Technical Specification for the Delivery of Content to Sky UK

[V1.4 | October 2024]

Contents

1 Overview

1.1 Keywords

The keywords “must”, “should” and “may” are to be interpreted as per below.

> **Must** – denotes an unconditional obligation, that is to be followed precisely, to conform with the specification.
>
> **Should** – denotes a requirement that achieves the best results in most, or all, circumstances. Not complying with this must be deliberate, with rational and compelling reasons, and a sound comprehension of the consequences. Unless specified, not complying with a “should” does not require pre-approval, however, to avoid what may be an unintentional oversight being seen by viewers, justification for the deviation may be sought from Sky’s QC department.
>
> **May** – denotes an allowed possibility that is at the discretion of the supplier or production whether to adhere to or not.

Where a requirement is not preceded by one of the above keywords, it is to be understood as a “must”, unless an alternative modal verb is used.

1.2 Objective

This document covers the technical requirements for Commissioned Productions and Licenced Acquisitions.

It combines the requirements previously documented in *Sky’s Technical Specification for Ultra High-Definition Content* and *Digital Production Partnership’s Technical Standards for Delivery of Television Programmes to Sky*, along with further updates.

If familiar with the retired specifications, the Change Log at the end of this document will list the updates. However, to ensure efficient delivery of content, it is always recommended that the most up-to-date document is acquired, fully read, and understood.

As knowledge, technology and standards evolve, this document will be updated when appropriate. Please ensure you are referencing the most up-to-date version. Email ashley.ross@sky.uk if you would like to be added to the mailing list to be informed each time the Technical Specification is updated.

Following this document ensures the delivery of compliant assets, which meet the expected standards and enable efficient processing of those assets within Sky. It is the responsibility of the supplier to meet the requirements in this Technical Specification. Failure to satisfy Sky’s Quality Control will result in content being rejected.

Whilst certain requirements may seem obvious to some Commissioned Productions, they are documented to set a contractual baseline for quality expectations. Any deviation must be discussed with Sky.

Live content is no longer covered in this document. Speak with your Sky representative for requirements relating to live productions and other contribution feeds.

All questions related to the delivery of content should be directed to the relevant email address in section 5.1 Key Contacts where the query will be addressed in a timely manner or escalated to the pertinent individual. Feedback on this document can be sent to ashley.ross@sky.uk.

1.3 The Organisation of the Document

Licenced Acquisitions are only required to comply with the Licenced Acquisitions Requirements and Delivery Requirements sections.

Commissioned Productions must comply with the Production Standards, Post Production Standards and Delivery Requirements sections in this document, as well as *Sky UK's Production Pack* – your assigned Production Coordinator will be able to provide you with an up-to-date Production Pack.

Common requirements, best practices and alternative options are detailed in the appendix. These are referenced where relevant and must be adhered to where applicable.

2 Production Standards

2.1 Audio Recording

- Sound must be recorded as a 24-bit Linear PCM signal with a sample rate of 48kHz.

Where a Non-Scripted Production requires alternative recording formats due to production logistics (e.g., covert recording), the audio should not exhibit any dynamic and/or frequency response artefacts as a result of recording in a low-quality codec or at low data rates.

- The microphone must be appropriately placed to capture pertinent sound with minimal background noise.
- The recording must be free from distortion.
- Where appropriate, Productions should acquire audio elements which facilitate the production of multichannel surround and immersive audio mixes.

See Appendix 1: Common Audio Faults for a list of general issues that must not be present in the final deliverable.

2.2 Image Capture

To ensure the minimum requirements are met, details of the production pipeline may be requested by Sky. These details should include:

- The camera(s) make and model
- Framerate
- Opto-Electrical Transfer Function (OETF)
- Colourimetry
- Video codec
- Bitrate
- Bit-depth
- Effective pixel resolution and whether a Bayer filter is utilised
- Chroma sub-sampling
- De-squeezing ratio and any intended use of mattes

In instances where the desired lens, camera or production pipeline is not familiar to Sky, samples may be requested. These samples must be of similar shooting style and graded in the style intended by the Production, along with the capturing of a zone plate test chart, as per EBU Tech 3335.

Due to the nature of Non-Scripted Productions, the minimal set of requirements are adjusted to be more pragmatic for those production needs.

See Appendix 2: Common Visual Faults for a list of general issues that must not be present in the final deliverable.

2.2.1 Primary Image-Acquisition

To ensure viewers observe a noticeable improvement in resolution between the different definition tiers (e.g., HD and UHD) as well as SDR and HDR, the minimum camera requirements in Table 1 must be met for the commission type and format.

Table 1. Minimum Camera Requirements.

Camera Parameter	Scripted			Non-Scripted		
	HD	UHD-SDR	UHD-HDR	HD	UHD-SDR	UHD-HDR
Resolution	1920 x 1080	3840 x 2160		1920 x 1080	3840 x 2160	
Compression	Lossless			Intra @ ≥4Mbits per frame	Intra @ ≥10Mbits per frame	
Chroma Subsampling	4:2:2	4:4:4		4:2:2		
Colour Bit Depth	10	12		10		
OETF	Log			Log or BT.709		Log, HLG or PQ
Colourimetry (AKA Colour Gamut or Primaries)	Camera's Proprietary Wide Colour Gamut			BT.709	BT.2020 or The Camera's Proprietary Wide Colour Gamut	
Dynamic Range	>13 stops	≥14 stops	>14 stops	>12 stops	≥ 13 stops	>13 stops

Shooting on film may be accepted with prior approval.

2.2.1.1 Resolution

Resolution is not only a count of effective photosites on the sensor, but also a measure of the camera's ability to accurately capture detail. This is also subject to other factors including encoding parameters, lenses, lighting of subjects and the signal-to-noise ratio at different exposures. For the avoidance of doubt, "resolution" in the table above is the measured output from capturing a zone plate test chart, as per EBU Tech 3335.

