DELIVERY REQUIREMENTS

LIVE PROGRAMME DELIVERY SPECIFICATION

MORE THAN TV

Abstract

This document outlines the technical requirements for the delivery of Live programmes as agreed by the UK Broadcasters: BBC, BT Sport, Channel 4, Channel 5, ITV, Sky, STV and TG4.

The document includes the technical parameters that all Ultra-High Definition (UHD) , High Definition (HD) and Standard Definition (SD) file delivered programmes must meet to be acceptable by the broadcasters. It is set out as follows:

Part 1: Picture and sound quality and QC requirements.

Part 2: Additional technical requirements for Live programme delivery.

Part 3: Broadcaster specific requirements that are mandatory and unique and to **ITV.**

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IMPORTANT NOTE: This document is a template, and is designed for use by content providers as the basis for their own instance of this document. Text in red should be updated or removed as appropriate. This template is not designed for use by producers; rather, the documents produced from this template will be designed for producers.

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PART 1: GENERAL REQUIREMENTS

Technical Requirements

This part of the document details the technical and quality requirements that every programme must comply with. It also forms a binding obligation on the producers of programmes delivered to the UK broadcasters.

Assessment of quality is highly subjective and therefore dependent on the nature of the programme. Some of the quality requirements are expressed in relative terms ("reasonable", "not excessive") and it will be necessary to make a judgement as to whether the quality expectations of the intended audience will be fulfilled and whether the broadcaster will feel that value for money has been achieved.

Photosensitive Epilepsy and Quality Control

Every programme submitted for transmission must satisfy the Ofcom Photosensitive Epilepsy guidelines, which are detailed in the QC section of this document. Any programme failing to meet these requirements or any of the other QC requirements, may be rejected and returned to the supplier for repair.

Please be aware that the producer of the programme as well as the broadcaster may be liable for any action taken by Ofcom or a member of the public, for a breach of the Photosensitive Epilepsy requirements.

Equalities Act 2010

The Equalities Act 2010 (formerly the Disability Discrimination Act) states that where a service provider offers or provides services to members of the public, the provider must take such steps as is reasonable to make it easier for disabled people to make use of the service.

Broadcasters are service providers and this therefore applies to them (DCMS Guidance 2006).

Broadcasters and programme makers are required to consider the needs of people with hearing or visual impairments especially for dialogue, voiceovers and when mixing sound, as well as when generating onscreen text, subtitles and graphics.

The Communications Act 2003 sets targets for broadcasters (monitored by Ofcom) to provide subtitling, sign language and audio description services, so programme makers may be asked to provide appropriate additional material.

1 VIDEO TECHNICAL REQUIREMENTS

1.1 Video Formats

1.1.1 Ultra-High Definition

Material delivered to this specification must be acquired, post-produced and delivered as follows:

- 3840 x 2160 pixels in an aspect ratio of 16:9[1];
- 50 or 25 frames per second progressive - known as *2160p/50 or 2160p/25*;
- colour system must be YC_rC_b *only*;
- colour sub-sampled at a ratio of 4:2:2;
- colour space – ITU-R BT.2100[2];
- image dynamic range[3] parameters detailed in ITU-R BT.2100 must be agreed with the broadcaster before delivery.

The UHD format is fully specified in ITU-R BT.2100.

Notes:

The frame rate must be agreed with the broadcaster before shooting begins.

For images acquired at 50 frames a second, vision mixer cuts and edits shall occur so that the start of the first frame of the progressive video pair is aligned to the start of the first (upper) field of an interlace video signal as defined by SMPTE ST2051.

1.1.2 High Definition

Material delivered to this specification must be acquired, post-produced and delivered as follows:

- 1920 x 1080 pixels in an aspect ratio of 16:9 as defined in EBU TECH 3299 System 2;
- 25 frames per second (50 fields) interlaced[4] – known as *1080i/25,* top field first;
- colour sub-sampled at a ratio of 4:2:2;
- colour space – ITU-R BT.709.
- The HD format is fully specified in ITU-R BT.709.

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[1] *Broadcasters may commission programmes in any of the three resolutions (7680 x 4320, 3840 x 2160, 1920 x 1080) defined in ITU-R BT.2100.*

[2] *Conventional reference primaries may be optionally used as described in SMPTE 2036-1:2014 but this limits the images to a maximum of 60fps and does NOT permit HDR images. The reference primaries in SMPTE ST2036-1 are consistent with Recommendation ITU-R BT.709 and their use MUST be agreed by the broadcaster BEFORE shooting commences.*

[3] *Details and an explanation of "image dynamic range" can be found in the ITU Report ITU-R BT.2390.*

[4] *This includes acquisition using the progressive segmented frame (PsF) format to carry 25fps progressive images.*

1.1.3 Standard Definition

Where agreed by the broadcaster, legacy material delivered for UK SD TV transmission must be:

- 702 x 576 pixels in an aspect ratio of 16:9;
- 25 frames per second (50 fields) interlaced - known as *576i/25*, top field first;
- colour sub-sampled at a ratio of 4:2:2;
- colour space – ITU-R BT.601.

The SD format is fully specified in ITU-R BT.601..

Note: SD video has a picture area with a minimum of 702 x 576 pixels, where the 702-pixel wide picture must be centred in the active 720-pixel wide line. The picture information may extend the full width of the 720-pixel wide line, providing the image shape is not distorted.

1.2 Signal Parameters

In a video signal, each primary component should lie between 0 and 100% of the video range between black level and the peak level (R, G and B). Ideally, video levels should lie within the specified limits so that programmes can be distributed without adjustment.

When television signals are manipulated in YUV form, it is possible to produce "illegal" combinations that, when de-matrixed, would produce R, G or B signals outside the range 0% to 100%.

1.2.1 Video Level Tolerance

In practice it is difficult to avoid generating signals slightly out of range and it is considered reasonable to allow a small tolerance:

- *The RGB components and the corresponding Luminance (Y) signal, should not normally exceed the "Preferred Minimum/Maximum" range of digital sample levels in the table below,*
- *Measuring equipment should indicate an "Out-of-Gamut" occurrence only after the error exceeds 1% of an integrated area of the active image.*

For further details see the EBU Recommendation, EBU R103.

Any signals outside the "Preferred Minimum/Maximum" range are described as having a gamut error (or as being out of gamut). Signals cannot exceed the "Total Video Signal Range" and will therefore be clipped.

System	Range in Digital Sample (Code) Values		
System Bit Depth	Expected Video Range	Preferred Minimum/Maximum	Total Video Signal Range
8 bit (SD Only)	16 – 235	5 – 246	1 – 254
10 bit (HD & UHD)	64 – 940	20 – 984	4 – 1019

Full range video levels must *not* be used for delivered television programmes.

Colour gamut "legalisers" should be used with caution as they may create artefacts in the picture that are more disturbing than the gamut errors they are attempting to correct. It is advisable not to "legalise" video signals before all signal processing has been carried out.

1.2.2 High Dynamic Range

Guidance for HDR programmes is available in the HDR Supplement. However, the broadcaster must be consulted before an HDR production commences.

The Recommendation ITU-R BT.2100 specifies two High Dynamic Range (HDR) methodologies: Hybrid Log Gamma (HLG) and Perceptual Quantisation (PQ).

Note: SMPTE ST 2036-1 cannot be used for High Dynamic Range images.

The HLG specification offers a degree of compatibility with legacy displays by more closely matching the previously established television transfer curves. The PQ specification achieves a very wide range of brightness levels for a given bit depth using a non-linear transfer function that is finely tuned to match the human visual system.

Programmes can be mastered using either HDR method defined in ITU-R BT.2100.

- Commissioned programmes must normally be delivered as HLG HDR.
- Programme Acquisitions delivered as PQ HDR must be converted to HLG HDR using the approach described in the Annex of ITU-R BT 2100
- HDR programmes should normally be graded on displays with a maximum brightness of between 1000 and 2000cd/m^2.

For HLG productions, it is recommended that the reference level of graphics should be 75 IRE as it leaves sufficient headroom for "specular highlights" and allows comfortable viewing when HLG content is shown on HDR and SDR displays.

Note: 75 IRE is equivalent to 203 cd/m^2 on a 1000 cd/m^2 reference display, or 343 cd/m^2 on a 2000 cd/m^2 reference display.

1.2.3 Blanking

Images must fill the active picture area. No 'blanking errors' are permitted on new, up-converted, or archive material.

A two-pixel tolerance is permitted during computer graphics or complex overlay sequences where key signals, graphic overlays or other effects do not fully cover the background image. Where animated key signals or overlays cause moving highlights at the edge of the active image it is preferable to blank these pixels completely. A note of the timecodes and reasons for these errors should accompany the delivered programme.

1.2.4 Field Dominance

For SD and HD programmes, cuts must happen on frame boundaries (i.e. between field 2 and field 1). Motion on *PsF* material must always occur between field 2 and field 1 (i.e. field 1 dominance).

If material is shot at *50 frames* a second, the correct 2-frame marker phasing must be maintained when converting to *1080i/25* or *1080PsF/25*.

1.3 VIDEO LINE UP

1.3.1 SMPTE ST2036-1 UHD, HD and SD Programmes

UHD programmes produced using ITU-R BT.709 colour space, as well as HD and SD programmes, must use 100% colour bars (100/0/100/0) that fill the 16:9 raster. SMPTE pattern bars are not acceptable. Programme video levels must be accurately related to their associated line-up signals.

1.4 Origination

The EBU Recommendation EBU R118 is used to assess the suitability of cameras. Contact the broadcaster if there are any concerns about the suitability of a camera.

- Cameras for UHD programmes can be UHD Tier 1 or 2, but some UHD co-producers may not accept all cameras in UHD Tier 2.
- UHD programmes can only be originated with progressive scan.
- Cameras for HD programmes must meet or exceed the parameters of HD Tier 2L.
- HD programmes may be originated with either interlaced or progressive scan (see Film Motion for additional guidance). This process must be agreed with the broadcaster in advance.
- Interlaced and progressive scan HD material may be mixed within a programme if it is required for editorial reasons or the nature of the programme requires material from varied sources.
- SD acquired programmes should use Tier 2L cameras whenever practical and care should be taken when down converting.

1.4.1 DSLR Cameras

DSLR cameras are only acceptable for time-lapse sequences, stop-frame animation and other specialist requirements such as infra-red and hostile conditions. They are not suitable for use as video cameras unless they have EBU R118 test report results that meet the UHD Tier 2 or HD Tier 2L requirements. Exceptions can be made for covert shoots or dangerous locations at the discretion of the broadcaster. The broadcaster must agree to the use of DSLR cameras in advance of any shooting.

1.4.2 Drones and Remotely Operated Cameras

- Cameras attached to these devices must meet the requirements in EBU R118 unless agreed with the broadcaster in advance.
- Unless a drone or remote rig has adequate image stabilisers it is recommended that the camera attaché has a higher resolution than needed to allow electronic stabilisation to be carried out during post-production.
- Programme producers are required to ensure drones and other remotely operated cameras are only controlled by trained and licenced operators when used in the UK. Producers should be aware of specific local and territorial restrictions and regulations especially when drones and remotely operated cameras are used outside the UK.

