TV 2 AS

HD DELIVERY FOR TV 2 AS

Version 4.4

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DELIVERY FOR TV 2 AS HD
Delivery Guide for TV 2 AS

All programmes for transmission on TV 2 are required to deliver to the specifications laid out in this document.

TV 2 AS can receive HD content as files only.

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1. Delivery Format

1.1. HD Programmes commissioned on file must be delivered on:

- **XDCamHD 422 wrapped in MXF OP1a.**

File based delivery is TV 2 AS' preferred way of receiving material.

1.2. Video format and wrapper HD master files:

- XDCam HD 4:2:2 long GOP @ 50 Mbps wrapped in MXF OP1a (Sony)
- MXF Timecode according to AS-11 using the material package TC.
- GOP Structure being N = 3, M = 12. First GOP must be closed.
- Aspect ratio 16:9
- Resolution 1920x1080
- Standard / Frame rate PAL/25 (Interlaced, interlaced upper field first)
- Bit rate 50 Mbps
- Audio tracks 1-2 stereo
- Audio tracks 3-8 discrete 5.1 audio if available. If not available, tracks 3-8 shall be silent.

1.3. High definition programmes must be acquired, post produced and delivered in high definition. Programmes must contain a minimum of 75% native high definition material. Up to 25% of the programme's duration can come from standard definition sources. Standard definition sources are defined as:

- All standard definition video formats
- Cameras with image sensors under ½"
- Frame based (intra-frame) recording formats below 100Mbs
- Inter-frame based recording formats below 50Mbs
- Super16 film whether transferred to tape in high definition or not
- 35mm film transferred to or copied from standard definition tape formats
- Non-linear editing codecs with bit rates below 120Mbs
- Live contributions links of less than 140Mbs (MPEG2)

1.4. High definition programmes should in general be clean of noise, well-lit and sharp (unless artistic considerations require otherwise).

1.5. Particular care should be taken up-converting standard definition material to include in high definition programmes. Only high quality up-conversion equipment should be used. Use of "in VTR" up converters or up conversion using non-linear editing software is not acceptable.

This requirement protects the standard definition viewer who will see the standard definition material after multiple conversions.

1.6. When stereo sequences are included in surround programmes, it is acceptable to "up-mix" the audio. Any audio treated this way must down-mix without any noticeable degradation and must be fully stereo and mono compatible. It is not permissible to up-mix entire programmes.

1.7. Multi-channel (5.1) timing on tape: The Multichannel audio signal should be in sync with the stereo signal ON TAPE. This positioning allows further processing to be done to the final tape if required.

1.8. Video format and wrapper SD master files (the delivery of a master file in SD format, must be agreed upon during purchase):

- IMX 50 Mbps I frame only wrapped in MXF OP1a
- MXF Timecode according to AS-11 using the material package TC.
- Aspect ratio 16:9
- Resolution 720x576 Anamorphic
- Standard / Frame rate PAL/25 (Interlaced, interlaced upper field first)
- Bit rate 50 Mbps
- Audio tracks 1-4 stereo (24 bit)
- Audio tracks 5-8 empty (24 bit)

2. Video Standards

2.1. TV 2 AS will accept high definition programmes acquired using 1920 x 1080 interlace at 25 frames a second (now called 1080i25), upper field first.

2.2. All delivered high definition master tapes must be 1080i25 (whether the programme was acquired using 1080p25 or 1080i25). Rollers, moving captions and DVE moves must be added in 1080i25 to prevent unacceptable judder.

2.3. Technical standards are fully detailed in the following documents;

- **EBU Tech 3299-E** (Systems 2) "High Definition (HD) Image Formats for Television Production."
- **SMPTE S274-2008** "Television - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates" (Revision of SMPTE 274M- 2005).
- **ITU-R BT.709-5** "Parameter values for the HDTV standards for production and international programme exchange."
- **EBU R128** "Loudness Normalisation and Permitted Maximum Level of Audio Signals."