- The captured resolution must consider any post-production needs to reframe. Shots that fall below the permitted delivery resolution when cropped/reframed may be considered as non-HD/non-UHD and could lead to rejection of the deliverable. Therefore, a Production may need to capture at a higher resolution than what is listed in Table 1.

Bayer filters can compromise a camera's ability to achieve the expected resolution. When used, a Production may need to oversample the pixel resolution to achieve satisfactory results.

Subject to the post-production pipeline, Productions may be permitted to capture at a lower resolution than what is stated in the table when mattes would be used to fill the 16x9 raster of the deliverable (e.g., capture at a resolution of 3840x 1920 for an aspect ratio of 2.00:1) However, where possible, we would encourage the use of using the camera's full resolution to then reframe in post.

2.2.1.2 Compression

Inter-frame coding, which may not meet the requirements specified in the table above, may be permitted for some Non-Scripted Productions where certain constraints necessitate it. This must be discussed with Sky ahead of production if required.

2.2.1.3 Colour Bit Depth

16-bit capture is encouraged for higher-end Scripted Production.

- To limit visible banding, Productions which will require significant changes to luminance or colour saturation, either due to stylistic choice or due to the challenging nature of a production which may hinder consistently accurate exposure, must capture at a greater bit-depth than what is listed in Table 1.

2.2.1.4 Dynamic Range

Whilst there are various methods to measure dynamic range, the stops of dynamic range listed in Table 1 are included for guidance.

2.2.2 Exposure

The impact of the chosen Exposure Index (EI), in relation to aperture and sensor sensitivity, should be understood. Intentionally introduced noise, through low lit images and camera settings, should be avoided as it can impair the resolution and compromise downstream processes. Downstream encodes may suffer from unintended image quality degradation, with varying results on different resolutions and bitrates. Where possible, video noise that is introduced in-camera should be minimised.

- All content must be appropriately lit and exposed, such that the main subject, and intended lowlight and highlight elements, are discernible, without an undue dependence on restoring detail or enhancing image elements during the grade.

Note that, since the HDR version must exhibit appropriate highlights that exceed the levels achievable in SDR, particular care may need to be given to brighter areas within the frame (e.g., avoid overexposing highlights).

- Where a HDR Production does not allow for any corrections in a grade (e.g., a tight turnaround of a live event) the reference white point must remain consistent throughout and aligned for the subsequent SDR mapped output.

2.2.3 Lenses

- The lens must be free from:
    - Chromatic aberrations
    - Geometric distortion
    - Blemishes such as dirt, moisture, and scratches

2.2.3.1 Optical Resolution

Whilst most lenses that are chosen by Productions are sufficient, those chosen for a softer look may not be.

- Lenses must be capable of delivering the optical resolution (MTF) which fulfils the pixel resolution capabilities of the camera(s) used.

- The optical resolution must be sufficient within the areas of the lens where the subject will be framed and expected to be in focus.

- Respective members of the camera team must be aware of any shortfalls related to the optical resolution of the lenses, maintaining an adequate MTF across the image plane used.

Such image drop-offs can be due to different factors such as the distances of focus, focal lengths, and aperture settings. Optical resolution loss and aberrations are most commonly accentuated away from the centre of the lens.

If there is uncertainty with a lens's ability to capture sufficient optical resolution, it should be tested with the camera(s) of choice, demonstrating a similar shooting style that uses any pre-determined camera settings and graded in a similar manner to that intended by the Production. In addition, the Production may also need to capture a zone plate test chart as per Tech 3335. Samples can then be sent to Sky for evaluation.

2.2.3.2 Vignetting

The degree of the vignetting, at different focal lengths and aperture settings, in conjunction with the camera's sensor, must be understood and provisioned for.

- Unless for the editorial effect, vignetting should not be present on the final deliverable.

- If vignetting is corrected in post-production via reframing, there will be an obligation to capture at a greater resolution, so that the deliverable sent to Sky meets the requirements in this document.

2.2.3.3 Anamorphic Lenses

The use of anamorphic lenses may result in the minimum horizontal resolution requirements not being met.

- Anamorphic lenses should only be used where the camera sensor does not fulfil the aspect ratio requirements of the delivered programme and should only be used when deemed to deliver an improved resultant image resolution than cropping the sensor output.

Further reduction of the horizontal resolution that may impair the deliverable's resolution must be minimised.

- Where, by necessity, use of an anamorphic lens result in the encoded horizontal resolution measuring less than the minimum requirement of the deliverable, the signal should be encoded as RGB or, in the case of Y'CbCr signals, utilise 4:4:4 chroma subsampling.

For example:

  - Where the image is encoded in-camera with anamorphic geometry, chroma sub-sampling of 4:2:2 would not be permitted.
  - 4:2:2 would be permitted when the image is de-squeezed in-camera and then encoded with the correctly proportion geometry.

Images that are encoded with a horizontal resolution measuring less than the minimum requirement of the deliverable may lack sufficient resolution and therefore may be classified as non-qualifying footage.

2.2.4 Non-Qualifying Cameras

Footage from cameras that do not comply with the Primary Image-Acquisition requirements is referred to as non-qualifying footage and should not be used. However, where a situation presents no alternative (e.g., covert filming carried out by a Non-Scripted Production), use of non-qualifying footage is permitted but it must be limited to the constraints detailed in this section.

- For Scripted Productions, instances of very short shots are permitted (e.g., "crash-cam" shots), and approval is required for any prolonged use.

- Whilst non-qualifying footage must always be limited, the nature of certain shooting conditions and/or subjects associated with Non-Scripted content may require prolonged use. If there is a requirement for non-qualifying footage to exceed 25% of programme duration, it must be discussed with Sky ahead of production with a detailed editorial justification.

