, RAI reserves to indicate and modify references to the web applications to be used for product delivery.

Operating information is available online at the following address:

www.qualitaepianificazione.rai.it

7.5 Programs delivered on multiple media

If the duration of a program exceeds the maximum capacity of the physical medium delivered or RAI itself expresses additional constraints that make splitting the program necessary, it will have to be delivered on multiple media and/or several files.

In this case, program images at the end of one media must link without overlapping and without gaps with those at the beginning of the next media.

Media must be numbered sequentially starting from 1.

The program timecode must be progressive between the various media, so that there are no discontinuities between the last effective frame of the previous part and the first frame of the following part of the program (paragraph 6.6).

The recording structure of each media or file must in any case comply with the indications listed in paragraph 6.

Each physical medium must not contain more than one programme, except the case of compilations of uniform and very short programs.

7.6 Accompanying documentation and labelling

Each product delivered on professional video or IT media must:

- have a label containing a minimal set of listed information required for identification, listed in **Table 4**
- be accompanied by a technical file as indicated in section 9

Field	Notes
RAI contract number	
Code <i>Format identifier</i>	<i>See section 11</i>
Full title of program	<i>For serials, also indicate the season number</i>
Episode number	
Episode title	
Image format/Aspect Ratio	
Audio track structure	<i>Identify the structure by the RAI-ID index as specified in the tables in Chapter 10</i>

Table 4 - Media labelling

The information provided on the media label must also be included on the label affixed to the relative packaging (container).

7.7 Subtitles

Delivery modes for files containing subtitles vary depending on the format or delivery method of the product and are indicated in **Table 5**.

delivery mode of audio/video product	Delivery mode of subtitles
Sony Professional Disc media	Storage in user space on disk
delivery with IT media (hard disk drive)	Storage on the same IT media
delivery by IT transfer	Send using the procedures envisaged by the application used for transfer

Table 5 - Subtitle delivery mode

With the exception of the IT transfer delivery mode, files containing subtitles must comply with the same nomenclature indicated in paragraph 7.2 to which a suffix must be added to identify the language of the subtitles.

Nomenclature:

<Title>_s<SeasonNum>_ep<EpisodeNum>_<EpisodeTitle1>_<FORMAT>_sub<LANG>

Example:

audio/video files

LoremIpsum_s09_ep001_DolorSitAmet_1080i25.MXF

file subtitles in Italian

LoremIpsum_s09_ep001_DolorSitAmet_1080i25_subIT.STL

file subtitles in English

LoremIpsum_s09_ep001_DolorSitAmet_1080i25_subEN.STL

For delivery of 3DTV products, files containing subtitles must use the following nomenclature:

<Title>_s<SeasonNum>_ep<EpisodeNum>_<EpisodeTitle>_<FORMAT>_<LH|RH>_sub<LANG>

Example:

audio/video files

LoremIpsum_s09_ep001_DolorSitAmet_1080i25_LH.MXF

LoremIpsum_s09_ep001_DolorSitAmet_1080i25_RH.MXF

file subtitles in Italian

LoremIpsum_s09_ep001_DolorSitAmet_1080i25_LH_subIT.STL

LoremIpsum_s09_ep001_DolorSitAmet_1080i25_RH_subIT.STL

8. File format - Technical Specification

This section describes both general and detailed technical specifications required for delivery of products to RAI using file formats. Specific requirements are grouped into **Profiles**, i.e. sets of technical specifications that characterise the audio/video files used in professional spheres and admitted for delivery.

The file container formats accepted by RAI are:

- Material Exchange Format (file extension “.MXF”) for the profiles described in paragraphs 8.7, 8.8, 8.9, 8.10, 8.12, 8.13, 8.14, 8.17, 8.18, 8.19 and 8.20.
- Apple Quicktime¹⁶ (typical file extension “.MOV”) for the profiles described in paragraphs 8.11, 8.15 and 8.16

Errore. L'origine riferimento non è stata trovata. **Table 6** contains the pertinent SMPTE standard for the MXF content.

¹⁶ <https://developer.apple.com/library/mac/documentation/QuickTime/QTFF/QTFFPreface/qtffPreface.html>

SMPTE Reference	Title
SMPTE 326	SMPTE Standard - for Television — SDTI Content Package Format (SDTI-CP)
SMPTE 356	SMPTE Standard - Type D-10 Stream Specifications — MPEG-2 4:2:2P @ ML for 525/60 and 625/50
SMPTE 377	SMPTE Standard - Material Exchange Format (MXF) - File Format Specification
SMPTE 378	SMPTE Standard - Material Exchange Format (MXF) — Operational pattern 1A (Single Item, Single Package)
SMPTE 379-1	SMPTE Standard - Material Exchange Format (MXF) — MXF Constrained Generic Container
SMPTE 379-2	SMPTE Standard - Material Exchange Format (MXF) — MXF Generic Container
SMPTE 381-1	SMPTE Standard - Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF Generic Container
SMPTE 381-2	SMPTE Standard - Material Exchange Format (MXF) - Mapping MPEG Streams into the MXF Constrained Generic Container
SMPTE 381-3	SMPTE Standard - Material Exchange Format—Mapping AVC Streams into the MXF Generic Container
SMPTE 382	SMPTE Standard - Material Exchange Format — Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container
SMPTE 385	SMPTE Standard - for Television - Material Exchange Format (MXF) Mapping SDTI-CP Essence and Metadata into the MXF Generic Container
SMPTE 386	SMPTE Standard - for Television — Material Exchange Format (MXF) Mapping Type D-10 Essence Data to the MXF Generic Container

Table 6 - SMPTE Standard for MXF

8.1 File compliance tools and profiles

The vendor is required to verify in advance the compliance of the audio/video files supplied in relation to these Technical Specifications and is also required to use the methods and control instruments that RAI has the faculty to indicate when stipulating the contract.