Note: broadcasters may have additional requirements for the use of drones and remote cameras as part of their editorial or health and safety guidelines.

1.5 Film for UHD and Acquisition

Super16 film is *not* considered to be HD or UHD no matter what processing or transfer systems are used[5]. The following 35mm film types and stock are acceptable for high definition acquisition:

- 3 perf – any exposure index although an exposure index of 250 or less is preferred;
- 3 perf – only if daylight stock with an exposure index of 250 or less is used.

To avoid causing problems with high definition transmission encoding, film should be well exposed and not forced more than one stop.

35mm stock (new or archive) scanned at UHD (or 4k and cropped to 3840) is usually acceptable for UHD production, but the entire capture, processing, scanning and post-production workflow must be agreed by the broadcaster in advance.

Note: there are some circumstances where 35mm film is not suitable for UHD programme production.

1.6 Post Production

HD and SD projects must be set to export progressively shot material as interlaced. Electronically generated moving graphics and effects (such as rollers, DVE moves, wipes, fades and dissolves) must be generated and added as interlaced to prevent unacceptable judder.

UHD Projects are always progressive. Electronically generated moving graphics and effects (such as rollers, DVE moves, wipes, fades and dissolves) must be edited to prevent unacceptable judder. For 2160p/50 deliverables, such effects must be edited at 50 frames per second. If programmes are intended to be delivered as 2160p/25, this must be agreed with the broadcaster in advance.

1.6.1 Video Codecs used for Post Production

Post-production codecs used to edit HD programmes should be at least 160Mb/s. It is however acceptable to use the native camera codec provided the codec is constant throughout the production workflow.

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[5] *Requirements for programmes commissioned to acquire on Super16mm film can be found here.*

Note: UHD post-production codec choice will depend on the delivery frame rate and the requirements of co-producers for a Mastering Format (such as IMF) delivery.

1.6.2 Film Motion or Film Effects

It is *not* acceptable to shoot *1080i/25* and add a film motion effect in post-production. High Definition cameras can capture in either *1080i/25* or *1080p/25*. Where film motion is a requirement, progressive capture is the only acceptable method.

Conversion from 50 progressive frames per second material to 25 progressive frames per second is permitted, provided that the frame conversion process does not produce excessive motion judder or image softening or visible frame blending; and that an appropriate shutter speed has been used. The process must be agreed with the broadcaster in advance.

1.6.3 Frame Rate Conversion

To prevent image degradation, Motion Compensation standards conversion sometimes known as Motion Predictive or Motion Vector Conversion should normally be used.

Speed change is the preferred method of converting from 24fps (including 23.976fps) to 25fps. Due attention must be given to the audio.

Software standards conversion packages should also use Motion Compensation processing. It is not permitted to use simple "timeline" conversion. Contact the broadcaster for more information.

Below are the recommended processes for frame rate conversion.

- 24p and 24/1.001p to 25p – speed change is the recommended conversion process.
- 24p and 24/1.001p to 50p – speed change plus frame doubling.
- 30p and 30/1.001p to 25p – Motion Compensated Conversion required.
- 30p and 30/1.001p to 50p – Motion Compensated Conversion required.
- 60p and 60/1.001p to 25p – not recommended, speak to broadcaster if required.
- 60p and 60/1.001p to 50p – Motion Compensated Conversion required.
- HD 25PsF to UHD 25p – no frame rate conversion or de-interlacing required.
- HD 25PsF to UHD 50p – frame doubling, no de-interlacing required.
- SD/HD 25i to UHD 25p – use should be limited, de-interlacing.
- SD/HD 25i to UHD 50p – de-interlacing and frame doubling.
- De-interlacing processing should be carried out via a multi-field (five-field or greater) de-interlacer or a motion compensated de-interlacer.

Content acquired at 24 (24/1.001) fps which has been converted to 60 (60/1.001) interlace or progressive via the "2:3 pull down" process, should first have the repeated fields/frames removed to produce the original frame rate. The resulting video can then be replayed at 25 fps.

1.6.4 Up conversion to UHD

Archive or Lower Resolution (HD and SD) material will usually require de-interlacing and frame rate processing during up conversion to UHD.

It is usually best practice to convert SD or HD 60Hz standards to the equivalent SD/HD 50Hz standard before up conversion.

1.7 Picture Aspect Ratio

All new commissions must fill a 16:9 screen vertically and horizontally without geometric distortion. The following exception may be allowed but the broadcaster must give permission before shooting commences.

1.7.1 Cinemascope Ratios as Letterbox

Movies delivered to dedicated movie channels should be delivered with an active picture ratio that matches the current consumer release unless the broadcaster requests otherwise. Other programmes may use wider picture ratios if agreed in advance by the broadcaster.

Movies and programmes with picture ratios of 2.00:1, 2.35:1/2.39:1 (21:9) or 1.85:1 should be centred vertically between black bars in a 16:9 frame with no geometric distortion. If there are any variants of aspect ratio please contact the broadcaster to establish the required version.

1.7.2 Floating Images

Short sequences of images surrounded by black borders (floating images) may be used for artistic effect. However, widescreen consumer TV sets operating in Auto Zoom / Auto mode often interpret large black borders at the top and bottom of the screen as letterbox, so are likely to enlarge the picture. The resulting unpredictable zooming can be annoying for the viewer and undermine the artistic intent. If used, the black space around floating images must be consistent across sequences of images.

1.7.3 Pillar-Boxed HD Material

Some 'pillar-boxed' material is acceptable at the discretion of the broadcaster where it has been acquired on a medium that has the capability to be transferred to a legitimate HD or UHD resolution, for example, 35mm film shot using 4-perf at an aspect ratio narrower than 16:9. The pictures must be centrally framed in a 16:9 raster with no geometrical distortion.

1.8 Archive Material

Archive material must meet all the technical requirements in this document, including those for up-converted SD video where relevant.

1.8.1 General Quality

Archive material must be taken from the best available source, and any improvement or restoration work which could reasonably be expected must be done (for example grading, dropout repair or audio equalisation).

1.8.2 Up-Converted SD Material

Particular care must be taken with SD archive material in order to deliver the best possible quality after up-conversion. In general, standard definition pictures must look no worse than the original after being up converted, post processed and down converted for delivery on SD services. Only high quality up-conversion processes will achieve this.

Standard definition video contains a half-line at top and bottom on alternate fields. This must be removed on up-conversion to HD or UHD or it will introduce visible flickering at top and bottom of the HD/UHD frame.

- Any VITC or switching signals visible at the top of SD material must be removed.
- Any line blanking from SD signals must not appear in the HD or UHD conversion.
- For these reasons all SD material must be zoomed-in by a small amount during up-conversion.

1.8.3 Picture Aspect Ratio

Archive material that is not 16:9 should be zoomed to fill the 16:9 raster where possible without compromising the image quality or composition. Alternatively, it may be presented in a pillar-box or letterbox format, which:

- may be of an intermediate ratio between 4:3 and 16:9, but must be of consistent width across sequences;
- must be centrally framed in the 16:9 raster;
- must show no geometrical distortion;
- must have clean and sharp pillar-box edges (i.e. any video or film edge artefacts may need to be blanked);
- must be black outside the active picture, unless otherwise specified by the broadcaster.

1.8.4 Safe Areas

Any archive captions or on-screen-text already in the archive material should be kept within the caption safe area if possible. Exceptions should be noted in the accompanying QC documents.

1.9 Use of Lower Resolution Images

To maintain a high standard and meet audience expectations, the amount of material of a lower resolution than the commissioned format is limited to 25% of the programme's total duration. Lower resolution material must not be used for large uninterrupted sections of the programme, unless agreed by the broadcaster.

1.9.1 Non-UHD Material

Some UHD programmes will contain some material from standard definition and high definition originals and sources that do not meet the UHD requirements. This material is all called 'non-UHD' in this document. Non-UHD material includes material acquired using the following methods or formats:

- All SD and HD formats;
- Cameras that do not meet the requirements of EBU R118 for UHD Tier 2;
- All codecs with bit rates below those specified in EBU R118 for UHD;
- Film that does not meet the required standard.

1.9.2 Non-HD Material

Some HD programmes will contain some material from standard definition originals, and sources that do not meet the HD requirements. This material is all called 'non-HD' in this document. Non-HD material includes and material acquired using the following methods or formats:

- HDV from all manufactures;
- All codecs with bit rates below those specified in EBU R118 for HD Tier 2L;
- Cameras that do not meet the requirements of EBU R118 for HD Tier 2L;
- Material generated or processed on 720-line equipment;
- Film that does not meet the required standard.

1.10 3D

Programmes delivered for 3D transmission will be subject to additional requirements and agreement with the broadcaster. The broadcaster section gives details of 3D production and delivery.

1.11 Safe Areas for On-Screen Text

All on screen text must be clear and legible and must be within the safe areas specified. All font sizes must be legible after down conversion. There are two primary caption safe areas defined for UK transmission of 16:9 programmes.

16:9 safe	This is used by most UK programmes/broadcasters.
4:3 safe	This is required by some broadcasters for end credits or for programmes distributed internationally. Check the broadcaster requirements for guidance on end credits.

At the discretion of the broadcaster, programmes such as feature films and some acquisitions may be excluded from this requirement.

1.11.1 Text Size

The minimum SD font height is 20 SD lines. Therefore, where burnt in UHD or HD text will be down converted, the minimum height of the text should be no less than:

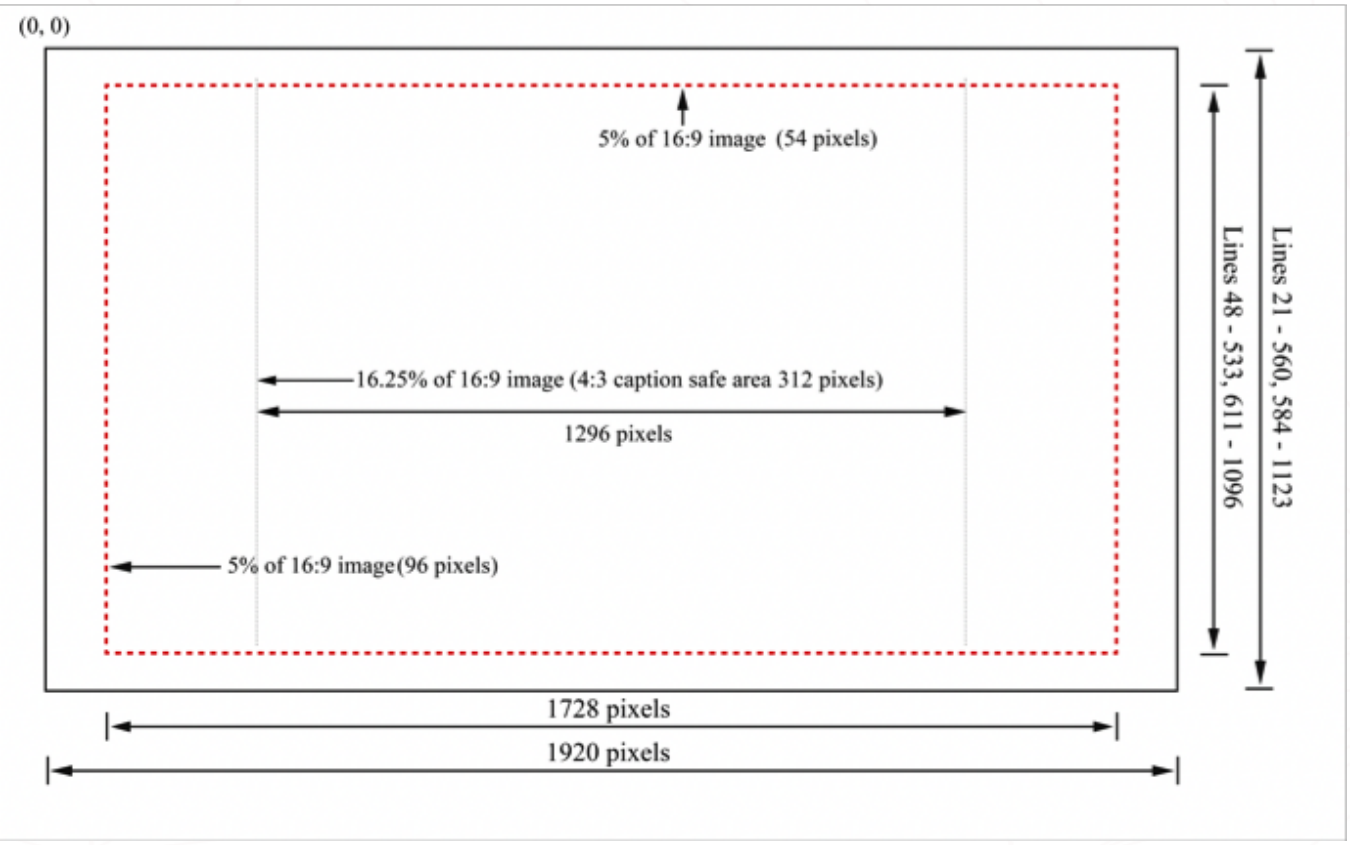
- 40 HD lines/pixels (to be legible after down conversion);
- 80 UHD lines/pixels (to be legible after down conversion).

1.11.2 In Vision Captions for Foreign Language Assets

Foreign dialogue should have burnt-in English subtitles, free from spelling and grammatical errors, and held for a sufficient time to be comfortably read. Subtitles must also be clearly visible at all times; if subtitles are positioned over an area of the screen which is the same colour as the font; a trim or drop shadow must be utilised and for consistency this should be used on all subtitles throughout the programme or feature.

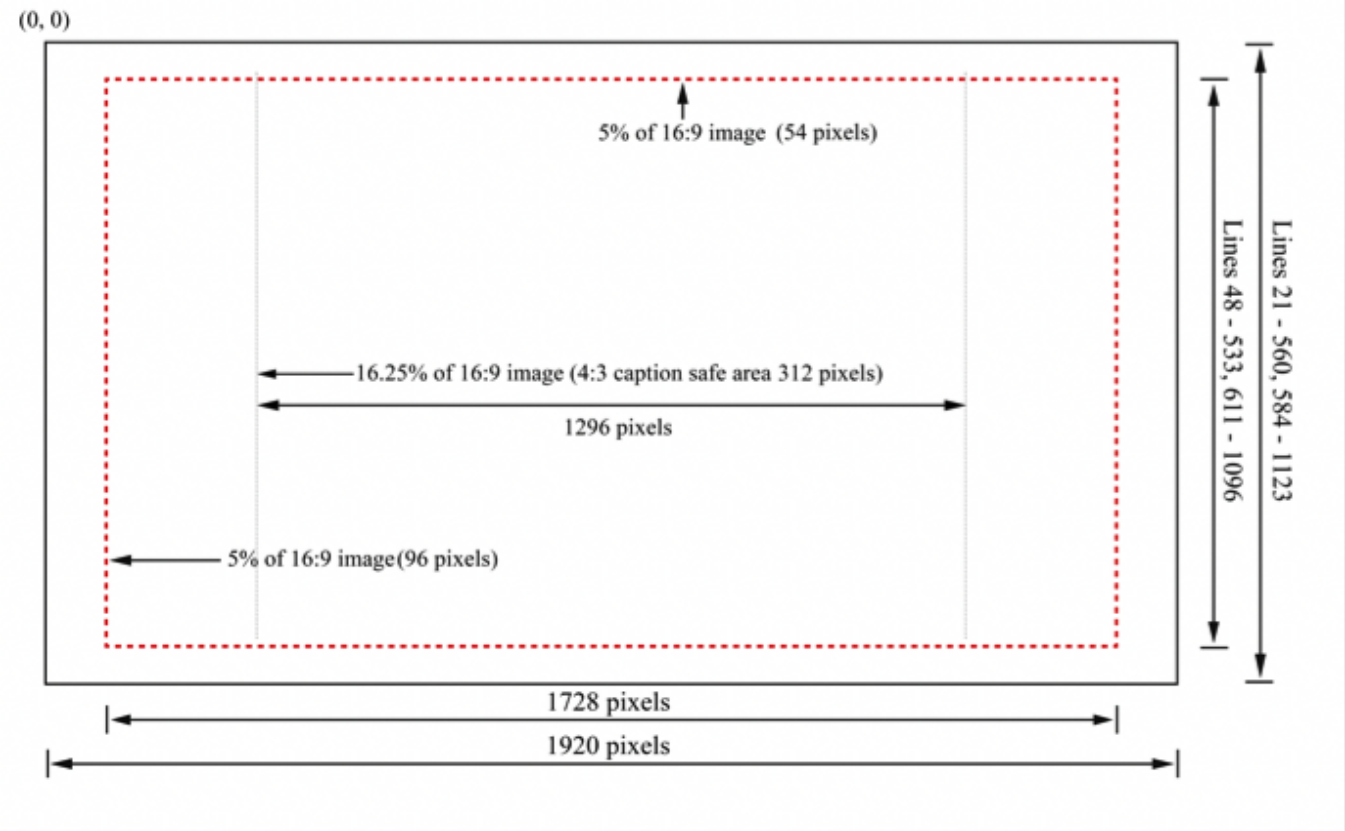
1.11.3 Safe Areas for SD On Screen Text

Text Safe Area for 720 x 576 (Interlace)	Defined as percentage (%) of active picture	SD pixels (inclusive) first pixel numbered 1	TV line numbers (inclusive) line numbering as per ITU-R BT.601
16:9 Text safe	90% of Width 90% of Height	36 – 684 29 – 546	38 – 295 (F1) & 351 – 608 (F2)
4:3 Text safe	67.5% of Width 90% of Height	117 – 603 29 – 546	- 38 – 295 (F1) & 351 – 608 (F2)



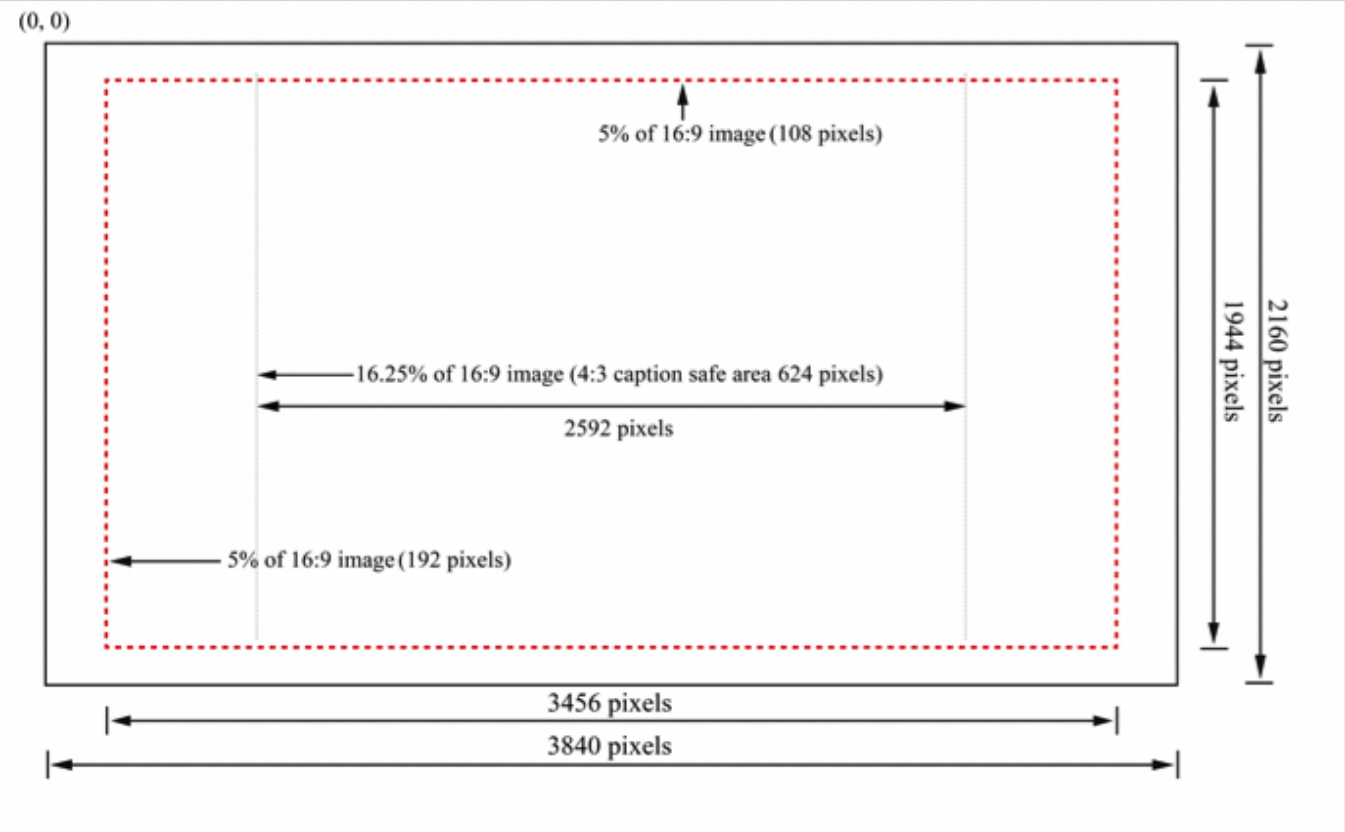
1.11.4 **Safe Areas for HD On Screen Text**

Text Safe Area for 1920 x 1080 (Interlace)	Defined as percentage (%) of active picture	HD pixels (inclusive) first pixel numbered 1	TV line numbers (inclusive) line numbering as per ITU-R BT.709
16:9 Text safe	90% of Width 90% of Height	96 – 1823 54 – 1025	48 – 533 (F1) & 611 – 1096 (F2)
4:3 Text safe	67.5% of Width 90% of Height	312 – 1607 54 – 1025	- 48 – 533 (F1) & 611 – 1096 (F2)



1.11.5 Safe Areas for UHD On Screen Text

Text Safe Area for 1920 x 1080 (Interlace)	Defined as percentage (%) of active picture	UHD pixels (inclusive) first pixel numbered 1	UHD Standards do not specify TV line numbers
16:9 Text safe	90% of Width 90% of Height	192 – 3647 108 – 2052	-
4:3 Text safe	67.5% of Width 90% of Height	624 – 3215 108 – 2052	-



2 AUDIO TECHNICAL REQUIREMENTS

2.1 Dialogue

Broadcasters receive many complaints about unclear dialogue. Remember the audience has not seen the programme many times before transmission and has not seen a script. The audience does not usually have "broadcast quality" audio reproduction equipment. It is the responsibility of the producer to ensure that dialogue is clear, easy to hear and to understand by a first-time viewer who is using consumer equipment.