- Where non-qualifying cameras are used, they must be of the highest quality achievable and the Production must understand the chosen camera's shortfalls and where possible, make efforts to minimise their appearance (e.g., limited exposure range, aliasing on patterns and textures, rolling shutter on motion and encoding artefacts on complex images).

2.2.5 Frame Rate

- Commissioned Movies can capture at 24 frames per second (incl. 24/1.001 – AKA 23.976) and deliver at this framerate.

- Scripted Productions should capture at 25 frames per second. Where it is a requirement for a series to shoot at 24 frames per second (incl. 24/1.001 – AKA 23.976) to comply with a Co-Commissioned Productions, the deliverable sent to Sky must be converted to 25fps.

- Non-Scripted Productions may capture at 25 frames per second. However, where accurate rendering of fast movement is required, such as 'Live Events' (e.g., football) and 'As Live Events' (e.g., pre-recorded music festivals, entertainment shows etc.) the production should capture at 50Hz (i.e., 50 interlaced fields per second when an HD production or 50 progressive frames per second when a UHD production).

It is not acceptable to capture 50fps for a 25fps progressive frames per second deliverable as this can introduce otherwise avoidable frame interpolation artefacts or result in an unacceptable stutter due to the absence of alternate frames.

It is not acceptable to shoot in interlace and convert to progressive (e.g., add a film motion effect) in post-production, as this compromises the image's resolution.

As detail in the Conversion of 50 Progressive Frames Per Second to 50 Interlace Fields Per Second section, edits on 50fps content must occur after the odd frame / before the even frame.

2.2.6 Aspect Ratio for Commissioned Productions

- Where there is a requirement to produce a version with an alternative aspect ratio to that intended for delivery to Sky (e.g., for a Co-Production or International Distribution) Sky's deliverable must still meet the requirements in this document, where the qualifying resolution cannot be compromised. Contact Sky in advance if third-party requirements may compromise the deliverable sent to Sky.

- Prolonged sections of windowboxing must be avoided and short instances of windowboxing should be avoided. Therefore, consideration must be given to various archive footage that may be in a multitude of different aspect ratios. To avoid windowboxing archive footage, the Production may need to commit the main body of material to a 1.78:1 aspect ratio, as this would then limit the mattes on archive footage to only pillarboxes or letterboxes.

- Permitted aspect ratio must be agreed with your Production Coordinator.

2.2.7 Miscellaneous Production Points

- Production equipment (e.g., microphones) must not be in the shot unless intended. Scripted Productions may need to remove their appearance during post-production.

There may be requirements to capture footage for different versions commissioned, such as international re-versioning, which may necessitate the shooting of additional content for other language versions (e.g., relevant signage in German, Italian and English). This is not essential unless confirmed during the commissioning stage.

3 Post-Production Standards

See Appendix 2: Common Visual Faults for issues that must be avoided.

3.1 Non-Qualifying Footage

Non-qualifying footage refers to any footage that has been captured on cameras that do not comply with the Primary Image-Acquisition Requirements section of this document, including but not limited to archive footage.

- Non-qualifying footage must always be editorially justified and unless agreed with Sky, its use in a Non-Scripted Production must be limited to 25% of the duration. All other footage must come from qualifying cameras (e.g., contemporary interviews in a documentary).

- Unless agreed with Sky, Scripted Productions must not include non-qualifying footage except for short instances (e.g., "crash-cam" shots) or where archive footage is editorially justified (e.g., reference to historical events).

3.1.1 Archive Footage

- Where archive footage is used, it must be of the highest quality obtainable. To a reasonable degree, a re-grade and repairs might be required (e.g., audio level correction, reducing visible defects, removing audio ticks, etc.).

See Appendix 3: Framerate Conversion Methods for requirements on the treatment of different frame rates.

3.1.1.1 Archive Up-Scaling

- Footage sourced from a lower resolution than the deliverable will require re-scaling to avoid windowboxing.

- Enhancements may be made (e.g., a re-grade), however, care must be taken to ensure up-scaled footage must look no worse than the source if later down-scaled (e.g., scaled to SD within Sky's content delivery systems).

- VITC, switching signals and half lines at the top and bottom part of the field blanking interval, which may be present on Standard Definition sourced content, must not be visible when up-scaled.

3.1.1.2 Aspect Ratio of Archive Footage

- Aspect Ratio considerations detailed in the Production section of this document must be respected during Post-Production.

- The aspect ratio of any footage, including archive, must not exhibit incorrect geometry (e.g., squashed/stretched).

- It should be centred in the frame, maximising its use of the raster available and utilising either a blur or mattes to fill the unoccupied area (i.e., without windowboxing). Only short instances of windowboxing would be accepted and only due to the use of archive footage.

- Where the source quality allows it, crops are permitted so that the image fills the raster, but only when it does not compromise the composition or the image's resolution (e.g., this may be achievable with high-resolution stills).

3.1.1.3 Signal Range and Dynamic Range Conversion of Archive

Care must be taken when converting video range representation, transfer function and colourimetry.

- The video range representation (e.g., full range or narrow range) must always be determined and correctly mapped during a conversion.
- When converting transfer function and colourimetry (e.g., HDR to SDR), the original "look" must be respected.

It is not acceptable to excessively stretch an SDR sourced image in an HDR signal. The result of SDR-to-HDR conversion must not introduce visible banding artefacts. It is recommended that SDR reference white is mapped to ~58% of the PQ EOTF or ~75% of the HLG EOTF.

Similarly, unusually dark, or low contrast, images must be avoided when mapping an HDR sourced image in an SDR signal.

For HDR to SDR conversion, it is recommended that the appropriate peak of the HDR signal is determined and then mapped in a way that respects midtones and shadow detail. Care must also be taken when mapping from a wide colour gamut (e.g., BT.2020) to a standard colour gamut (e.g., BT.709). The colour gamut must be converted in a way that maintains the original look.