8.2 Aspect Ratio, Active Format Description and Bar Data

For delivery of MXF files, the following is required:

- the presence and the correct signalling of the Aspect Ratio in the MXF header
- the presence and the correct signalling of the Active Format Description (AFD) based on the active region of the image (excluding black bars at the edges.)

The reference standard for AFD is SMPTE 2016-1

If the AFD is unable to describe the aspect ratio of the image, use Bar Data in accordance with the SMPTE 2016-1 standard.

8.3 Timecode

The timecode must be included in the MXF metadata in accordance with the SMPTE 12 M-1 standard and the EBU R122 Recommendation. In particular, the following is required:

- The timecode must be present as a separate and incremental monotone track in the Material Package

- If the timecode is present in other locations (e.g. Source Package and/or System Item), it must coincide with the Material Package timecode

8.4 Track duration

The duration of video and audio tracks and timecodes must be fully aligned.

8.5 File segmentation

Unless explicitly agreed otherwise with RAI, delivery of products segmented on multiple files is **not** allowed.

8.6 Audio track layout

Each **Profile** must have audio organisation (as regards the number of tracks and the number of channels per track) that meets the dispositions indicated in Table 7:

number of tracks	Channels per track	Profile	paragraph
1	8	<i>SDTV MXF/D10</i>	8.7
8	1	<i>HDTV MXF/XDCAM HD422 1080i25</i>	8.8
16	1	<i>HDTV MXF/AVC 1080p25</i>	8.9
		<i>HDTV MXF/AVC 1080p50</i>	8.10
		<i>HDTV MOV/ProRes422HQ 1080p25</i>	8.11
		<i>HDTV MOV/ProRes4444 1080p25</i>	8.12
		<i>UHDTV MXF/AVC 2160p25</i>	8.13
		<i>UHDTV MXF/AVC 2160p50</i>	8.14
		<i>UHDTV MOV/ProRes4444 2160p25</i>	8.15
		<i>UHDTV MOV/ProRes4444 2160p50</i>	8.16
		<i>UHDTV MXF/DNxHR 2160p25</i>	8.17
		<i>UHDTV MXF/DNxHR 2160p50</i>	8.18
		<i>UHDTV MOV/ProRes422HQ 2160p25</i>	8.19
<i>UHDTV MOV/ProRes422HQ 2160p50</i>	8.20		

Table 7 – Audio channel/track organisation

8.7 SDTV MXF/D10 Profile

The main features of the SDTV MXF/D10 are summarised in Table 8.

SDTV MXF/D10 Profile Characteristics	
MXF Operational Pattern	OP-1a
Essence Container	SMPTE D10 Mapping
Video	720x576 (image in 720x576) 25 frames per second, interlaced scan, YCbCr, 4:2:2, 8 bit MPEG-2, INTRA Only, 50Mbit/s
Audio	8 mono channels PCM, 48KHz, 16 bit
References to specific standards	
SMPTE ST386:2004	Material Exchange Format (MXF) — Mapping Type D-10 Essence Data to the MXF Generic Container
SMPTE ST356:2001	Material Exchange Format (MXF) — MPEG-2 4:2:2P @ ML for 525/60 and 625/50
ISO/IEC 13818-2	Generic coding of moving pictures and associated audio– Part 2: Video

Table 8 - SDTV MXF/D10 Profile

Note: the use of MPEG2 in SMPTE356 requires Profile 4:2:2 using only INTRA coding, value restrictions and constant bit-rates and other limitations.

8.8 HDTV MXF/XDCAM HD422 1080i25 Profile

Table 9 summarises the main characteristics of the *HDTV MXF/XDCAM HD422 1080i25* profile based on the specifications indicated in document SMPTE RDD9:2013.

Profile Characteristics HDTV MXF/XDCAM HD422 1080i25	
MXF Operational Pattern	OP-1a
Essence Container	MPEG ES Mapping, AES-BWF Mapping Generic Essence Multiple Mapping
Video	1920x1080 pixels, 25 frames per second, interlaced scan, YCbCr, 4:2:2, 8 bit MPEG-2 Long GOP, 50Mbit/s
Audio	8 mono channels PCM, 48KHz, 24 bit
References to specific standards	
SMPTE RDD 9:2013	MXF Interoperability Specification of Sony MPEG Long GOP Products
ISO/IEC 13818-2	Generic coding of moving pictures and associated audio– Part 2: Video

Table 9 - HDTV MXF/XDCAM HD422 1080i25 Profile

8.9 HDTV MXF/AVC 1080p25 Profile

Table 10 Summarises the main characteristics of the *HDTV MXF/AVC 1080p25* profile based on the specifications indicated in document SMPTE RDD 32:2014.