2.2 Loudness

It is no longer acceptable to deliver new programmes mixed to the old PPM6 specifications.

Programmes must be mixed to comply with EBU R128. Exceptions may be made for movies intended for dedicated movie channels or platforms. Where the broadcaster requires a Blu-Ray/DVD surround mix with a greater dynamic range, a stereo R128 mix must also be supplied. The Broadcaster will supply details of how the audio is to be delivered in these cases.

2.2.1 Loudness terms

R128 terms used in this document, how they are measured and the DPP delivery requirements are listed below.

Description	Measurement	Reference	Description
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
DPP Delivery Requirements			
Programme Loudness (EBU Tech 3343)	The loudness measured over the duration of the programme.	LUFS	Non-live -23.0 LUFS ±0.5LU Live (including as-live) -23.0 LUFS ±1.0LU
Maximum True Peak (EBU Tech 3343)	The maximum value of the audio signal waveform.	dBTP (True Peak)	It is recommended that the maximum true peak level should not exceed -3dBTP. Content will fail if the maximum true peak exceeds -1dBTP

Programme Loudness (EBU Tech 3343)	The loudness measured over the duration of the programme.	LUFS	Non-live -23.0 LUFS ±0.5LU Live (including as-live) -23.0 LUFS ±1.0LU
Loudness Range is for guidance only			
Loudness Range (EBU Tech 3342 & 3)	This describes the perceptual dynamic range measured over the duration of the programme	LU	Programmes should *aim* for an LRA of no more than 18LU
Loudness Range of Dialogue	Dialogue must be acquired and mixed so that it is clear and easy to understand	LU	Speech content in factual programmes should aim for an LRA of no more than 6LU A minimum separation of 4LU between dialogue and background is recommended

All programmes must be compliant with the *Programme Loudness* and *Maximum True Peak* requirements below. Other parameters are currently given for guidance only.

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.

2.2.2 **2.2.2 Guidelines for True Peak Audio Levels**

The following table is ***only for guidance*** on the true peak levels of different types of audio. At all times dialogue should be distinct and clear.

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

2.3 Metering requirements

Meters must comply with the specifications in EBU Tech 3341. Programmes must be measured using the EBU Integrated (I) mode and the measurement must be applied to the whole programme (EBU Tech 3343). The optional LFE channel must be excluded from all measurements.

2.4 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.

2.4.1 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 1kHz (2kHz is acceptable on M&E channels), sinusoidal, free of distortion and phase coherent between channels.

Digital Audio Reference level is defined as 18dB below the maximum coding value (-18dBFS).

2.4.2 Stereo Phase

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

2.5 Surround Sound Requirements

Surround sound is transmitted in the 5.1 format and should be delivered as discrete tracks.

Surround sound programmes must also include a stereo mix that meets 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 metadata.

For both the surround mix and stereo down-mix to comply with EBU R128 the down-mix should be normalised before layback.

Stereo and surround audio tracks must be synchronous.

2.5.1 Surround Line-Up Tones HD Programmes

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 programme must carry stereo tone. is acceptable to use the EBU BLITS tone on HD programmes.

2.5.2 AES Sample Timing

Very small timing differences between audio tracks in a surround programme 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 channels must be no more than 0.2 samples (i.e. the timing between each channel of the six audio tracks of a surround sound signal).

2.6 Surround sound mixing requirements

To help programme makers meet their responsibilities, it is important that all transmitted audio can be easily and clearly monitored by both editorial and technical staff during the production process.

To maintain a house style for certain programme types or strands, broadcasters may have specific requirements for the mixing mode as described below.

2.6.1 Dialogue and a Surround Mixer

There are three modes for the placing of dialogue in a surround mix.

Mode 1 All dialogue should be present in each of the three front channels – but this does not mean that the dialogue must be at equal level in each of the front channels. Mode 1 is generally more suited to the home listening environment.
Mode 2 In-vision dialogue across the three front channels and out-of-vision dialogue in the centre channel only.
Mode 3 All dialogue in the centre channel only. Mode 3 is similar to cinema mixing and as such may be the least suited to the home listening environment.

For details of the mode required for each programme type see the broadcaster section at the beginning of this document.

2.6.2 General Mixing Requirements

The stereo mix delivered with a surround programme will not be transmitted on the HD platforms. Viewers of the HD channels listening in stereo (or mono) will always hear a receiver derived automated down-mix of a surround sound programme using the Dolby Metadata parameters. HD platforms only transmit AC3 (DSAT) or AAC (DTT) audio either as Stereo or Surround.

The stereo mix may not be transmitted on the Standard Definition channel(s) either, depending on platform. Some SD channels already only transmit an automated down-mix and this practice will increase.

The audio parameters controlled by the metadata include: centre and rear down-mix levels, LFE level, and the extent of any dynamic range control applied. Therefore:

- It is essential to check the automated down-mix using a monitoring system that applies or simulates the metadata settings. Any external processor (e.g. a Dolby DP570) must be set to apply the programme's metadata;
- The Lt/Rt and Lo/Ro fold-down parameters used for down mixing must match the settings in the Dolby metadata – especially the down-mix levels of the CENTRE and SURROUND legs;
- pre-mixed stereo content should be up-mixed, where appropriate, to match the surround sound to maintain the audio image throughout a surround broadcast. A method of up mixing approved by the broadcaster must be adopted, which anchors dialogue to the front and disperses effects around the image;

- up-mixed material must also down-mix to stereo and mono with no audible artefacts. The injudicious use of phase shifting and delay within some up-mixing algorithms may become more noticeable in the subsequent receiver down-mix process, and result in unacceptable down-mixed audio;
- where up mixing is not available, stereo sections or inserts containing speech should be "converged" (spread) across LEFT, RIGHT and CENTRE channels adding an element into the Centre channel of the surround mix. The front L/R channel levels should generally be 6dB lower than the Centre-channel level.

For general surround sound (e.g. audience reaction) phase-coherence invariably benefits both the wrap-around effect in 5.1 and the stereo down-mix. Coincident microphone techniques (e.g. crossed-pairs) tend to outperform spaced mono microphones in this context.

2.6.3 Stereo and Centre Channel Monitoring

It is essential that the mono and stereo down-mixes of a surround programme are monitored in at least equal measure to the surround mix. A large majority of viewers will be listening in stereo rather than 5.1 for some time to come.

It is also important to be aware that the centre channel could allow viewers listening in surround to overhear off-microphone conversation not intended for broadcast, but which may be masked when monitoring in stereo or mono.

2.6.4 Consistency of Image

When a surround programme contains mono content interleaved with stereo pre-recorded items it is important to maintain the consistency of the sound image and prevent the effect of dialogue appearing to jump between Centre Only and Phantom Centre (Left/Right) only.

2.7 Dolby metadata settings

For the correct reproduction of the audio by domestic receivers, it is vital that the correct metadata is input and carried through the broadcast chain to the consumer. There are differences in the settings based on programme type or genre as well as requirements for specific or dedicated television channels (e.g. Sport Channels, Movie Channels, Music Channels etc.).

Dolby metadata *must* remain constant throughout a programme.

It is not possible to publish a common set of Dolby metadata settings that would be appropriate for all programme's styles. The UK broadcasters have limited the parameters that can be varied to the following:

- Dialogue Level;
- Line Mode Compression;
- RF Mode Compression;
- Centre Down-Mix Level;
- Surround Down-Mix Level;
- Surround 3dB Attn.;
- Dolby Surround Mode;
- Preferred Stereo Down-Mix;
- Surround Phase Shift.

For details of the settings required for each programme type see the broadcaster section.

Where required, Dolby surround metadata specified in SMPTE RDD 6 must be carried in an SMPTE ST 436 track, as detailed in the AS-11 UK DPP HD specifications.

See the Surround Sound Supplement for details of how to add the metadata to AS-11 UK DPP HD files

2.7.1 Guidance for Acquired Programmes and Movies

Acquired programmes and movies can be received with or without metadata. Unless the audio is re-mixed during a compliance edit, any supplied metadata should be passed though. If no metadata exists the following parameters should be used.

Parameter	Value
Dialogue Level	-23dB
Line Mode Compression	Film Standard
RF Mode Compression	Film Standard
Centre Down-Mix Level	-3dB
Surround Down-Mix Level	-3dB
Surround 3dB Attn.	Movies – Enabled All others – Disabled
Dolby Surround Mode	Enabled
Preferred Stereo Down-Mix	LtRt
Surround Phase Shift	Enabled
Surround Down-Mix Level	-3dB
Surround 3dB Attn.	Movies – Enabled All others – Disabled

2.8 Sound to vision synchronisation

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.

2.8.1 Audio/video sync markers

To assist in maintaining A/V sync through the post-production process, a 'sync plop' should be used which must meet the following conditions:

- the sync plop must be between timecode 09:59:57:06 and 09:59:57:08;

- the audio plop must be 1kHz tone in all channels (82.5Hz in the LFE channel) at -24dBFS (-18dBFS is acceptable for stereo programmes);
- the duration of the vision flash must be 2 frames to allow it to pass through standards conversion successfully;
- the duration of the audio plop must be 1 frame, starting on the first frame of the vision flash. It must be synchronous across all audio channels and with the video flash (within ±5ms).

If an end sync plop is used it must be no closer than 10 seconds to the end of the programme and comply with the relevant points above.

3 QUALITY CONTROL (QC)

It is the responsibility of the production company to ensure programmes meet the technical and editorial requirements of the commission. This responsibility includes ensuring the company carrying out the QC process has adequate resources.

3.1 General Quality

All programmes are expected to reach a high standard of video and audio quality. This does not mean low quality material cannot be used. Archive and specialist low quality material used in context is acceptable. If there is any doubt, contact the broadcaster for advice.

3.1.1 General Video Quality

- The picture must be well lit and reasonably but not artificially sharp.
- The picture must be free of excessive noise, grain and digital compression artefacts.
- The picture must be free of excessive flare, reflections, lens dirt, markings and obstructions (e.g. lens hood), and lens aberrations.
- Movement must appear reasonably smooth and continuous, and must not give rise to distortions or break-up to moving objects, or cause large changes in resolution.
- The picture must be free of excessive black crushing and high light compression. Hard clipping of highlights (e.g. by legalisers) must not cause visible artefacts on screen.
- There must be no noticeable horizontal or vertical aliasing, i.e. jagged lines, or field-rate or frame-rate fluctuations in fine detail.
- Colour rendition, especially skin tones, must be consistent throughout and provide a realistic representation of the scene portrayed unless it is altered as an editorially essential visual effect.
- The picture must be stable and continuous – i.e. no jumps, movements, shifts in level or position. There should be no flash frames or very short shots unless editorially essential.
- There must be no visible contouring / artefacts caused by digital processing. Quantisation noise must not be apparent.
- There must be no noticeable spurious signals or artefacts e.g. streaking, ringing, smear, echoes, overshoots, moiré, hum, cross-talk etc.