See BT.2446-1 for further guidance.

Note that automatic conversions may benefit from further tweaking in the grade to optimise the results and maintain the artistic intent.

3.1.2 Archive Audio

- Adjustments must be made to ensure that audio is clear and that the levels stay consistent with the rest of the programme unless editorially justified.
- When integrating audio that has been mixed differently (e.g., diverged/centre only dialogue, mono/stereo in 5.1/Atmos, etc.), care should be taken to minimise strident changes in the sound stage.

3.2 Edit

See Appendix 3: Framerate Conversion Methods for considerations applicable to 50fps Productions.

3.2.1 Edit Errors

- Missing media, missing frames and duplicate frames will result in rejection.
- Flash frames or shots comprising of a small number of frames must also be avoided unless editorially essential. However, even intentional short shots must pass a Flash and Pattern Analyser test.
- As detail in the Conversion of 50 Progressive Frames Per Second to 50 Interlace Fields Per Second section, edits on 50fps content must occur after the odd frame / before the even frame.

3.2.2 Flash and Pattern Analyser (FPA)

Flickering or intermittent lights, and certain types of repetitive visual patterns, can cause serious health problems for some viewers with Photosensitive Epilepsy (PSE).

- So not to excluded viewers, efforts must be made to reduce the inclusion of such footage as content must pass an FPA test for UK regulatory regulations. For further details see ITU BT.1702-2 and OFCOM guidance on Harm and Offence Annex 1.

3.2.3 Post-Production Visual Pipeline

Scripted Productions:

- A scene-referred workflow, such as ACES, is recommended. However, it is acceptable to work within the colour space defined by the camera's OETF and colourimetry when it results in a satisfactory grade with uncompromised quality.

- Use of image sequence (e.g., DPX) is preferred, however, other uncompressed or lossless workflows are also permitted for Scripted Productions.

- A ≥ 12-bit colour depth must be maintained from the camera to the grade.

Non-scripted Productions:

- Non-scripted Productions may utilise a pipeline that is practical for their production needs. If capturing footage in an uncompressed codec, Non-Scripted Productions are permitted to perform the online conform in a compressed format.

- Care must be taken to avoid further intermediary transcodes within the post-production workflow before the final conform. Serial transcodes of lossy codecs can introduce unacceptable artefacts and unnecessary loss of resolution which may result in the rejection of content.

- A ≥ 10-bit colour depth must be maintained from the camera to the grade.

3.2.4 Converting 2K and 4K:

- Where shooting resolution is 4k (4096 x 2160), the UHD deliverable (3840 x 2160) should not be rescaled but instead cropped – i.e., 1:1 pixel mapped – to avoid pixel interpolation. Similarly, if the shooting resolution is 2k (2048 × 1080), the HD deliverable (1920x 1080) must not be rescaled but cropped – i.e., 1:1 pixel mapped – to avoid pixel interpolation.

3.2.5 Grade

- There should be no degradation in image quality between capture and the grade (e.g., reducing resolution). Where, by necessity, there is a reduction, it must not fall below the minimum Primary Image-Acquisition requirement.

Other than where editorially justified, the grade *within a format*, should remain consistent, with particular note to the below:

- Unless altered for an editorial effect, colour rendition, especially skin tones, must be consistent throughout.
- Luminance and chroma levels must be consistent on sequences that are repeated across multiple episodes, such as the opening credit sequence. Due to concern that an error may have occurred, the content will be rejected or referred if a sequence differed on an episode without editorial justification.
- When grading a subsequent season, the look must remain consistent unless editorially justified.

3.2.5.1 Applied Stylistic Effects

- Heavy use of artificial sharpening, softening or noise (including film grain effect) should not be applied so not to compromise the image.

Note that video noise and film grain can impair the resolution and compromise downstream processes. Downstream encodes may suffer from unintended image quality degradation, with varying results on different resolutions and bitrates.

3.2.5.2 Low Luminance Images

Whilst grading suites provided precisely controlled equipment and viewing environments, the same is not true for most home viewing. Low luminance images where the subject and relevant surroundings cannot be clearly distinguished cause frustration and complaints from viewers.

- Content should be suitable for viewing in ordinary home viewing environments, where controlled, low lighting cannot be guaranteed, and display technology will vary.

- Care must be given to shadow details, with consideration to what is inconsequential image information, and what needs to be preserved through re-encodes and consumer TV presentation. Note that nuance shadow detail can be lost through encoding and consumer TVs often emphasise objectionable banding artefacts in shadow detail, which can be more apparent where midtone information is scarce.

3.2.5.3 High Dynamic Range

- Where an HDR (ITU-R BT.2100) deliverable has been commissioned, a separate SDR (ITU-R BT.709) grade must also be provided.

- The HDR version should be graded using the PQ EOTF. Approval is required to use the HLG EOTF.

- The HDR content must be delivered to Sky in the same HDR format in which it was graded. It is not acceptable to convert from one HDR format to another between the grade and delivery.

- The grades must look stylistically similar across the SDR and HDR formats, particularly with regards to midtones.

- HDR grades must offer a perceptual increase in dynamic range over SDR. Transient overshoots that exceed SDR levels, which are detectable on equipment but barely perceivable to viewers, do not qualify.

- Where appropriate, the HDR grade should utilise the wider colour gamut available, with chromaticity that exceeds what is available in BT.709.

- Automatic SDR-to-HDR up-conversions are not permitted.

- MaxCLL and MaxFALL metadata must be present for PQ Commissioned Productions. To avoid erroneous offshoots produced by compression artefacts, the measurements should be carried out at the final stage of the HDR grade, rather than on any downstream derivatives.

Speak to your Sky contact ahead of being commissioned if the intended look will not utilise HDR's increased dynamic range, as an additional HDR grade may not be required. HDR grades which offer little, to no benefit over SDR, will be rejected.