3. Action and Caption safe areas

Graphics and action shall be within the safe areas specified for delivery to be sure that the items are readable. "Safe Area" is defined as 95% of the picture height and width.

4. Audio

4.1. Audio Standards

Programmes shall be delivered in Mono or Stereo Format as required.

- Left audio shall be present on Channel 1.
- Right audio shall be present on Channel 2.

Mono shall be in Dual Mono format with identical and coherent audio on both Left and Right channels.

Audio codec is PCM uncompressed. Sampling frequency is 48 KHz @ 24 bit for HD. Sample frequency is 48 KHz @ 24 bit for SD.

4.2. Audio Level, Reference Level and Measurement

TV 2 has committed to the use Loudness (EBU R128). All programs must be compliant with the loudness parameters listed in this chapter.

Sound Quality

Sound must be recorded with appropriately placed microphones, giving minimum background noise and without peak distortion. The audio must be free of spurious signals such as clicks, noise, hum and any analogue distortion. The audio must be reasonably continuous and smoothly mixed and edited.
Audio levels must be appropriate to the scene portrayed and dynamic range must not be excessive. They must be suitable for the whole range of domestic listening situations. Stereo audio must be appropriately balanced and free from phase differences, which cause audible cancellation in mono. The audio must not show dynamic and/or frequency response artefacts because of the action of noise reduction or low bit rate-coding systems.

4.3. Terms, Requirements and Guidelines

Terms and Requirements

R128 introduces new terms for the measurements of audio. The terms used in this document, how they are measured and the delivery requirements are listed below. All programs must be compliant with the Program Loudness and Maximum True Peak requirements below. Other parameters are currently given for guidance only.

Term	Description	Measurement	Requirement
LU	Loudness Unit	1LU = 1dB change in loudness	EBU Tech 3343
LUFS	Loudness Unit relative to Full Scale	LUFS	EBU Tech 3343
LRA	Loudness Range	LU	EBU Tech 3342

Delivery Requirements

Term	Description	Measurement	Requirement
Program Loudness	The loudness measured over the duration of the program.	LUFS	-23.0 LUFS Note: A tolerance of ±1.0LU is accepted for live delivery
Maximum True Peak	The maximum value of the audio signal waveform.	dBTP (True Peak)	-3dBTP recommended. Programs are deemed to have failed QC if level exceeds -1dBTP
Loudness Range (for guidance only)	This describes the perceptual dynamic range measured over the duration of the program.	LU	Programs should aim for an LRA of no more than 18LU

Although the target loudness is -23 LUFS, in exceptional circumstances other target levels may be permitted by agreement with the broadcaster. Other target levels must be agreed with the broadcaster before the final mix.

Delivery Requirements, Short-Form Content (advertisements, promos etc.)

Term	Description	Measurement	Requirement
Program Loudness	The loudness measured over the duration of the program.	LUFS	-23.0 LUFS
Maximum True Peak	The maximum value of the audio signal waveform.	dBTP (True Peak)	-3dBTP recommended. Programs are deemed to have failed QC if level exceeds -1dBTP
Maximum Permitted Shortterm Loudness Level	The maximum short term loudness of the program	LUFS	-18.0 LUFS (+5.0 LU on the relative scale) (see note below)
Loudness Range (for guidance only)	This describes the perceptual dynamic range measured over the duration of the program.	LU	(not applicable)

Note: Short-Form Content is defined as a program of short duration, typically shorter than 30s (but up too approximately 2 minutes' duration). In addition to advertisements

(commercials) and promotional items, interstitials, stingers, bumpers and similar very short items belong to this category.

Guidelines for True Peak audio levels

Material	Recommended Maximum Peaks
Uncompressed Music	-3 dBTP
Compressed Music (depending on degree of compression)	-10 dBTP
Heavy M & E (gunshots, warfare, aircraft, loud traffic, etc.)	-3 dBTP
Background M & E (office/street noise, light mood music etc.)	-18 dBTP

Metering Requirements
Meters must comply with the specifications in EBU Tech 3341. Programs must be measured using the EBU Integrated (I) mode and the measurement must be applied to the whole program.