Profile Characteristics HDTV MXF/AVC 1080p25	
MXF Operational Pattern	OP-1a
Essence Container	AVC ES Mapping, AES-BWF Mapping Generic Essence Multiple Mapping
Video	1920x1080 pixels, 25 frames per second, progressive scan, YCbCr, 4:2:2, 10 bit MPEG AVC Long GOP, 50Mbit/s
Audio	16 mono channels PCM, 48KHz, 24 bit
References to specific standards	
SMPTE RDD32:2014	XAVC MXF Mapping and Operating Points
ISO/IEC 14496-10:2012	Coding of audio-visual objects – Part 10: Advanced Video Coding

Table 10 – HDTV MXF/AVC 1080p25 Profile

8.10 HDTV MXF/AVC 1080p50 Profile

Table 11 Summarises the main characteristics of the *HDTV MXF/AVC 1080p50* profile based on the specifications indicated in document SMPTE RDD 32:2014.

Profile Characteristics HDTV MXF/AVC 1080p50	
MXF Operational Pattern	OP-1a
Essence Container	AVC ES Mapping, AES-BWF Mapping, Generic Essence Multiple Mapping
Video	1920x1080 pixels, 50 frames per second, progressive scan, YCbCr, 4:2:2, 10 bit MPEG AVC Intra Profile, Class 200¹⁷
Audio	16 mono channels PCM, 48KHz, 24 bit
References to specific standards	
SMPTE RDD32:2014	XAVC MXF Mapping and Operating Points
ISO/IEC 14496-10:2012	Coding of audio-visual objects – Part 10: Advanced Video Coding

Table 11 – HDTV MXF/AVC 1080p50 Profile

¹⁷ See SMPTE RP2027:2012

8.11 HDTV MOV/ProRes422HQ 1080p25 profile

Table 12 summarises the main characteristics of the *UHDTV MOV/ProRes 1080p25* profile based on the Apple ProRes compression format.

Profile Features - HDTV MOV/ProRes422HQ 1080p25	
Essence Container	Apple Quicktime
Video	1920x1080 pixels, 25 frames per second, progressive scan RGB, 4:2:2, 10 bit Apple ProRes 422HQ ¹⁸
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 12 - HDTV MOV/ProRes422HQ 1080p25 profile

8.12 HDTV MOV/ProRes4444 1080p25 profile

Table 13 summarises the main characteristics of the *UHDTV MOV/ProRes 1080p25* profile based on the Apple ProRes compression format.

Profile Features - HDTV MOV/ProRes4444 1080p25	
Essence Container	Apple Quicktime
Video	1920x1080 pixels, 25 frames per second, progressive scan RGB, 4:4:4, 10 bit Apple ProRes 4444 ¹⁹
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 13 - HDTV MOV/ProRes4444 1080p25 profile

¹⁸ https://www.apple.com/final-cut-pro/docs/Apple_ProRes_White_Paper.pdf

¹⁹ https://www.apple.com/final-cut-pro/docs/Apple_ProRes_White_Paper.pdf

8.13 UHDTV MXF/XAVC 2160p25 Profile

Table 14 Summarises the main characteristics of the *HDTV MXF/XAVC 2160p25* profile based on the specifications indicated in document SMPTE RDD 32:2014

Profile Characteristics UHDTV MXF/AVC 2160p25	
MXF Operational Pattern	OP-1a
Essence Container	AVC ES Mapping, AES-BWF Mapping, Generic Essence Multiple Mapping
Video	3840x2160 pixels, 25 frames per second, progressive scan, YCbCr, 4:2:2, 10 bit XAVC 4K Intra CBG Profile Class 480²⁰
Audio	16 mono channels PCM, 48KHz, 24 bit
References to specific standards	
SMPTE RDD32:2014	XAVC MXF Mapping and Operating Points
ISO/IEC 14496-10:2012	Coding of audio-visual objects – Part 10: Advanced Video Coding

Table 14 - UHDTV MXF/AVC 2160p25 Profile

8.14 UHDTV MXF/XAVC 2160p50 Profile

Table 15 summarises the main characteristics of the *UHDTV MXF/XAVC 2160p50* profile based on the specifications indicated in document SMPTE RDD 32:2014.

Profile Characteristics UHDTV MXF/AVC 2160p50	
MXF Operational Pattern	OP-1a
Essence Container	AVC ES Mapping, AES-BWF Mapping Generic Essence Multiple Mapping
Video	3840x2160 pixels, 50 frames per second, progressive scan, YCbCr, 4:2:2, 10 bit XAVC 4K Intra CBG Profile Class 480²⁰
Audio	16 mono channels PCM, 48KHz, 24 bit
References to specific standards	
SMPTE RDD32:2014	XAVC MXF Mapping and Operating Points
ISO/IEC 14496-10:2012	Coding of audio-visual objects – Part 10: Advanced Video Coding

Table 15 - UHDTV MXF/AVC 2160p50 Profile

²⁰ See SMPTE RDD32:2014

8.15 UHDTV MOV/ProRes4444 2160p25 profile

Table 16 summarises the main characteristics of the UHDTV MOV/ProRes ProRes4444 2160p25 profile based on the Apple ProRes compression format

Profile Features - UHDTV MOV/ProRes4444 2160p25	
Essence Container	Apple Quicktime
Video	3840x2160 pixels, 25 frames per second, progressive scan RGB, 4:4:4, 12 bit Apple ProRes 4444²¹
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 16 - UHDTV MOV/ProRes4444 2160p25 profile