Where the creative intent results in a single episode that does not exhibit the benefits HDR offers, when the rest of the series does (e.g., a flashback episode with a muted grade), Sky should be informed ahead of delivery to avoid incorrect rejection of the individual episode.

See Appendix 4: Additional HDR Information for guidance on grading HDR and use of HDR metadata.

3.2.6 Viewing Room

See Appendix 5: Reference Environment for Critical Viewing for details on the expectations of grading and QC environments.

3.2.7 Display Requirements

See Appendix 6: Display Requirements for details that must be met.

3.3 Graphics

Graphics encompasses any on-screen graphical overlay, including but not limited to subtitles.

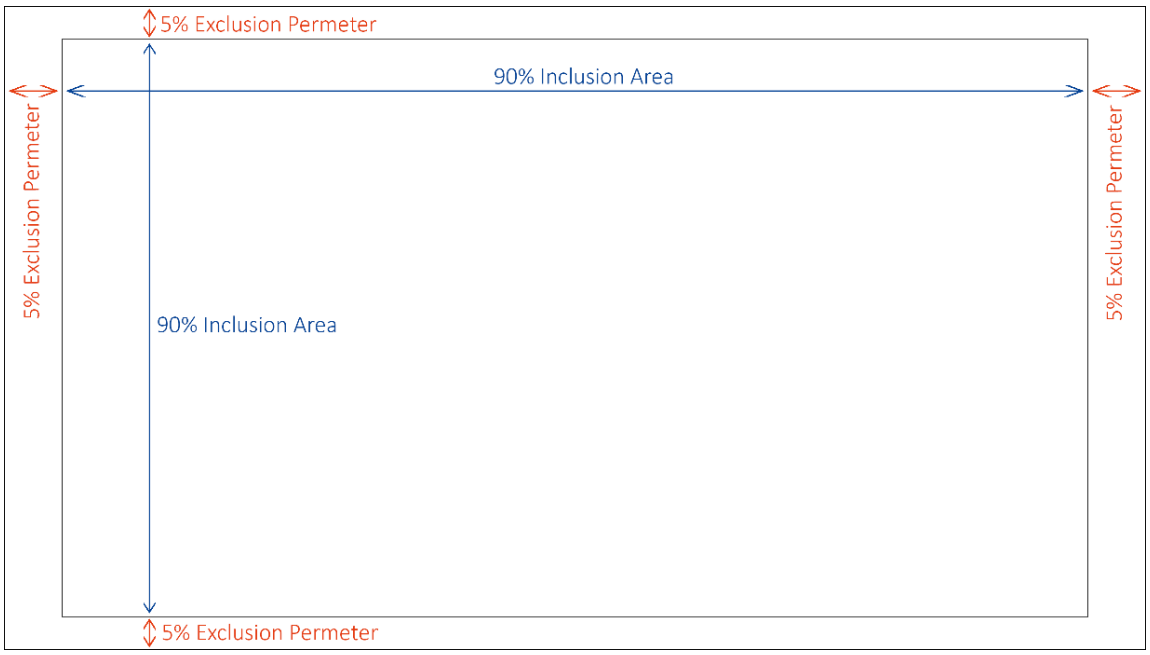
- Moving graphics must match the scan type of the footage they overlay.
- All on-screen text must be free from spelling and grammatical errors, and held for a sufficient time to be comfortably read.
- If on-screen text is positioned over an area of the screen which is the same colour as the font; a trim or drop shadow must be utilised and, for consistency, this must be used on all subtitles throughout the series or feature.
- The font size of text must be big enough to retain well-defined clarity on compressed and lower resolution renditions.

3.3.1 Graphic Safe Area

- Relevant parts of graphics (e.g., text) must reside within the Graphics Safe Area of the frame, defined by EBU R 95, Ver 1.1.

Tools that add safe area overlays commonly express this as the inclusion area of the middle 90% of the height, and the middle 90% of the width. In EBU R 95 it is defined as the 5% exclusion perimeter. These are the same as clarified in *Figure 1. Safe Area*. See EBU R 95, Ver 1.1 for details.

Figure 1. Safe Area



3.3.2 Luminance Levels of Graphics

- Content will be rejected if the luminance level of graphics, particularly on HDR, is deemed unsuitable.

Subject to the context of what's in the frame and the neighbouring frames, Reference White (AKA diffuse white or graphics white) should sit around 100% in SDR, 58% (203 cd/m^2) in PQ and 75% in HLG, as per ITU-R BT.2408-3 (Table 2). This may differ where the established look and/or graphic colour justifies it.

3.3.3 In-Vision Subtitling for Foreign Language (AKA Forced Narrative Subtitles)

- Where Forced Narrative subtitles are used, they must be burnt into the vision of the delivered content - Sky does not currently support forced subtitles that are not burnt-in before delivery (including TTML in an IMF package).

- Subtitles must not obscure any on-screen graphics.

3.3.4 End Credits

- The end credits must be presented as sequential cards and not rolling credits.

3.3.5 Textless Elements

- Textless Elements must be included in the same deliverable, after the main feature/episode. These must also be mute throughout.

If there is extensive use of graphics throughout the whole asset (e.g., a heavily subtitled asset), a fully textless version may be included after the main texted version, but this must be agreed with Sky ahead of delivery.

3.4 Post-Production Audio

See Appendix 1: Common Audio Faults and Appendix 7: Audio Room Requirements for details.

3.4.1 Audio Bit Depth

- A 24-bit Linear PCM signal, with a sample rate of 48kHz, must be retained throughout post-production through to delivery.

3.4.2 Audio Mixes

- The essence of the audio mix must match the video (e.g., without a spot effect missing) and it must remain in-sync throughout.

- All content must have both a 5.1 and stereo mix. Approval is required to deliver only a stereo mix, and this is only an option for HD commissions.