3.1.2 General Audio 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.
- Surround and 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 due to the action of noise reduction or low bit rate coding systems.

3.1.3 UHD Programmes

QC requirements for UHD programmes *must* be discussed with the broadcaster before shooting begins. Initially quality controls will be on a genre-by-genre basis. In time, as broadcasters and co-producers gain a better understanding of UHD they will be able to provide more guidance.

3.2 Photosensitive Epilepsy (PSE)

Flickering or intermittent lights and certain types of repetitive visual patterns can cause serious problems for viewers who are prone to photosensitive epilepsy. Children and teenagers are particularly vulnerable.

All UK Television channels are subject to the Ofcom BROADCASTING CODE 2017 which states:

Section 2.12

Television broadcasters must take precautions to maintain a low level of risk to viewers who have photosensitive epilepsy. Where it is not reasonably practicable to follow the Ofcom guidance (see the Ofcom website), and where broadcasters can demonstrate that the broadcasting of flashing lights and/or patterns is editorially justified, viewers should be given an adequate verbal and also, if appropriate, text warning at the start of the programme or programme item.

The Ofcom guidance is here.

3.2.1 PSE testing

Programmes for file delivery must be tested using any file-based PSE device that meets the guidance given by Ofcom. The DPP maintains a list of devices, available here.

Live and as live programmes may continue to use the Cambridge Research FPA 2.5 PSE device.

Additional requirements for Live programmes are given in the Live versions of the DPP delivery specifications.

Broadcasters require a PSE report (pass certificate) to be delivered with all programmes.

- PSE reports must be in pdf form and named according to the broadcaster's naming convention.
- The relevant metadata details must be completed.
- It is recommended that live programmes produce and keep a copy of the PSE checks carried out during the final rehearsal (if there is one) and the transmission.

Any failure whatsoever will result in rejection of the programme, and any affected sections must be repaired and re-tested before acceptance.

3.2.2 PSE – broadcast warnings

In exceptional cases, verbal and/or on-screen text warnings may be used at the beginning and during the programme. Each broadcaster has a policy on the inclusion of content that may cause harm or offence and will only be considered if:

- demonstrable attempts have been made to correct or replace the images,
    - and
- the relevant content is completely integral and necessary to the context of the programme,
    - and

- permission to use the relevant content has been cleared by the broadcaster and documented in writing by those responsible for the commissioning/editorial content.

No broadcaster allows a programme maker to authorise the use of warnings for material that fails a PSE test. Advance notification and planning requirements will vary by broadcaster.

3.2.3 UHD Programmes

UHD programmes may have a wider colour space than HD or SD programmes so only approved PSE devices can be used (irrespective of the dynamic range). It should be noted that there is no change to the current PSE requirements for testing HDR content. Contact the broadcaster for the latest advice on testing UHD programmes.

3.3 Automated Quality Control (AQC)

Any device that carries out the DPP AQC tests based on the EBU QC Test Items can be used.

Details of the DPP QC requirements can be found here.

The production company should ensure that all technical and editorial warnings or comments are acted on or noted. Mandatory requirements must be acted on or rectified. Broadcasters require an AQC report in PDF form, to be delivered with the master programme.

3.4 Eyeball Quality Control

Broadcasters require an eyeball QC report in PDF form, to be delivered with the programme file. The eyeball QC check is to ensure video and audio quality are consistent throughout. Further information on the eyeball QC parameters and an eyeball QC form template can be found here.

3.5 File Compliance (File delivery only)

The File Compliance check confirms that the file itself meets the AMWA AS-11 technical requirements. A compliance check is carried out by the broadcaster before a programme file can be accepted. AQC devices with a AMWA Format Conformance Testing Certificate can be used to check AS-11 compliance.

PART 2: LIVE DELIVERED PROGRAMMES

This part of the document details the additional technical requirements that programmes must comply with for the successful file delivery of Live programmes.

4 DEFINITIONS AND RESPONSIBILITIES

4.1 Definitions

A live programme is any programme that is not delivered by tape or by file, and requires some form of communications link for delivery.

These programmes will fall under the following sub-categories:

• Live: the programme output from the remote location goes straight to air via the broadcaster's play-out facility.
• Compliance Live: As Live but a short delay exists in the signal path to allow for intervention by the broadcaster for compliance or legal reasons.
• As Live: the programme is produced on-site as if it were live, but the output recorded and played-out at a delayed time (or date) in the schedule. Recording and playout may occur at the production site, or the broadcaster's play-out facility.
• Late Delivery: the programme is produced and edited very close to its scheduled time, and as such, tape or file delivery to the broadcaster's play-out facility is not practical. Delivery is via a link or permanent line from another facility.

Point of delivery is the location or building to which the live programme is commissioned to deliver, usually the broadcaster's play-out or central routing facility.

Permanent Link is any dedicated path from the location to the point of delivery that uses land- based circuits that are permanently assigned for use by the broadcaster.

Contribution Link is any path from the location to the point of delivery that is not a dedicated or permanent link, such as a bookable circuit, a satellite feed, or microwave link.

Resilience Level is the level of resilience (back-up) that a live programme is required to have. The level of resilience is a requirement of the individual broadcaster, and may vary depending upon the production.

4.2 Responsibilities

The production should have a technical contact available as far as is possible in advance of the programme, to allow the broadcaster to confirm technical planning and for dealing with any queries.

There must be a technical contact available at the source during the programme itself and throughout the line-up period.

The technical contact for the programme is responsible for making sure that:

• the programme meets the general overall Technical Standards outlined in Sections 2 and 3 of this document;
• the cue and communications circuits are adequate and fully operational;
• the video and audio signals are continuous and stable throughout the broadcast period;
• resilience levels meet the broadcaster's requirements;
• the signal leaving their site and incoming to the broadcaster can be passed through the play- out and transmission chain without the need for further technical intervention unless previously agreed & using pre-booked facilities (excludes any synchronisation required at the broadcaster's point of delivery);

• there is sufficient monitoring in place to confirm the signal quality from the location to the point of delivery;
• all sources are stable and synchronous at all times;
• pre-recorded inserts are the same aspect ratio, resolution and match the quality of the live material.

Line-up signals must be available at least 30 minutes prior to the programme start time although it is strongly recommended that contact on the day is made well in advance of line-up and all possible links are tested as soon as technically possible.

4.3 Cue and Communication

A dedicated, stand-alone technical telephone number must be provided and distributed well in advance of the transmission. This should be a fixed landline telephone.

For direct contributions into network transmissions, a feed of the source production talk-back will be required at the play-out facility. A dedicated, land-based, "4-wire" circuit offers flexibility and should be considered the minimum requirement.

Talk-back (open or keyed, depending on the broadcaster's choice) must be offered to play-out for the duration of the programme and should be available from thirty minutes before the start of transmission.

It is preferable to arrange instantaneous or low-latency video/audio return or cue paths to sources. Return audio or video cue circuits of the programme may be necessary for programmes that require two-way communication between centres. It is important to consider the latency and reliability of the cue path especially when the programme has live interviews.

Due to the latency of a Digital Terrestrial or Digital Satellite off-air signal (up to 6 seconds), off-air cueing should be considered as a last resort and for contingency purposes only.

It is acceptable to use mobile telephones for communication during the line-up period but during transmission use of mobile phones should be agreed in advance and they should not be relied on as the only means of communication.

4.4 Photosensitive Epilepsy (PSE) and Live Programmes

Live programmes must meet the Ofcom PSE requirements.

Programmes must be checked during rehearsals and every effort made to meet the requirements before transmission.

• If the situation is not under the control of production or there is any chance a programme might breach the requirements, it is the responsibility of the programme's producer to arrange for a warning announcement or caption to be used before and during the transmission the transmission.

• Although normally PSE warnings cannot be authorised by a programme producer, Live transmissions are the only exception. If there is any doubt, especially where stage lighting is not under the control of the production, it is better to give a verbal or caption warning.

4.5 Generator Provision

Unless otherwise agreed, Production companies should ensure OB suppliers, or remote locations, have UPS/Generator provision so the live programme transmission can be maintained in the event of any loss of power at the remote location. Critical systems should always be protected by UPS and if generator power is used it should be a dual system which allows synchronous changeover. This provision should be fully tested prior to transmission to ensure the functionality is fit for purpose.

5 LINK SPECIFICATIONS

5.1 UHD Links

Details for delivery of Live and As Live UHD programmes are given in the broadcaster section.

5.2 HD Links

The quality of the link from the remote location to the broadcaster's point of delivery has a major effect on the quality of the programme seen by the audience. The content, genre and workflow requirements of the programme are the primary factors that determine the bandwidth of the link.

For instance, Programmes that feed into post production via the link will usually require a higher link specification than programmes that are completed on site, where the link is only used for transmission. The same can apply to programmes that are archived **via a link**.

Link specifications are always a trade-off between quality, cost and available bandwidth. However, the link should never be considered in isolation. In addition to the type and settings of the link encoder, the use of location radio cameras, and the transmission compression used by the broadcaster must be considered. Where there is any doubt, programme production companies should ask their link provider to speak to the broadcaster's technical contacts.

In all instances, the delivered picture format shall be:

- 1920 pixels wide x 1080 pixels high;
- 16:9 Aspect ratio;
- 25 frames per second, delivered as 50 interlaced fields per second*.

*Programmes may use cameras and insert material using the 25-frame progressive option (1080p/25) delivered in PsF.

Any external reference source at a remote site should be locked to GPS.
The **types** of links used for any Live HD programmes shall fall into the following categories.

5.2.1 Uncompressed via Optical Fibre

1.485 Gb/s HD-SDI connection, SMPTE 292M, [often known as 1.5Gbs HD-SDI]. This remains uncompressed along its route to the point of delivery.

Wherever possible, practical, or cost-effective, programmes should use an uncompressed 1.485Gbs HD-SDI connection.

In all instances where the signal can be carried uncompressed, stereo audio for the programme should be carried as discrete linear PCM (unless Dolby E is requested by the broadcaster).

5.2.2 Compressed via Optical Fibre

Links that provide a 1.5Gbs HD-SDI connection at the point of delivery, but which use compression/decompression along their route.

Locations with access to already-established SD-SDI fibre connections (such as STM-1 SDH fibres) should use compression codecs that allow HD-SDI to be transferred via SD-SDI (e.g. JPEG2000, Dirac, etc.). This is a well-established method in the UK.

Locations with access to other single hop fibre connections should use compression codecs that use nominal video bitrates of:

- JPEG2000 - 140 Mbps;
- H.264 Part 10, Long GOP 4:2:2 – 45 Mbps.
- MPEG2, Long GOP, 4:2:2 – 60 Mbps.

5.2.3 Compressed via Satellite Link

Where fibre is not available, links via satellite may be used. The following are permissible and achievable largely by using DVB-S2 modulation schemes. Modulation schemes should be carefully chosen so that the increase in transponder capacity (in MHz) required to deliver the optimal video bitrate (in Mbps) does not come at the cost of a decreased robustness of signal.