8.16 UHDTV MOV/ProRes4444 2160p50 profile

Table 17 summarises the main characteristics of the UHDTV MOV/ProRes ProRes4444 2160p50 profile based on the Apple ProRes compression format

Profile Features - UHDTV MOV/ProRes4444 2160p50	
Essence Container	Apple Quicktime
Video	3840x2160 pixels, 50 frames per second, progressive scan, RGB, 4:4:4, 12 bit Apple ProRes 4444²¹
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 17 - UHDTV MOV/ProRes4444 2160p50 profile

²¹ https://www.apple.com/final-cut-pro/docs/Apple_ProRes_White_Paper.pdf

8.17 UHDTV MXF/DNxHR 2160p25 Profile

Table 18 summarises the main characteristics of the *UHDTV MXF/DNxHR 2160p25* profile based on the AVID DNxHR compression format.

Profile Characteristics <i>UHDTV MXF/DNxHR 2160p25</i>	
Essence Container	MXF
Video	3840x2160 pixels, 25 frames per second, progressive scan, YCbCr, 4:2:2, 12 bit AVID DNxHR HQX²²
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 18 - UHDTV MXF/DNxHR 2160p25 Profile

8.18 UHDTV MXF/DNxHR 2160p50 Profile

Table 19 Summarises the main characteristics of the *UHDTV MXF/DNxHR 2160p50* profile based on the AVID DNxHR compression format

Profile Characteristics <i>UHDTV MXF/DNxHR 2160p50</i>	
Essence Container	MXF
Video	3840x2160 pixels, 50 frames per second, progressive scan, YCbCr, 4:2:2, 12 bit AVID DNxHR HQX²²
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 19 - UHDTV MXF/DNxHR 2160p50 Profile

8.19 UHDTV MOV/ProRes422HQ 2160p25 profile

Table 20 summarises the main characteristics of the *UHDTV MOV/ProRes ProRes422HQ 2160p25* profile based on the Apple ProRes compression format

Profile Features - <i>UHDTV MOV/ProRes422HQ 2160p25</i>	
Essence Container	Apple Quicktime
Video	3840x2160 pixels, 25 frames per second, progressive scan, YCbCr, 4:2:2, 10 bit Apple ProRes 422HQ²³
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 20 - UHDTV MOV/ProRes422HQ 2160p25 profile

²² http://resources.avid.com/SupportFiles/attach/HighRes_WorkflowsGuide.pdf

²³ https://www.apple.com/final-cut-pro/docs/Apple_ProRes_White_Paper.pdf

8.20 UHDTV MOV/ProRes422HQ 2160p50 profile

Table 21 summarises the main characteristics of the *UHDTV MOV/ProRes ProRes422HQ 2160p50* profile based on the Apple ProRes compression format

Profile Features - UHDTV MOV/ProRes422HQ 2160p50	
Essence Container	Apple Quicktime
Video	3840x2160 pixels, 50 frames per second, progressive scan, YCbCr, 4:2:2, 10 bit Apple ProRes 422HQ²⁴
Audio	16 mono channels PCM, 48KHz, 24 bit

Table 21 - UHDTV MOV/ProRes422HQ 2160p50 profile

²⁴ https://www.apple.com/final-cut-pro/docs/Apple_ProRes_White_Paper.pdf

9. Metadata and Technical documentation

On delivery of the product, RAI also requires the delivery of specific technical documentation as listed in Table 22 .

Delivery mode of audio/video product	Delivery mode of technical documentation
Sony Media Professional Disc	Printed technical data sheet and Technical data sheet in electronic format included in the data space on the media
IT media (hard disk drive)	Technical data sheet in electronic format included in the IT media containing the product
IT transfer	IT transfer of the technical data sheet in electronic format using the allowed procedures

Table 22 - Technical documentation delivery method

9.1 Printed technical data sheet

The printed technical data sheet to be attached to the product must contain the metadata indicated in Table 23.

Metadata	Notes
Producer	
Reference Contact	
RAI contract number	
Code <i>Format identifier</i>	<i>See section 11</i>
ISAN code	<i>Acronym for International Standard Audiovisual Number</i> http://www.isan.org/
Full title	
Season number	<i>for “serials”, also indicate the season number</i>
Episode number	
Episode title	
Media numbering	<i>For SD, HD and UHD products, the media number should be written in the format 1/N, 2/N, etc., where N is the total number of items making up the program; when there is only one media item, the wording “1/1” should preferably be included.</i> <i>For 3DTV materials, the media number should be written in the format 1/N-LH, 2/N-LH, etc., for the LH channel and 1/N-RH, 2/N-RH, etc., for the RH channel where N is the total number of items making up the program and LH/RH identify the channel; when there is only one media item, the wording “1/1-LH” and “1/1-RH” should preferably be included</i>
Overall program duration	<i>In hh:mm:ss:ff format</i>
Program duration on the media	<i>if delivery is made on multiple media</i>
Image format / Aspect Ratio	
Original image format	
Audio track structure	<i>Identify the structure by using the RAI-ID index as specified in the tables in Chapter 10</i>
Program start timecode	
Program end timecode	
Presence of upconverted or inferior quality material	

Table 23 - Printed technical data sheet

9.2 Technical data sheet in electronic format

For the supply of the technical data sheet in electronic format, RAI effectively requires the same information provided by the printed version but in the following formats:

1. *XML*²⁵ file complying with the “EBU Core Metadata Set” format standard (EBUCore) version 1.6 (June 2015). For IT media, this file must be included in the same folder as the audio/video file and have the same name but the file extension “.XML”. For XDCAM media, the file must be saved in the data area of the media and have the same name as the audio/video file but the extension “.XML”.