- An additional Dolby Atmos mix may also be required and will be confirmed during the commissioning stage. It must be discussed with Sky ahead of being commissioned if the title will not leverage the benefits of a 3D sound stage, as a Dolby Atmos mix may not be required. Dolby Atmos mixes that offer little, to no benefit over 5.1, will be rejected.

The 5.1 mix may be derived from the Dolby Atmos mix.

The stereo mix should be an automated Lo/Ro downmix from the 5.1 mix. See Appendix 8: Dolby Audio Metadata for the downmix parameters which should be used.

Even though viewers may not have 5.1 or Dolby Atmos listening environments, those mixes are available to them and their playback equipment will downmix to the device's ability (e.g., a TV with only stereo output).

- For this reason, all mixes must be monitored in the different permutations through to mono. Care must be given to ensure essential nuance elements remain clear, and sections where many audio tracks contain activity, or are particularly loud, don't become unintentionally overbearing or muddled.

Diverged dialogue (i.e., where sync dialogue is mixed across the front 3 audio channels) is being phased out.

- A new series, or renewal of a new season with Dolby Atmos introduced, must not be mixed with diverged dialogue – this applies to both the Dolby Atmos mix and the corresponding and 5.1 mix.
- A renewed season of an existing series that had previously mixed the dialogue diverged, may choose to continue this style, or change to point-source dialogue.
    - Where appropriate for Scripted content, the Mixer may choose to judiciously pan point-source dialogue between channels of the 5.1, or place as a separate moving audio-object within an Atmos mix.
    - However, Non-Scripted must remain centre channel only (if choosing not to continue a diverged mixing style established in previous seasons).
- A Series that had previously mixed point-source dialogue, cannot change to mixing the dialogue diverged.
- The mixing style must be consistent across all episodes within a season.

See Appendix 9: Audio Mixing Best Practices for further guidance.

3.4.3 Music & Effects (M&E) / Mix Minus Narration (MMN)

To facilitate with re-versioning in other languages:

- All non-dialogue audio in a Scripted Commission must be represented in the fully filled Music & Effects (M&E) mix. This includes all ambience and foley fill that is present on the main mix. This must also be at 'mix level' (i.e., at the same level these elements are adjusted to in the main mix, as though sync dialogue was present) and undipped (as might be relevant for Scripted content containing a narration).

- An undipped Mix Minus Narration (MMN) must be supplied for Non-Scripted Commissions. This must contain the music, effects, and sync dialogue, with only the narration removed.

3.4.4 Audio Level

- With regards to Trailers and Movies intended for platforms or channels where the content is not segmented for commercial breaks to be added between its parts, (e.g., a Sky branded movie-only channels), the audio must be supplied with the same nearfield mix that is on the consumer DVD or Blu-ray, albeit with a maximum True Peak level that does not exceed -1dBTP. This may not necessarily be R128 compliant. Only where there is not a DVD or Blu-ray release, the audio supplied must be the same nearfield mix that is provided to other streaming services, albeit with a maximum True Peak level that does not exceed -1dBTP. This may not necessarily be R128 compliant.

- All other content is intended for channels with commercial breaks; therefore, it must be EBU R128 compliant. This content should be mixed so that the loudness measurement is compliant and not depend on automatic normalisation which can compress and/or offset the mix in an unintended way.

The M&E/MMN does not have to comply with R128, since the absence of dialogue will likely result in a different loudness measurement, however, the M&E/MMN must be at the same levels in both the main and M&E/MMN mix, albeit undipped.

See Appendix 10: Loudness Levels for further information.

3.4.5 Dolby Atmos for Commissioned Productions

- Dolby Atmos mixes with little to no activity overhead will be rejected.

- A fixed channel-based immersive mix is not acceptable for pre-recorded content (e.g., 5.1.4 channels without dynamic objects).

- Automatic up-mixing of 5.1 to Dolby Atmos is not acceptable. Nor should the 5.1 be the primary mix, with a pass that pulls out some effects in the overheads for the Atmos. When Dolby Atmos has been commissioned it should be the primary mix, created first, and must fully utilise the 3D environment wherever appropriate.

- The beds and objects within the Dolby Atmos mix must be separated into Dialog, Music, and Effects. Unless otherwise specified, an additional M&E/MMN Dolby Atmos Master File (DAMF) may need to be rendered.

- The DAMF must include 30-seconds of pre-roll and 30-seconds of post-roll.

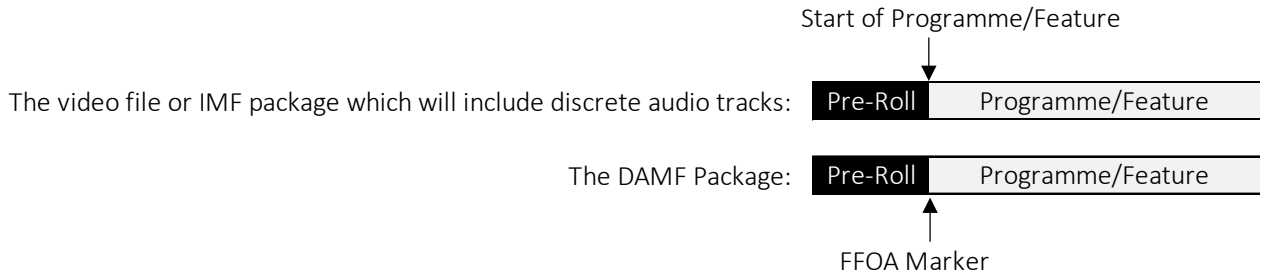
Dolby Atmos is delivered to viewers in the E-AC-3 codec. The spatial coding emulation, available in both the Dolby Atmos Mastering Suite and the Dolby Atmos Production Suite, should be used to monitor the home viewing experience of Dolby Atmos, with the number of elements set to 16.