Single-hop satellite links should have a nominal video bitrate of:

- H.264 Part 10, Long GOP 4:2:2 – 45 Mbps.
- MPEG2, Long GOP, 4:2:2 – 60 Mbps.

Where the link directly feeds a second compressed link, the signal should not be decoded back to baseband but passed to the second link as a transport stream.

Stereo audio should be carried as MPEG1 Layer II (stereo) at 384kbs. Multi-channel audio may need to be carried as Dolby E.

5.2.4 Compressed via Microwave Point-to-Point Link

In some locations, a point-to-point microwave link may be used as an alternative to satellite links. Microwave links can be used for short hops from the location to a fixed fibre link point or where a satellite up-link must be remote from the production location. Where microwave links are used to feed a second compressed link, the signal should not be decoded back to baseband but passed to the second link as a transport stream.

The payload on the link should have a nominal video bitrate of:

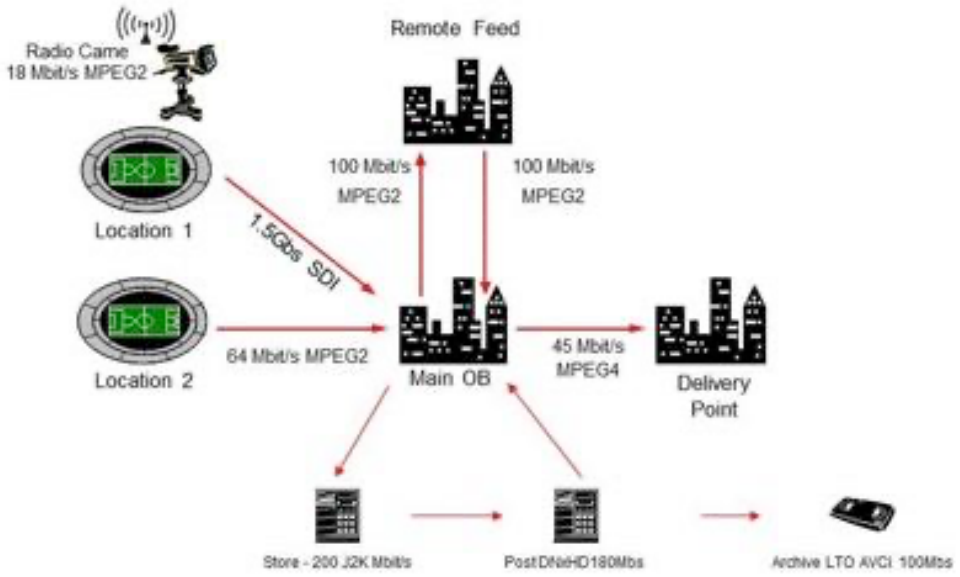
- H.264 Part 10, Long GOP 4:2:2 – 45 Mbps.
- MPEG2, Long GOP, 4:2:2 – 60 Mbps.

Please speak to the broadcaster about multi-hop microwave links or combination microwave/satellite links.

Stereo audio should be carried as MPEG1 Layer II (stereo) at 384kbs. Multi-channel audio may have to be carried as Dolby-E.

5.3 Picture Quality & Bit Rates (concatenation issues)

Different devices and contribution links use different compression codecs. A "codec map" must be produced for the broadcaster listing all codecs (including the bit rates) through which a programme signal passes before arriving at the point of delivery.



Example of a codec map

This means you must produce a list of all the compression rates used along the route of the signal's delivery, even if only one coder/decoder pair is used.

Pictures viewed at the point of delivery should be free from visible compression artefacts when viewed on a broadcast style flat screen 40-inch display at normal viewing distance (3H, where H is the height of the visible screen-size).

To allow further processing (recording, editing etc.) especially if the signal is comprised of any additional contribution links, the highest bit rate possible must be used.

Maintaining as high a bit rate as possible throughout the production and play-out process is especially pertinent when considering that the signal has to then undergo further compression and decompression in the transmission chain delivering the final product to the viewer.

5.4 Standards Conversion

Only very high quality motion compensation (sometimes known as Motion Predictive or Motion Vector) standards converters can be used. Where a programme requiring frame-rate & standards conversion is supplied via a contribution link of less than 100Mbps, the standards conversion must be done before the contribution link.

5.5 SD Links (if required)

Where Compressed Standard Definition contribution is used, it should have a video bit rate of at least 25Mbs MPEG2 Long GOP. The GOP structure and encoder setup is the same as for HD links

Standard Definition video is 702 x 576 pixels, and the 702 pixel-wide picture must be centred in the active 720 pixel-wide line. This leaves 9 pixels to the left and 9 pixels to the right unused. (This is a result of a legacy inherited from PAL analogue TV signals).

The picture information may extend the full width of the 720-pixel wide line, providing the image shape is not distorted.

5.6 Audio

5.6.1 Stereo Audio

In all instances where the signal can be carried uncompressed, stereo audio for the programme should be carried as discrete linear PCM. If the signal must be carried in a compressed format, Stereo audio should be carried as MPEG1 Layer II (stereo) at 384kbs.

5.6.2 Multi-Channel Audio

Multichannel (surround sound) should normally be discrete PCM where there is sufficient bandwidth available in the link to the point of delivery. Dolby E should be used for multi-channel audio when bandwidth is limited or at the request of the broadcaster.

Use of the Low Frequency Effect Channel (LFE) channel is optional. Use of the LFE channel should comply with Recommendation **ITU-R BS.775**. There should no sample timing differences between the individual channels of a surround signal.

Each stereo pair or multi-channel group (the 6 audio tracks of a surround sound signal) must be transported in a single SMPTE ST.302 PES to maintain the phase relationship between channels.

5.6.3 Audio Track Allocation

It is difficult to prescribe the exact audio track layout for all live programmes. International, host broadcaster, local requirements and link bandwidth may vary the audio layout requirements.

All broadcasters are working towards the standard audio layout below. However, in many situations this layout is not yet implemented due to legacy requirements.

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AES	Track	PROPOSED STANDARD
1	1	Main Stereo L
	2	Main Stereo R
2	3	M&E Stereo L
	4	M&E Stereo R
3	5	Main Front L
	6	Main Front R
4	7	Main Front Centre
	8	Main Front LFE
5	9	Main Surround L
	10	Main Surround R
6	11	M&E Front L
	12	M&E Front R
7	13	M&E Front Centre
	14	M&E Front LFE
8	15	M&E Surround L
	16	M&E Surround R

5.6.4 Commentary Lazy Talkback

Spill of crowd or general background noise picked up by the commentary microphones contribute acoustically to the width of the front image.

In sports coverage (and other programmes produced in very noisy locations) it is important to ensure that there is some residual crowd sound in the centre channel, to minimise the audible 'hole' that otherwise results when a commentary microphone is muted, for example by the activation of 'Lazy Talkback'.

5.6.5 AV Synchronisation

AV sync should be checked via the audio desk (not just the links truck in the case of OBs) at least once a day.

Any professional AV sync equipment is acceptable but systems that can be used across all audio tracks (up to 16) simultaneously are preferred.

- AV sync timing through the audio desk to the point of delivery should be ±5ms.
- AV sync timing should also be within ±5ms from any remote sources into a studio or an OB including non-live inserts from tape or file.
- Any external reference source at a remote site should be locked to GPS.

5.6.6 AV Synchronisation - Radio Link Cameras

Radio link cameras are always a compromise between delay and image quality. Image quality should always be the overriding consideration. Where radio and cabled cameras are mixed covering a location with lip-sync, and it is not possible to delay the audio, the radio camera should not have a delay greater than 40ms compared to the cable cameras. The director is responsible for making sure any visible lip-sync issues are kept to a minimum.

Where all cameras use radio links, the audio must be delayed to match the video. To minimise the issues caused by open talkback and presenter switched talkback the AV sync can be ±20ms.

5.7 TOD timecode

Programmes should use local time of day timecode pertinent to the venue and this should be carried in the VANC unless specifically requested otherwise by the broadcaster

5.8 Ancillary Data (VANC)

Where required the following lines must be used for ancillary data.

These lines should not be used for other data unless agreed by the broadcaster for a specific event or programme.

Line	Data	Comments
9	SMPTE ST 2020	Main use: Surround sound metadata
11	SMPTE ST 2016	Main use: AFD
12	OP47	Subtitles if required

5.9 Codec Requirements SD and HD programmes

5.9.1 MPEG 2 Encoders – additional requirements

- GOP (Group-of-Pictures) should be 15 frames. This represents a good balance between coding efficiency (requiring long GOPs) and error resilience (requiring short GOPs).
- B-frames should not be used as these are typically coded at a lower quality than I and P frames and will lead to poor picture quality in the home. Note: not all encoders on the market allow B-Frames to be disabled, so please check before accepting the unit.
- GOP structure should be **/IPPPPPPPPPPPPPP/**
- 4:2:2 colour subsampling should be used to avoid colour smearing when concatenated with the 4:2:0 emission coders used for broadcast transmission.
- **"Intra-DC precision"** should be set to 11 bits. 11 bits are required in the DCT (discrete cosine transform) domain to accurately convey an 8-bit video signal. This is not normally a user setting but should be checked with an analyser before accepting the encoder.

5.9.2 H.264 Encoders – additional requirements

- 10-bit video is preferred. There is no bitrate penalty.
- GOP length should be a minimum of 15, in line with MPEG2.
- B-frames and hierarchical B-frames are permitted.
- 4:2:2 colour subsampling is preferred but 4:2:0 may be acceptable.

5.9.3 H.265 (HEVC) Encoders

Use of HEVC (H.265) must be discussed and approved by the broadcaster in advance.

PART 3 – BROADCASTER SPECIFIC REQUIREMENTS

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PART 3 – ITV LIVE DELIVERY REQUIREMENTS

This part of the document details ITV contact and delivery information and any specific or genre based technical requirements for ITV Live programming.

Technical Responsibility and Contacts:

ITV has a licence requirement to ensure technical quality is maintained to a satisfactory standard. This summary, whilst not exhaustive, provides a guide to the key operational requirements suppliers need to adhere to when delivering live programming to ITV. This section should be read in conjunction with the Digital Production Partnership (DPP) programme delivery guidancefor live programming documented earlier in this document. Additional operational information can also be downloaded from **www.itv.com/commissioning/producers-guidelines**. Any questions or issues relating to compliance with ITV's technical delivery requirements should be addressed in the first instance to the following.

NAME	EMAIL ADDRESS	TELEPHONE
Bill Brown Head of Media Standards & Connectivity	**Bill.brown@itv.com**	**07808 632 285**

Please note the above contact details are strictly for technical enquiries relating to programme production/delivery only. Any other queries should be sent to iTV Viewer services at itvviewerservices@itv.com.

Live Programme Deliverables

Production companies producing live programming for ITV are contractually obligated in all instances to provide an archive copy of their programme as broadcast to ITV post transmission. The only acceptable delivery format will be a DPP AS-11 file, which should be uploaded to the ITV within 7 days of the programmes live transmission date. ITV Connectivity will provide file upload credentials. Upload credentials are not published in this document for security reasons.