See NOTES box for more information.

2. *XLS(X)* file in Microsoft Excel format (Office 2007 or more recent version). This file must faithfully reproduce the tabular format indicated in the specific reference document available through the following web address:
www.qualitaepianificazione.rai.it.

Example naming conventions:

audio/video files

Lorem Ipsum_s09_ep001_DolorSitAmet_1080i25.MXF

Technical data sheet in XML format

Lorem Ipsum_s09_ep001_DolorSitAmet_1080i25.XML

Technical data sheet in XLS format

Lorem Ipsum_s09_ep001_DolorSitAmet_1080i25.XLS

NOTES

The EBUCore standard is defined by EBU TECH 3293²⁶ technical specifications and the related *XML layout* with which *XML* tags must comply.

Compulsory metadata must be the same as that contained in the printed technical data sheet; additional and supplementary metadata may be provided freely but always in conformity with EBUCore.

These technical specifications are supported by specific documents provided by RAI that describe and illustrate the metadata mapping RAI requires as regards *xml* naming and allocation in the EBUCore standard.

These documents are available online at www.qualitaepianificazione.rai.it

²⁵ <https://it.wikipedia.org/wiki/XML>

²⁶ <https://tech.ebu.ch/docs/tech/tech3293.pdf>

9.3 Dolby E Metadata

If a soundtrack encoded in Dolby E is supplied, RAI requires that certain Dolby²⁷ metadata be restricted to specific values.

Restricted Dolby metadata are listed in Table 24

Dolby Metadata	values required by RAI
PROGRAMME CONFIG	5.1
BIT DEPTH	16
DIALOGUE LEVEL (DIALNORM)	-23 dBFS
CHANNEL MODE	3/2
LFE CHANNEL	ENABLED
RF OVER MODULATION PROTECTION	DISABLED
DOLBY SURROUND MODE	DISABLED
PREFERRED STEREO DOWN MIX	Lo/Ro
DOLBY SURROUND EX MODE	NOT SURROUND EX
A/D CONVERTER TYPE	STANDARD
DC FILTER	ENABLED
LOW PASS FILTER	ENABLED
LFE LOW PASS FILTER	ENABLED
SURROUND 3 dB ATTENUATION	DISABLED

Table 24 - Dolby Metadata required

Table 25 provides the list of Dolby metadata whose values must be defined by the supplier in relation to the product delivered.

Dolby Metadata	RAI Notes
LINE MODE COMPRESSION	Accepted values: <ul style="list-style-type: none"> FILM STANDARD FILM LIGHT
RF MODE COMPRESSION	Accepted values: <ul style="list-style-type: none"> FILM STANDARD FILM LIGHT
CENTRE DOWN MIX LEVEL	Typical value: -3dB
SURROUND DOWN MIX LEVEL	Typical value: -3dB
LT/RT CENTRE DOWN MIX LEVEL	Typical value: -3dB
LT/RT SURROUND DOWN MIX LEVEL	Typical value: -3dB
LO/RO CENTRE DOWN MIX LEVEL	Typical value: -3dB
LO/RO SURROUND DOWN MIX LEVEL	Typical value: -3dB

Table 25 - Dolby Metadata managed by supplier

²⁷ <http://www.dolby.com/us/en/technologies/a-guide-to-dolby-metadata.pdf>

10. Audio tracks layout

10.1 Audio configurations on 8 tracks layout

RAI-ID	Configuration	Tracks	Audio Track Number							
			1	2	3	4	5	6	7	8
8T01	Dual Mono/ITA	8	Complete mix Dual Mono (ITA)	Complete mix Dual Mono (ITA)	mute	mute	mute	mute	mute	mute
8T02	Stereo/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	mute	mute	mute	mute	mute	mute
8T03	Stereo/ITA+ Stereo/OTH	8	Complete mix Left (ITA)	Complete mix Right (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	mute	mute	mute	mute
8T04	Dual Mono/OTH+ M&E	8	Complete mix Dual Mono (OTH)	Complete mix Dual mono (OTH)	Music&Effects Dual mono	Music&Effects Dual mono	mute	mute	mute	mute
8T05	Stereo/ITA+ M&E	8	Complete mix Left (ITA)	Complete mix Right (ITA)	Music&Effects Left	Music&Effects Right	mute	mute	mute	mute
8T06	Stereo/OTH+ M&E	8	Complete mix Left (OTH)	Complete mix Right (OTH)	Music&Effects Left	Music&Effects Right	mute	mute	mute	mute
8T07	Stereo/ITA + M&E + MCA/ITA + AD/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	Music&Effects Left	Music&Effects Right	MCA Dolby E (ITA)	MCA Dolby E (ITA)	AD Left (ITA)	AD Right (ITA)
8T08	Stereo/ITA + Stereo/OTH + MCA/ITA + AD/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	MCA Dolby E (ITA)	MCA Dolby E (ITA)	AD Left (ITA)	AD Right (ITA)
8T09	Stereo/ITA + Stereo/OTH+ MCA/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	MCA Dolby E (ITA)	MCA Dolby E (ITA)	mute	mute
8T10	Stereo/ITA + MCA/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	mute	mute	MCA Dolby E (ITA)	MCA Dolby E (ITA)	mute	mute
8T11	Stereo/ITA + AD/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	mute	mute	mute	mute	AD Left (ITA)	AD Right (ITA)
8T12	Stereo/ITA+ MCA/ITA	8	Complete mix Left (ITA)	Complete mix Right (ITA)	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)
8T13	Stereo/OTH+MCA/OTH	8	Complete mix Left (OTH)	Complete mix Right (OTH)	MCA L (OTH)	MCA R (OTH)	MCA C (OTH)	MCA LFE (OTH)	MCA Ls (OTH)	MCA Rs (OTH)
8T14	Stereo/ITA+ MCA/M&E	8	Complete mix Left (ITA)	Complete mix Right (ITA)	MCA L (M&E)	MCA R (M&E)	MCA C (M&E)	MCA LFE (M&E)	MCA Ls (M&E)	MCA Rs (M&E)
8T15	Stereo/OTH+MCA/M&E	8	Complete mix Left (OTH)	Complete mix Right (OTH)	MCA L (M&E)	MCA R (M&E)	MCA C (M&E)	MCA LFE (M&E)	MCA Ls (M&E)	MCA Rs (M&E)