3.4.5.1 Dolby Atmos Alignment

- The DAMF must run at the same framerate, maintaining synchronisation with the video, stereo and 5.1. Note that 50fps is not formally supported by the Dolby Atmos Render but is achieved when the DAMFs framerate is set to 25fps.

- The DAMFs First Frame of Action (FFOA) in the .atmos file (i.e., as entered into the Dolby RMU), which for clarity would also mark the end of the pre-roll, must accurately align with the video's whole hour FFOA timecode. The FFOA will be used to ensure correct sync with the video when married-up at Sky.

Figure 2. Example of How Video and Dolby Atmos Will Be Aligned



- The Last Frame of Action (LFOA) marker must accurately mark the final frame intended to be included in the content (the DAMF must then also include the previously stated post-roll after the LFOA marker).

3.4.6 Dolby Metadata

See tables in Appendix 8: Dolby Audio Metadata for the downmix parameters which Sky will add to the 5.1 and Dolby Atmos sent to viewers.

3.4.7 Audio Phasing

See Appendix 11: Audio Phase Considerations for information.

3.4.8 Programme Layout

To better align the International deliverable with the Sky deliverable, Sky UK no longer requires what was referred to as the "Bumper-to-Bumper" layout – i.e., we won't require the inclusion of Programme Bumpers, nor the 1-second of black and silence between parts.

- Commissioned Productions must be in a soft parted layout.

A soft parted layout is where a programme exists as one continuous programme, without any breaks included, but the audio, video and pace are structure in a manner that allows for natural break points to be inserted.

Based on the timecodes that the Production adds to the Clock/Slate (see section 3.4.10 Clock/Slate for Commission Production for more details), Sky will input the specified in and out parting timecodes into our systems. Downstream encoders will use these timecodes to cut the programme into parts during transmission and the VOD transcoding stage.

Therefore, the material must be edited and supplied in a manner that allows for this and without the need for further audio and video tweaks to soften the transition to a commercial break. In some situations, this may necessitate the audio and/or video to fade to achieve a suitable transition, though this is not mandatory when the edit style can still facilitate an appropriate break point and is editorially justified. Short instances of black and/or silence are also permitted if it helps achieve a suitable cut to commercial break. The audio and/or video of the intended separate parts must not bleed into one another.

Speak to your Production Coordinator for further guidance on the number of parts and part durations.

This is not required for Sky Cinema Original movies. These movies must be a single part version, without accommodating for commercial breaks.

3.4.9 Line-Up & Post-Roll

Table 2. Line-Up & Post-Roll for Commissioned Production

Timecode	Duration	Section	Video	Audio
09:59:30:00	00:00:20:00	Bars & Tone	The appropriate colour bar test pattern*	GLITS or EBU stereo line-up / BLITS / Silence on Dolby Atmos
09:59:50:00	00:00:07:00	Asset Info	Ident Clock or Slate	Silence
(09:59:57:00)	(00:00:00:02)	(*Optional* sync plop)	(2 frames of reference white)	(1kHz tone on the first white frame only)**
09:59:57:00	00:00:03:00	Break Pre-Start of Title	Black	Silence
10:00:00:00	-	Start of Asset	First frame of action	First frame of action
Feature / Programme (see the previous section for details on the layout of programme parts)				
After Feature / Programme	00:00:03:00	End of Programme Card	May be animated or static e.g., Company Logo	Fade or cut to silence by end of 3''
-	00:00:02:00	"Holding frame" for the End of Programme Card***	Freeze or 'living hold' of the Programme Card	Silence
-	00:00:10:00	Break Before Textless	Black	Silence
-	(00:00:00:02)	(*Optional* sync plop)	(2 frames of reference white)	(1kHz tone on the first white frame only)
Textless Elements (entire textless version should be supplied only when there is heavy use of text/graphics throughout)				
-	00:00:02:00	Edit Safeguard	Black	Silence

***** The appropriate colour bar test pattern must be used for the delivered format:

- SDR: ITU-R BT.471 Colour bars (a) 100 / 0 / 100 / 0
- Narrow Range HLG: ITU-R BT.2111-2 FIGURE 1
- Narrow Range PQ: ITU-R BT.2111-2 FIGURE 2
- Full Range PQ: ITU-R BT.2111-2 FIGURE 3

****** The 1kHz tone should measure -18 dBFS for each channel in the stereo mix. It should measure -24 dBFS in each channel of the 5.1, which when downmixed to stereo would produce a signal around -18 dBFS on each channel. The varied number of audio tracks available in Dolby Atmos makes it impractical to specify a per-channel dBFS level for the 1kHz tone. Therefore, the mixer can choose to apply a 1kHz tone to all tracks, only the bed(s), or only a single channel in the bed. The important aspect is to ensure that the cumulative 1kHz tone must be audible and not exceed -18dBFS when downmixed to stereo.

******* Although this is rarely exercised, the "holding frame" or "edit safeguard" functions as a buffer that allows Sky to accommodate a shift by up-to 2-seconds of the actual cut-off from the programme, should the need arise.

- Colour bars should appropriately match the video range representation (narrow/full range), transfer function and colourimetry of the content.

- Only the end of the final part must contain a freeze/hold. This freeze/hold at the end of the final part is commonly the production company's logo or Sky Studios logo, and this must remain visible for the total 5-second duration, with the audio ending 3 seconds into this. It is not acceptable to fade to black and freeze on the black frames.

The "Sky Original" ident will be systematically added to the end (i.e., as a hard cut), therefore all audio must come to a clean end before, or by, 3-seconds into the End of Programme Card. There is not an option to bleed the audio of the main programme into the "Sky Original" ident.