ITV Connectivity Sign-Off

ITV Connectivity is responsible for managing the delivery of contribution feeds for all ITV live programming from the ITV handover point into Red Bee Media for playout. Contact must be made with ITV Connectivity at the earliest possible opportunity after commission to discuss these requirements.

Pre-Transmission Planning Meeting

Prior to the live programme a meeting will be set up by Broadcast Operations to discuss scheduling across all channels. Attendance at this meeting by all parties involved in the live programme supply chain is mandatory. This Meeting will cover all aspects of the live programme delivery, including schedule over-runs and under-runs, contingency schedules if required, standby programmes and delivery. It is also a mandatory requirement for programme production representatives to attend pre-transmission planning meetings and undertake to ensure details of all operational requirements are distributed to their production teams. This meeting is in addition to any other meetings instigated by ITV Connectivity.

Booking Remote Circuits

Prior to the live programme a meeting will be set up by Broadcast Operations to discuss scheduling across all channels. Attendance at this meeting by all parties involved in the live programme supply chain is mandatory. This Meeting will cover all aspects of the live programme delivery, including schedule over-runs and under-runs, contingency schedules if required, standby programmes and delivery. It is also a mandatory requirement for programme production representatives to attend pre-transmission planning meetings and undertake to ensure details of all operational requirements are distributed to their production teams. This meeting is in addition to any other meetings instigated by ITV Connectivity.

Production companies providing live programming on any ITV linear channel will be responsible for providing as a minimum of two contribution circuits from the remote OB location, or studio, to a specified ITV handover point. Those two circuits shall be designated as Main and Backup and must be separate and diversely routed from each other. The Main circuit should always be delivered via fibre where possible

The route taken and connectivity provider are at the production company's discretion but the quality and robustness of these paths must be carefully considered as they form part of the contract SLA. Both paths should either terminate directly at Red Bee Media (ITV's playout provider) or at a location where ITV Connectivity can book onward circuits without incurring additional cost. If any additional expense is incurred the production will be responsible for paying those additional costs.

If no fibre connectivity is available from the OB location then delivery of the Main feed via satellite may be permitted. Where a dual uplink for Main and Backup is used, the downlink should be carried out at diverse locations with at least one of the feeds on passed to Red Bee Media by fibre. Red Bee has some capacity to directly downlink satellite feeds, though at busy periods they may not be able to carry out every downlink required which may result in some feeds having to be downlinked at an alternative location and then on passed to Red Bee Media via fibre. Use of this facility is not guaranteed so productions intending on using Red Bee's satellite downlink facilities should contact ITV Connectivity at the earliest possible opportunity to ensure downlink capacity is available and delivery plans can be accommodated.

The Backup circuit, where possible, should also be delivered via fibre, but for the sake of resilience and redundancy it is ITV policy that this circuit must be completely separate and diversely routed from the Main path from the point of origin to Red Bee Media. Routing both circuits via any of the same infrastructure would constitute a single point of failure which would be deemed unacceptable to ITV. If a second, fully diverse fibre-based circuit is unavailable the Backup circuit may be delivered via satellite.

Satellite Separation

To improve resilience when your live programme Main and Backup contribution feeds are delivered via dual satellite, you must ensure where possible, that there is a minimum of 30 degrees separation in space between satellites to reduce the risk of both feeds being compromised or lost due to unforeseen weather events. This requirement must not be compromised on the basis of cost. Where satellite separation cannot be achieved, then consideration should be given to changing the satellite modulation parameters to deliver a more robust signal in case of weather-related events. These modulation schemes should be carefully chosen so that the increase in transponder capacity (in Mhz) required to deliver the required video bitrate (in Mbps) does not come at the cost of reduced technical quality of the picture. If it is not possible to achieve this requirement then you must inform ITV as soon as you become aware of the site limitations.

If your live programme is being delivered via dual satellite only and is scheduled in peak hours on ITV's main flagship channel, then ITV will additionally require you to deliver a low bitrate tertiary feed to provide further redundancy.

If satellite contribution is used and your OB location is located near an airport or airfield extra care and due diligence should be undertaken to ensure aviation traffic in the area doesn't compromise any uplinked satellite feed. This risk should be clearly understood and mitigated after conducting a site recce well in advance of transmission.

Low Bitrate Contribution Feeds

Where appropriate ITV now permits the provision of a low bitrate contribution feed as an HD backup for live programmes on ITV2, ITV3, ITV4 and ITVBe only or as a tertiary feed for live programmes scheduled on ITV, ITV2, ITV, ITV4 or ITV Box Office. The main HD programme feed must still be provided as a fibre or satellite feed delivered in accordance with the requirements outlined in this document. The proposed encoding solution and detailed end to end delivery path of a low bitrate contribution feed must be fully approved and signed off by ITV Connectivity at the beginning of the programme planning stage before delivery of a low bitrate contribution feed will be allowed.

Given the high profile nature of ITV live content, provision of a live low bitrate HD main or backup contribution feed will not be allowed on high value live content scheduled on ITV's main flagship channel and may not be allowed on high value content on other channels, although you will be permitted to provide a low bitrate IP tertiary feed for such content.

If permission is granted to deliver a low bitrate contribution feed then production must submit to ITV Connectivity a circuit diagram showing the end-to-end delivery path into Red Bee Media at least three weeks before the programmes scheduled transmission date. This diagram must show clearly all encoders/decoders used in the delivery path along with projected bandwidth/bitrates.

We strongly recommend that a detailed site survey be carried out at the OB location well in advance of the live programmes transmission date to ensure the above requested information is as accurate as possible.

The method of delivery of this low bitrate contribution feed (public Ethernet, bonded cellular, Ka band satellite or a mix of these methods) must be agreed for suitability with ITV Connectivity well in advance of transmission.

Consent to deliver a low bitrate feed should not be assumed as a given and ITV Connectivity, factoring in the proposed delivery methodology and projected bandwidth/bitrates will be the final arbiter as to whether this method of delivery will be acceptable to ITV.

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ITVX Web or Mobile Streaming

For live non-linear broadcasts (e.g. web,mobile streaming or ITVX only) a single feed delivered into one London Gateway will be deemed acceptable. In this scenario it will also not be considered necessary to provide a Back-Up feed, or standby power provision, unless this is specifically requested and funded by ITV at the commissioning stage.

Circuit Booking Times

The Main and Backup circuits must be booked and made available between the OB location or remote site and Red Bee Media at least 30 minutes before the scheduled start time of the programme to allow sufficient time for technical line-up. Circuits must also be available for a minimum of 15 minutes after the scheduled end time of the programme. This 15-minute window should be observed after the end time of any contingency schedule. Some live programming may require staggered transmission times across more than one channel. If this is the case, then all the associated line bookings should be arranged to switch at a time to allow and facilitate an adequate technical line-up period for all associated circuits before the start of the earliest scheduled programme start time.

Schematic Diagram

Production companies must provide an accurate Schematic Diagram on one A4 sheet of paper to ITV Connectivity documenting the end- to-end signal path, including backup circuits, between the remote location and Red Bee Media two weeks before transmission if possible and certainly no later than one week prior to the programmes scheduled transmission date.

The diagram should clearly indicate Local End numbers and document telephone contact details for key Technical/Production staff working on the live programme. This should include landline numbers. ITV Connectivity should be made aware of all third party contractors working on a live programme.

It will be the responsibility of production companies to ensure all third party contractors are fully conversant with ITV's technical delivery requirements relating to live programmes and that they fully comply with the technical requirements outlined in this document.

The submitted Schematic Diagram must contain a version number and date of issue for ITV sign-off. If any information on the Schematic Diagram changes after original submission to ITV Connectivity, then an updated version must be re-submitted to ITV (incrementing the version number) for subsequent approval and sign-off. Failure to provide accurate Schematic Diagrams to ITV Connectivity, or diagrams that are not subject to version control, will result in your technical design proposals being rejected at the point of delivery.

UPS & Generator Provision

Production companies must ensure OB suppliers or remote locations including studio facilities have UPS and Generator provision. This provision must fully comply with BS7909 regulations at all times. Any power systems used must have full failsafe provision. All generator power must be of a minimum dual synchronised twinset with each generator capable of taking the full operational load of the OB/Production centre to support the live ITV transmission. UPS must

also protect any broadcast dependant system that requires a clean shutdown or a 10 second plus reboot time.

Out of Vision Cue Dots (Mandated Requirement)

The use of Out of Vision Cue Dots on all live programmes supplied to ITV is now a mandatory requirement. The Out of Vision Cue Dot triggers should be carried within the VANC as OP47 data packets on Line 15 (578) using only ITV approved equipment. ITV will provide ad- hoc equipment and guidance to help production accommodate this change to live deliveries from studios and Outside Broadcasts. The legacy Invisidot 1 solution, referenced above will be gradually phased out by ITV during 2023 in favour of our new audio triggering solution (Invisidot 2)

Further information is available from ITV Connectivity. Our expectation is that programme suppliers will use one of the Invisidot solutions on both Main and Backup feeds. If this is not operationally possible, then the use of Invisidot on the Main feed and In Vision Cue Dots on the Backup feed would be acceptable. If these requirements cannot be met then this should be discussed with ITV Connectivity well in advance of your live programme.

In Vision Cue Dots

ITV have now mandated the use of Out of Vision Cue Dots on **ALL** live programmes. The use of the traditional In Vision Cue Dot is no longer acceptable and will only be allowed in exceptional circumstances and assessed on a case-by-case basis where it is demonstrated it isn't practical for operational reasons to use Out of Vision Cue Dots. In such a scenario, permission must be sought in advance of your live programme from ITV Connectivity outlining the reasons why you can't deploy the Out of Vision Cue Dot solutions. Should ITV Connectivity grant permission, then the following guidance in this paragraph applies. Any live programming delivered into Red Bee Media (which does not include live playouts where the part durations are known) must have access to a Cue Dot generator. The Cue Dot generator must be capable of inserting Cue Dots in either the left or right hand corner of vision as required. For sponsored programmes where the sponsor bumper is played out from Presentation, the Cue Dot should be inserted top left of frame. For programmes where the Sponsorship bumpers are played out from the OB location, or where the programme is not sponsored, then the Cue Dot should be inserted top right of frame. The Cue Dot must be of an acceptable size and position to satisfy the operational requirements of Red Bee Media. The use of a Cue Dot on **all** live programmes is a mandatory requirement.

Invisidot Two Cue Dot solution

During the second half of 2023 ITV will begin the phased migration to a new playout facility. As a result, the current Invisidot One soulution (OP47 insertion) will become end of life and will no longer be supported BY ITV or the new Red Bee playout facilty. We will therefore be implementing a new Cue dot solution named Invisidot 2 , which will be rolled out, on a phased basis during 2023. ITV Connectivity will advise which Invisidot solution should be used on your live programme during the Connectivity planning stage. This section provides guidance on the new system and how it will work operationally. Use of one of the invisidot solutions to flag pending commercial breaks, or junctions, will remain a contractual mandatory requirement for all live programming. The requirement for inbound contribution circuits into. Red bee if using the new Invisidot 2 solution requires two audio groups. Each audio group must have a combined bandwidth of 384kb/s minimum. PA talkback (Hot Mic) must be present on Track 8 of the inbound audio track. Please note that you will need to communicate clearly to any supplier in the TX chain that two audio groups are required as this can sometimes be a limitation.