Table 26 - Audio configurations allowed on 8 tracks

Table 26 - Audio configurations allowed on 8 tracks - LEGEND

ITA= Italian **OTH**= Original language

MCA= multi-channel soundtrack

mute = silence

AD = Audio Description - TeleAudio

M&E=Music&Effects - Musica & Effetti (no dialogue)

Dual mono = mono channel replicated on two tracks

10.2 Audio configurations on 16 tracks layout

RAI-ID	Description	Tracks	Audio Track Number															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
16T01	Stereo/ITA	16	Complete mix Left (ITA)	Complete mix Right (ITA)	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute
16T02	Stereo/ITA + Stereo/OTH	16	Complete mix Left (ITA)	Complete mix Right (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute
16T03	Stereo/ITA + M&E	16	Complete mix Left (ITA)	Complete mix Right (ITA)	M&E Left	M&E Right	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute
16T04	Stereo/OTH + M&E	16	Complete mix Left (OTH)	Complete mix Right (OTH)	M&E Left	M&E Right	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute	mute
16T05	Stereo/ITA + M&E + MCA/ITA	16	Complete mix Left (ITA)	Complete mix Right (ITA)	M&E Left	M&E Right	mute	mute	mute	mute	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	mute	mute
16T06	Stereo/ITA + Stereo/OTH + AD/ITA+ MCA/ITA	16	Complete mix Left (ITA)	Complete mix Right (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	mute	mute	AD Left (ITA)	AD Right (ITA)	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	mute	mute
16T07	Stereo/ITA + Stereo/OTH + MCA/ITA	16	Complete mix Left (ITA)	Complete mix Right (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	mute	mute	mute	mute	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	mute	mute
16T08	Stereo/ITA + AD/ITA	16	Complete mix Left (ITA)	Complete mix Right (ITA)	mute	mute	mute	mute	AD Left (ITA)	AD Right (ITA)	mute	mute	mute	mute	mute	mute	mute	mute
16T09	Stereo/ITA + AD/ITA + MCA/ITA	16	Complete mix Left (ITA)	Complete mix Right (ITA)	mute	mute	mute	mute	AD Left (ITA)	AD Right (ITA)	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	mute	mute
16T10	Stereo/ITA + MCA/ITA + Stereo/OTH + MCA/OTH	16	Complete mix Left (ITA)	Complete mix Right (ITA)	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	Complete mix Left (OTH)	Complete mix Right (OTH)	MCA L (OTH)	MCA R (OTH)	MCA C (OTH)	MCA LFE (OTH)	MCA Ls (OTH)	MCA Rs (OTH)
16T11	MCA/ITA + AD/ITA + MCA/OTH + AD/OTH	16	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	AD Left (ITA)	AD Right (ITA)	MCA L (OTH)	MCA R (OTH)	MCA C (OTH)	MCA LFE (OTH)	MCA Ls (OTH)	MCA Rs (OTH)	AD Left (OTH)	AD Right (OTH)

16T12	Stereo/ITA + MCA/ITA + Stereo/M&E + MCA/M&E	16	Complete mix Left (ITA)	Complete mix Right (ITA)	MCA L (ITA)	MCA R (ITA)	MCA C (ITA)	MCA LFE (ITA)	MCA Ls (ITA)	MCA Rs (ITA)	M&E Left	M&E Right	MCA L (M&E)	MCA R (M&E)	MCA C (M&E)	MCA LFE (M&E)	MCA Ls (M&E)	MCA Rs (M&E)
16T13	Stereo/OTH + MCA/OTH + Stereo/M&E + MCA/M&E	16	Complete mix Left (OTH)	Complete mix Right (OTH)	MCA L (OTH)	MCA R (OTH)	MCA C (OTH)	MCA LFE (OTH)	MCA Ls (OTH)	MCA Rs (OTH)	M&E Left	M&E Right	MCA L (M&E)	MCA R (M&E)	MCA C (M&E)	MCA LFE (M&E)	MCA Ls (M&E)	MCA Rs (M&E)

Table 27 Audio configurations allowed on 16 tracks

Table 27 Audio configurations allowed on 16 tracks - LEGEND

ITA = Italian; **OTH** = Original Language;

MCA = multichannel, **mute** = silence

AD = Audio Description - TeleAudio

M&E=Music&Effects - Musica & Effetti (no dialogue)

L=Left; **R**=Right; **C**=Centre; **LFE**=Low Frequency Effects; **Ls**= Left Surround; **Rs**=Right Surround

Dual mono = mono channel replicated on two tracks

11. Code *Format identifier*

In order to simplify the identification of the required format, a “**Format Identifier**” code has been developed which RAI inserts in the text of the purchase contract.