4.4. Stereo Audio Requirements

Stereo tracks must carry sound in the A/B (Left/Right) form. If mono originated sound is used, it must be recorded as dual mono, so that it may be handled exactly as stereo. It must meet all the stereo standards regarding levels, balance and phase.

- Tracks 1&2 - Stereo main audio Left (A1) and Right (A2) – labelled as "Audio".
- Tracks 3-8 - Empty – labelled as "Audio".

Stereo line-up tones
Each stereo audio pair must have either EBU stereo or GLITS line-up tone (not a mix of both). Tone must be 1 kHz, sinusoidal, free of distortion and phase coherent between channels. **Line-up tones are only relevant for the delivery of live programmes**. Audio files of GLITS and EBU stereo tones may be downloaded from the DPP web site (see 4.7). Digital Audio Reference level is defined as 18dB below the maximum coding value (-18dBFS).

Stereo phase
Stereo program audio must be capable of mixing down to mono without causing any noticeable phase cancellation.

4.5. Surround Sound Requirements (Multi-channel (5.1))

Surround sound is transmitted in the 5.1 format, and should normally be delivered as discrete tracks, except by agreement with the broadcaster. Programs delivering surround sound must also carry a stereo mix meeting all requirements for stereo delivery. This should generally be an automated down-mix of the surround channels, using the same down-mix parameters as are held in the surround metadata. In order

for both the surround mix and stereo down-mix to comply with EBU R128, the down mix should be normalized before layback (for file or tape delivered programs). Stereo and surround audio tracks must be synchronous.

Programs delivered with multichannel audio, must have the following track layout:

- Tracks 1&2 - Stereo main audio Left (A1) and Right (A2) – labelled as "Audio".
- Tracks 3&8 – Surround sound – labelled as "Audio".

Dolby Track Audio Track
3 Front Left
4 Front Right
5 Centre
6 LFE
7 Surround Left
8 Surround Right

Surround line-up tones
Each group of surround tracks must carry BLITS tone. Tones must be sinusoidal, free of distortion and phase coherent between channels. Stereo tracks derived by down mixing from the 5.1 audio should carry a down-mix of the BLITS tones, using the same down-mix parameters as those specified in the accompanying metadata. Any other stereo tracks delivered with the program must carry stereo tone as per section 4.2. An audio file of BLITS tone may be downloaded from the DPP web site (see 4.7). **Line-up tones are only relevant for the delivery of live programmes.**

4.6. AES Sample timing

This section refers to timing requirements for AES audio pairs embedded in HD SDI signals. Very small timing differences between audio tracks in a surround program will not be heard unless the stereo down-mix is monitored acoustically. An error of as little as one or two samples between the Left, Right and Centre channels can cause phasing and comb filtering for those listening in stereo. Timing differences between audio tracks in each AES pair in an SDI group and between each group containing a single audio program must be no more than 0.2 samples (i.e. the timing between each track of the six audio tracks of a surround signal.)
Note: This error has not been noticed on devices that treat audio as multi mono channel audio (e.g. NLEs).

4.7. Sound to Vision Synchronization

The relative timing of sound to vision should not exhibit any perceptible error. Sound must not lead or lag the vision by more than 5ms.

Audio / Video sync markers
To assist in maintaining A/V sync through the post-production process, a 'sync plop' may be used. If the delivered program leader contains one, it must meet the following conditions:

- The sync plop must be between timecode xx:xx:57:06 and xx:xx:57:08
- The audio plop must be 1kHz tone on all tracks at -24dBFS (-18dBFS is acceptable for stereo programs)
- The duration of the vision flash must be 2 frames to allow it to pass through standards conversion successfully
- The audio plop must be synchronous across all audio PCM audio tracks and

with the video flash (within +/- 5 ms)
If an end sync plop is used it must be no closer than 10 seconds to the end of the program and comply with the relevant points above.