Communication

BTs Public Switch Telephone Network (PSTN) will close in December 2025.By then, every phone line in the UK will have moved to a fully digital network that uses Internet Protocol (IP) across a fibre-based service.Any equipment that currently uses the PSTN will stop working: The Integrated Services Digital Network (ISDN) will also stop working.This change combined with ITVs phased move to a new playout centre means we have to consideri alternative arrangements to support production/engineering talkback for our live programming operation between the OB site and Red Bee Media in a non analogue world.. This section outlines ITVs approach to this change and your options for providing Production/Engineering talkback.

OB suppliers, remote locations or live studios, must use IP based communications. Acceptable solutions are Comrex or SIPitPRO. Those two solutions are compatible with Red Bee Media's technical infrastructure. If using Comrex or SIPITPro, OB providers should ensure they have registered with one of those providers and have sufficient credit to support the requirements of their live programme. Talkback provision into Red Bee is a production cost and not the responsibility of ITV or Red Bee Media. If other methods of communication are being considered, e.g. IP over satellite, then this must be discussed in advance with ITV Connectivity. The use of mobile phones as the primary source for Production/Engineering talkback is strongly discouraged and should only be used in very extreme circumstances. OB sites and remotes locations will be responsible for dialling into Red Bee to establish communications. Keyed/switched talkback is a mandatory requirement between the OB site/remote location and the playout centre. Open talkback is **NOT** permitted.

Technical Line-Up with Red Bee MCR

Technical line-up between the live location and Red Bee MCR should take place as soon as possible after the Main and Back-Up circuits are switched into Red Bee Media. In normal

circumstances circuits should be made available at least a minimum of 30 minutes before the live programmes scheduled transmission time. Some productions may require a longer technical line up period. Where possible all studio or OB facilities live output must be legalised before connection to transmission circuits. Legalisers should remain in circuit throughout the duration of the live broadcast.

Technical Line-Up Process

It's extremely important that technical line-up, which is a mandatory ITV requirement, can be carried out whilst the production gallery is able to rehearse. The production schedule should be planned accordingly to ensure this mandatory requirement can successfully take place. Red Bee Media MCR should carry out the following checks once the Main and Backup circuits are switched:

The Main and Backup transmission circuits should be routed through a frame sychronisor before arriving at Red Bee Media. Main and back up circuits should be clearly and uniquely identified between the OB site or live studio during the line-up process with Red Bee MCR. Once technically checked, those circuits should **NOT** be switched or routed via other paths throughout the duration of the live programme without reference to Red Bee Media MCR.

Audio and video levels on both feeds should be thoroughly checked to ensure signals are legal and within tolerance well in advance of transmission.

Audio levels and phase should be thoroughly checked. The responsibility for ensuring programme levels correlate to line-up rests with the remote production. Presentation & Engineering talkback should be thoroughly checked between the OB location, remote site or live studio and the Red Bee Media Network Director well in advance of transmission. This check should also include landline numbers.

A Test Signal feed, including accurate BITC (time of day) feed, from the remote site must be checked to enable circuit latency measurement at Red Bee. The Red Bee Media Network Director, when advising the OB, remote site or live studio, will account for this path delay time when communicating On-Air/Off-Air times to production to ensure accurate junctions are maintained.

A moving visual reference fed from the OB location, remote site or live studio must be used to check co-timing between HD and SD feeds at Red Bee Media.

Valid8 must be used for lip synch measurement and correction. If Valid8 is unavailable, this should be discussed in advance with ITV Connectivity.

In instances where line feeds for a major programme or series are being tested, it is recommended that preliminary testing is scheduled in advance of the day of transmission.

Booked circuit times should be thoroughly checked against Video i-Path or equivelent and the transmission schedule on the day of transmission as part of the technical line-up procedure to ensure the booked times of all circuits is adequate enough for the duration of the live programme, this should include cross checking the end time of the latest contingency schedule. Particular care should be taken around checking live sporting events such as football where extra-time and penalties maybe a possibility.

Operational Use of Cue Dot

The following information outlines the operational process that should be adhered to when using in or out of vision cue dots which is a mandatory requirement. The Cue Dot must be inserted approximately 1 minute before each end of part and removed a hard 5 seconds before the programme part ends. These timings must include sponsorship bumpers if these are being sourced from the OB site, remote location or live studio.

A visual check of the Cue Dot should be carried out between the remote site and Red Bee Media Presentation prior to transmission. Presentation will account for the path latency when the Cue Dot is inserted at the remote site (specific time) referenced against when the Cue Dot appears in vision at Red Bee Presentation. Red Bee Media MCR will confirm the absolute latency/delay from the OB location, remote site or live studio.

Production Assistant Operational Protocol

The following guidance outlines preferred operational practice between the Production Gallery and the Red Bee Network Director. The PA will give the Network Director an approximate one minute standby into commercial breaks and other pending junctions, seeking verbal acknowledgment from the Network Director that the 1 minute standby has been successfully received by transmission.

The PA will remove the in vision or out of vision Cue Dot 5 seconds before the end of programme parts or other pending junctions.

The PA should not give Red Bee Presentation a verbal count into commercial breaks unless requested to do so. This is due to latency issues rendering any count potentially inaccurate.

The Red Bee Media Network Director will confirm and acknowledge back On-Air times with the PA that accounts for path latency. The PA will acknowledge a one minute verbal standby to back On-Air times issued by the Red Bee Network Director. Following each commercial

break the PA and Red Bee Network Director will confirm the total commercial minutage already taken within the clock hour. If a PA insists on taking a commercial break resulting in the commercial minutage within that clock hour being breached, Red Bee Media Network Directors have been authorised not to take the break.

Red Bee Media Network Director Operational Protocol

The following guidance outlines best operational practice by the Red Bee Network Director:

The Network Director will take any circuit latency into account and make appropriate adjustments regarding On-Air/Off-Air times from commercial breaks. Communicating accurate back On-Air times to the Production Assistant at the remote OB location, remote site or live studio is the responsibility of the Network Director, not the PA, at the OB location. The Network Director will provide the Production Assistant at the remote OB location or live studio with an accurate one minute verbal standby to the programmes back On-Air time. The Network Director will insert a Cue Dot, which is a mandatory requirement for the ITV Network.

General Operational Procedures

On Air and Off-Air times should be thoroughly checked on the day of transmission with the Network Director. This check should take place well in advance of transmission. It should also include commercial break pattern checks and programme durations.

The Network Director should also check with the Red Bee Media Duty MCR Engineer that the booked time of all circuits is adequate for the duration of the live programme. Particular care should be taken around sporting events such as football where extra-time, penalties or other unforeseen over-runs can occur to ensure the duration of the circuits booked is long enough to cover such eventualities.

Should ITV undertake a live production where one or more local ends into Chiswick Park STC are shared across two ITV channels then the following protocol should be observed?

At the Planning meeting the OB/Remote Studio will identify a Senior member of the engineering team who will be responsible for the line switch at source, a telephone contact number for that person will be made available on the ITV/Red Bee technical documentation. This person must be able to listen across the incoming Network Directors 4 wire and the PA's switch. The PA at the OB/Studio must ask the Network Director at Chiswick to verbally acknowledge once they are clear of the show, so the switch may be safely made in time by the designated person.

Any latency or delay should be accurately agreed between the Network Director and the Production Assistant in advance of transmission. The Network Director will make any necessary adjustments to On-Air/Off air times.
Production/Engineering talkback must be thoroughly checked between Red Bee Presentation and the remote OB site or live studio well in advance of the live programme going On-Air. This check should also include any other agreed form of communication between sites.

In cases where the programme is scheduled across more than one channel, additional care needs to be taken with regards to the respective programme feeds and talkback provision.

Landline numbers and any other provided contact numbers must be thoroughly checked well in advance of transmission. It should not be assumed that phone numbers are correct. Clocks in Red Bee Media transmission and at the remote OB site, or live studio, must be thoroughly and accurately checked well in advance of the live programme going to air to establish and agree that the clocks at both ends are accurate and in synch. Any commercial break restrictions, if applicable, should be discussed and agreed between the OB Production Assistant and the Network Director well in advance of transmission. Special care should be taken to identify any potential clock hour violations. The remote production should roll the programmes Opening Titles and subsequent programme parts from minus 10 second pre-rolls. All parts should have a clock counting down from minus 10 seconds to On-Air.

All countdown clocks should clearly indicate the Programme Title, Production Number, Programme Part and any other appropriate or agreed information.

All information on the clocks should be easily readable and understood by operational staff at Red Bee Media.

All potential programme over-runs/contingency scenarios, if known prior to transmission, should be clearly understood, discussed and agreed well in advance of transmission between production staff and the Network Director. This check should also ensure all circuit bookings are accurate and match the scheduled duration of the live programme including any contingency schedules.

Managing Live TX Feeds Between Third Party Providers & Red Bee Media

The Red Bee Network Director will be responsible for managing live transmission feeds that go direct to air from a third party content provider or remote technical facility. If not already undertaken, a standard line-up procedure will need to be undertaken prior to the scheduled on-air time. Provision for this should be made in any line booking.

The Red Bee Media Network Director should confirm talkback communication prior to transmission, conduct a clock check with the operator at the remote playout facility to ensure clocks are accurately in sync at both ends and confirm scheduled on-air and off-air times. The Network Director should clearly outline in advance to the remote operator that they will receive a one minute standby to on- air and thereafter, in keeping with current protocol, it will be the responsibility of the operator at the remote end to roll their EVS to exactly meet the scheduled on-air time of the event being played out. It is not current policy for the Red Bee Network Director to provide the remote operator with a count to on-air for any of the programme segments. Dependent on circumstances, it may be necessary for the remote facility to confirm or supply programme part durations. Additionally, there may be a requirement for Red Bee to preview segments of the completed programme prior to transmission.

Monitoring Equipment

Photosensitive Epilepsy (PSE)

Suitable monitoring equipment should be deployed on the transmission paths to monitor and log photosensitive epilepsy events (PSE). Pre-recorded elements must be PSE compliant and rehearsals for live shows must be monitored to ensure compliance with the OFCOM PSE Guidelines during transmission. Please see Section 3.2 of this document for further information and guidance.

EBU R128 Audio Loudness Recommendation

PSE and R128 Loudness reports must be made available to ITV on request post transmission.

Version Control:

1. V6.0 Document re-brand
2. V6.1 Page 33 - Sam Wilkinson removed as the principal ITV contact and Bill Brown's contact details updated to reflect new Leeds base.
3. **V6.3 May 2023** Guidance added on use of the new Invisidot 2 solution.
4. **V6.3 May 2023** Notice of clousure of BTs PSTN and ITVs move to implement Comrex and SIPitPRO as acceptable forms of communication for live programming.
5. **V6.3 May 2023** Requirements added for live programming on **ITVX**.

Document Accuracy:

Every attempt has been made to ensure that the information contained in this document is accurate. Errors in this document should be reported to the DPP on **info@thedpp.com** and in the ITV specific section to Bill brown at **bill.brown@itv.com**.