The *Format Identifier* uniquely identifies the possible combinations of **<ID Format>**, **<ID Video Profile>** and **<ID Audio Profile>** values from those defined in these Technical Specifications.

The **Format Identifier** code comprises the series of three identifiers as listed in the tables of Attachment A (see section 12):

<ID Format>-<ID Video Profile>-<ID Audio Profile>

where:

- **<ID Format>** identifies the format/delivery media as listed in Table A1 of Attachment A
- **<ID Video Profile>** identifies the video profile as listed in Table A2 of Attachment A
- **<ID Audio Profile>** identifies the audio profile as listed in Tables A3 and A4 of Attachment A

<p>NOTE: The use of tables A3 and A4 for audio profile identification is strictly linked with the video profile used</p>

EXAMPLE:

For IT delivery of a file in *MXF/XDCAM HD422 1080i25* format with audio *Stereo/ITA+M&E* (*M&E* configuration means *Music&Effects*) on the contract the *format identifier* **FILE-HD1-8T05** will be used.

In order to identify the delivery format, the video profile and audio profile required, proceed as follows:

1. consult Table A1 to identify the reference ID for IT delivery (in this example the ID is **FILE**)
2. consult Table A2 to identify the reference ID for the video format (in this example the ID is **HD1**) and the reference Table identifying the **<ID Audio Profile>** code (in this example the ID is Table A3)
3. consult the Table identified at the previous point to identify the reference ID for the audio track structure (in this example the ID is **8T05**)

12. Attachment A – Format Identifier – allowed values

The following tables list the codes allowed in the creation of the format identifier described in section 11.

Table A1 – Delivery formats/media

<ID Format>	Delivery format/media
XDCAM	SONY XDCAM
HDCAMSR	SONY HDCAM-SR
HDD	HARD DISK DRIVE
FILE	FILE

Table A2 – Video Profile Identification

<ID Video Profile>	Video Profile	identification Table audio profiles
SD1	SDTV MXF/D10	A3
HD1	HDTV MXF/XDCAM HD422 1080i25	A3
HD2	HDTV MXF/AVC 1080p25	A4
HD3	HDTV MOV/ProRes422HQ 1080p25	A4
HD4	HDTV MOV/ProRes4444 1080p25	A4
HD5	HDTV MXF/AVC 1080p50	A4
UHD1	UHDTV MXF/XAVC 2160p25	A4
UHD2	UHDTV MXF/XAVC 2160p50	A4
UHD3	UHDTV MOV/ProRes4444 2160p25	A4
UHD4	UHDTV MOV/ProRes4444 2160p50	A4
UHD5	UHDTV MXF/DNxHR 2160p25	A4
UHD6	UHDTV MXF/DNxHR 2160p50	A4
UHD7	UHDTV MOV/ProRes422HQ 2160p25	A4
UHD8	UHDTV MOV/ProRes422HQ 2160p50	A4

Table A3 – identification of Audio Profiles based on 8 tracks layout

<ID Audio Profile>	Configuration / Audio Profile
8T01	Dual Mono/ITA
8T02	Stereo/ITA
8T03	Stereo/ITA + Stereo/OTH
8T04	Dual Mono/OTH + Music&Effects
8T05	Stereo/ITA + Music&Effects
8T06	Stereo/OTH + Music&Effects
8T07	Stereo/ITA + Music&Effects + MCA/ITA + AD/ITA
8T08	Stereo/ITA + Stereo/OTH + MCA/ITA + AD/ITA
8T09	Stereo/ITA + Stereo/OTH + MCA/ITA
8T10	Stereo/ITA + MCA/ITA
8T11	Stereo/ITA + AD/ITA
8T12	Stereo/ITA+ MCA/ITA
8T13	Stereo/OTH+MCA/OTH
8T14	Stereo/ITA+ MCA/M&E
8T15	Stereo/OTH+MCA/M&E

Table A4 – identification of Audio Profiles based on 16 tracks layout

<ID Audio Profile>	Configuration / Audio Profile
16T01	Stereo/ITA
16T02	Stereo/ITA + Stereo/OTH
16T03	Stereo/ITA + M&E
16T04	Stereo/OTH +M&E
16T05	Stereo/ITA +M&E +MCA/ITA
16T06	Stereo/ITA + Stereo/OTH + AD/ITA + MCA/ITA
16T07	Stereo/ITA + Stereo/OTH + MCA/ITA
16T08	Stereo/ITA + AD/ITA
16T09	Stereo/ITA + AD/ITA + MCA/ITA
16T10	Stereo/ITA + MCA/ITA + Stereo/OTH + MCA/OTH
16T11	MCA/ITA + AD/ITA + MCA/OTH + AD/OTH