Line-up tone downloads
A zip file of acceptable line up tones can be downloaded from the DPP website:
http://www.digitalproductionpartnership.co.uk/downloads/standards/
It contains:
Surround Programs - BLITS -18dBfs
Stereo Programs - EBU 1 kHz

5. Requirements for delivery of live programmes

5.1. Programme Types

Programmes in this section fall into the following categories:

1. Live programmes from within TV 2 buildings with a fixed and permanent connection to TV 2 AS

2. Live programmes with links provided by third parties (e.g. satellite, fibre, microwave etc.).

Usually high definition programmes should only deliver a high definition signal.

5.2. Technical parameters for the incoming signal

Signals from remote sources may pass through several different agencies (suppliers) therefore it is vital that:

- sufficient monitoring is in place at all interfaces to ensure continuity of signal quality.
- there is agreement over the share of responsibility for each element in the chain(s).
- all parties are able to monitor and assess the signals arriving and departing from their domain(s) of responsibility.
- audio and video are in sync arriving and departing from each area of responsibility.

The incoming signal must be able to be passed through the play-out and transmission chain without the need for manual intervention.

Unless agreed in advance all programmes must supply a high definition signal that meets the requirements of the ITU-R BT709-5 1920 x 1080 25-frame standard with synchronous embedded audio:

- Stereo audio will be embedded on audio tracks 1+2.
- Surround sound (when supplied) will be Dolby E encoded and embedded on audio track 3+4.
- If Dolby E is supplied, it should be on track 3+4, and should be continuous from -30 seconds (30 seconds before the start of the programme) until 10 seconds after the end of the programme.

The remote facility must be able to originate vision and audio line-up signals, including aspect ratio information and identifying the left and right audio channels and if required, the individual channels for a multi-channel or surround sound programme. Care should be taken to ensure that pre-recorded inserts are in the same aspect ratio and resolution as live material.

Required checks will include representative moving pictures and synchronous sound.

Line-up signals must be available at least 30 minutes prior to the programme start time, and a technically competent contact must be designated to liaise with the broadcaster's engineering staff.

The video and audio signals must be continuous and stable in all respects throughout the broadcast period. Remote sources to the facility must be fed in such a way to ensure stable synchronous signals are present on the transmission output at all times.

The digital signal characteristics must meet with EBU/SMPTE Recommendation 701.

5.3. High Definition Contribution Links

Programmes from studios in the TV 2 Network must be transferred with a minimum of 140Mb/s.

To maintain the quality of the high definition signal, a link with an appropriately high bit rate should be used. For the best possible quality an uncompressed link is always the best option however where this is not viable it is recommended links should be at least 60Mbs MPEG 2 for a single "hop" link.

To allow further processing (recording, editing etc.) especially if the signal is then sent by additional contribution links, the highest bit rate possible should be used. It is preferable that links in this case be at least 100Mbs MPEG2

5.4. Standards conversion from remote source

When a programme is supplied via a contribution link of less than 100Mbs, the standards conversion must be done on site *before* the contribution link.

6. Subtitling

Subtitle files shall be delivered in the. stl format. Framerate set to 25 fps.
Naming convention for the delivered file is <filename HR file>-opn.stl for OPN files and <filename HR file>-ttv.stl for TTV files. All subtitle files must contain 0-Text with the following parameters:

Keyword	Value
Title	Program Title
Story	Filename for HR file
Lang	Opn or ttv

7. Metadata

TV 2 want to make use of PAR/DAR information from the MXF header if possible. TV 2 are currently looking into the AMWA AS-11 X3 file exchange standard. Although we recognize the difficulties adopting our historical archive into this standard, we will remain open regarding adopting this standard for future deliveries.