LEGEND

ITA = Italian

OTH = Original Language;

Stereo = Stereo soundtrack

MCA= Multi-channel soundtrack

AD = Audio Description - TeleAudio

M&E= Music&Effects - Musica & Effetti (no dialogue)

Dual mono = mono signal replicated on two tracks

13. Technical Standards and Recommendations

Reference	Title
ITU-R BT.500	Methodology for the subjective assessment of the quality of television pictures
ITU-R BT.601	Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios
ITU-R BT.709	Parameter values for the HDTV standards for production and international programme exchange
ITU-R BT.1702	Guidance for the reduction of photosensitive epileptic seizures caused by television
ITU-R BT.2020	Parameter values for ultra-high definition television systems for production and international programme exchange
ITU-R BS.775	Multichannel stereophonic sound system with and without accompanying picture
ITU-R BS.1770	Algorithms to measure audio programme loudness and true-peak audio level
SMPTE 12-1	SMPTE Standard - For Television — Time and Control Code
SMPTE 12-2	SMPTE Standard - Transmission of Time Code in the Ancillary Data Space
SMPTE 274	SMPTE Standard - For Television — 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates
SMPTE 292	SMPTE Standard - 1.5 Gb/s Signal/Data Serial Interface
SMPTE 326	SMPTE Standard - for Television — SDTI Content Package Format (SDTI-CP)
SMPTE 356	SMPTE Standard - Type D-10 Stream Specifications — MPEG-2 4:2:2P @ ML for 525/60 and 625/50
SMPTE 377	SMPTE Standard - Material Exchange Format (MXF) - File Format Specification
SMPTE 378	SMPTE Standard - Material Exchange Format (MXF) — Operational pattern 1A (Single Item, Single Package)
SMPTE 379-1	SMPTE Standard - Material Exchange Format (MXF) — MXF Constrained Generic Container
SMPTE 379-2	SMPTE Standard - Material Exchange Format (MXF) — MXF Generic Container
SMPTE 381-1	SMPTE Standard - Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF Generic Container
SMPTE 381-2	SMPTE Standard - Material Exchange Format (MXF) - Mapping MPEG Streams into the MXF Constrained Generic Container
SMPTE 381-3	SMPTE Standard - Material Exchange Format—Mapping AVC Streams into the MXF Generic Container

Reference	Title
SMPTE 382	SMPTE Standard - Material Exchange Format — Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container
SMPTE 385	SMPTE STANDARD - for Television - Material Exchange Format (MXF) Mapping SDTI-CP Essence and Metadata into the MXF Generic Container
SMPTE 386	SMPTE Standard - for Television — Material Exchange Format (MXF) Mapping Type D-10 Essence Data to the MXF Generic Container
SMPTE 2016-1	SMPTE Standard - Format for Active Format Description and Bar Data
SMPTE 2019-4	Mapping VC-3 Coding Units into the MXF Generic Container
SMPTE 2020-3	SMPTE Standard - Vertical Ancillary Data Mapping of Audio Metadata — Method B
SMPTE RDD9	SMPTE Registered Disclosure Document - MXF Interoperability Specification of Sony MPEG Long GOP Products
SMPTE RDD32	SMPTE Registered Disclosure Document - XAVC™ MXF Mapping and Operating Points
SMPTE RP2027	SMPTE Recommended Practice - AVC Intra-Frame Coding Specification for SSM Card Applications
EBU R37	The relative timing of the sound and vision components of a television signal
EBU R95	Safe areas for 16:9 television production
EBU R103	Tolerances on "Illegal" colours in television
EBU R118	Tiering of High Definition Cameras
EBU R122	Material Exchange Format. Timecode Implementation
EBU R124	Choice of HDTV Compression Algorithm and Bit-rate for Acquisition, Production & Distribution
EBU R128	Loudness normalisation and permitted maximum level of audio signals
EBU R135	Production & Exchange Formats for 3DTV Programmes
EBU Tech 3304	Multichannel audio line-up tones
EBU Tech 3264	Specification of the EBU Subtitling data exchange format
EBU Tech 3293	EBU CORE METADATA SET (EBUCore)
MPEG ISO/IEC 13818-2	Generic coding of moving pictures and associated audio– Part 2: Video
MPEG ISO/IEC 14496-10:2012	Coding of audio-visual objects – Part 10: Advanced Video Coding

Glossary

EBU – European Broadcasting Union
ITU - International Telecommunication Union
SMPTE - Society of Motion Picture and Television Engineers
HDTV– High Definition Television
SDTV – Standard Definition Television
UHDTV – Ultra High Definition Television
3DTV – 3D High Definition Television
2K – Digital Cinema Format with 2048x1080 pixel resolution
4K – Digital Cinema Format with 4096x2160 pixel resolution
XDCAM® HD422 - recording format introduced by Sony based on MPEG: -2
HDCAM-SR®: Sony MPEG-4 SP (Studio Profile) recording format
Dolby E®: Coding technology developed by Dolby®
XAVC® - recording format introduced by Sony based on MPEG-4 AVC
ProRes® - Coding technology developed by Apple®
DNxHR® - Coding technology developed by AVID®
ISAN - International Standard Audiovisual Number