3.4.10 Clock/Slate for Commission Production

A countdown clock or slate must clearly display the following information:

- Programme ID (AKA Media ID)
- Feature or Series Title
- If a series, it should also include:
  - Season Number/Year
  - Episode Name/Number
- Version / Descriptor (if applicable)
- Framerate
- *First and Last Frame of Action for each part

*Note the new requirement for the timecodes of each part's First and Last Frame of Action.

e.g.:

- U1234567
- Landscape Artist of the Year
- Season 5 / 2019
- Episode 1
- Extended Version
- 25-fps
- Part 1 FFOA: 10:00:00:00 LFOA: 10:11:15:24
- Part 2 FFOA: 10:11:16:00 LFOA: 10:25:12:13
- Part 3 FFOA: 10:25:12:14 LFOA: 10:33:57:15
- Part 4 FFOA: 10:33:57:16 LFOA: 10:44:00:03

3.4.11 Watermarking and Steganography for Commissioned Productions

- Commissioned content must not be delivered with any watermarking or steganography copy protection.

3.4.12 Access Services for Commissioned Productions

Sky is committed to providing Access Services to those with sensory impairments. Where pertinent, supporting media should be supplied.

3.4.12.1 Captions for the Deaf and Hard-of-Hearing (SDH)

Commissioned Productions may need to supply EBU-STL closed caption files compliant with EBU TECH 3264-E, that also comply with Sky's 'Subtitling Guide' and remain in sync with the video throughout. Further information can be obtained from DL-Access.Services@sky.uk.

3.4.12.2 Audio Description (AD)

AD is not a mandated requirement; however, the Production may choose to create it to retain artistic influence on this audio element (e.g., employing the voice talent of choice). If this option is to be explored,

please contact your assigned Production Coordinator and DL-Access.Services@sky.uk for further information. The resulting AD must be delivered to Sky as a mono BWAV file.

3.4.13 Quality Control (QC) & Compliance

- QC and Compliance checks must be carried out on Commissioned Productions before delivery.
- It must be stated in the report where a failure point cannot be improved upon (e.g., issue inherent in archive footage).

It is the responsibility of the Commissioned Production company to ensure programmes meet the technical and editorial requirements, and that the company carrying out the QC process has the appropriate resources.

Some AQC devices combine the PSE and AQC reports whilst others allow manual entry for comments from the Eyeball test. Sky can accept all options if it is clear from the filename what is included and if the reports are shared with the pertinent email addresses listed in this section.

3.4.13.1 Automated Quality Control (AQC) testing

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 must ensure that all technical and editorial warnings or comments are acted on or commented on. Note that mandatory requirements must be rectified.
- Pass AQC reports must be emailed to DL-QCSpecialists@sky.uk, as PDFs, and named as the Programme ID, suffixed with "_AQC" – e.g., M1234567_AQC.pdf.

3.4.13.2 'Eyeball' Quality Control testing

The eyeball QC check is to ensure picture and sound quality meets the requirements in this document, and particularly that dialogue is clear and understandable by a first-time viewer. All audio mixes must be assessed.

See Appendix 5: Reference Environment for Critical Viewing, Appendix 6: Display Requirements and Appendix 7: Audio Room Requirements for information on the conditions to be met when carrying out a QC assessment of the content.

- Pass 'Eyeball' Quality Control reports must be emailed to DL-QCSpecialists@sky.uk, as PDFs and named as the Programme ID, suffixed with "_EYE" – e.g., M1234567_EYE.pdf.

3.4.13.3 Photosensitive Epilepsy (PSE) testing

- Programmes must be tested using a file-based PSE device that meets the guidance provided by Ofcom.
- Pass PSE reports must be emailed to DL-ComplianceCommissions@bskyb.com, as PDFs and named as the Programme ID, suffixed with "_PSE" – e.g., M1234567_PSE.pdf.

Whilst there are limited FPAs for HDR, the SDR counterpart must pass and have a similar intended look. If the SDR requires alteration, the HDR must also be tweaked to ensure there is not a significantly different look.

3.4.14 Redeliveries

- Versions delivered must be the final versions.

Unless instigated by Sky (e.g., due to a QC fail or a change requested by Sky), redelivering due to a change initiated by the production company may not be an option. If permitted; the Production will incur re-processing costs. The Production must contact Sky to discuss this before any action is taken.

4 Licenced Acquisitions Requirements

4.1.1 Versions

- Sky UK must receive the same edit as the BBFC assessed consumer release.

Where there are multiple versions of this (e.g., a theatrical cut and a director's cut) Sky should be provided with both, where possible.

- The aspect ratio should match the current consumer release.

Sky should be contacted to determine the preferred version if this varies depending on the format (e.g., full-frame IMAX sequences on Blu-ray, when the DVD remains consistently letterboxed throughout).

- Where a title has been remastered, Sky should receive the latest, highest quality restoration.

4.1.2 Source Quality

- Deliverables should be from an Intra-frame coded source, which should be an uncompressed DI, with no interim conversion. Visible encoding artefacts may result in rejection.

4.1.2.1 Format Categorisation

It is fundamental that there is an observable benefit between the different standardised formats – i.e., HD, UHD and HDR. Content will be rejected where there is not a perceivable improvement.

4.1.2.1.1 Resolution

- HD (i.e., 1920 x 1080) must exhibit a definition greater than a 1280 x 720 rendition and UHD (i.e., 3840 x 2160) must exhibit a definition greater than a 1920 x 1080 rendition.

The upscaling capabilities of consumer TVs add further challenges in ensuring an improvement to viewers choosing the higher definition versions of a title. Therefore, content that does not offer a notable benefit shall be rejected.

- A Production's image quality is expected to meet a similar standard to that detailed in the Primary Image-Acquisition section.

- Exceptions of this should not exceed more than 25% for non-scripted content. For example, Documentaries must have used high-quality cameras for all contemporary elements (e.g., interviews) whilst it is accepted that archive footage may be inferior.

- Dramas must not contain any compromised footage except for short instances (e.g., "crash-cam" shots).

Contact Sky if there is editorial justification for exceeding these parameters. The quality of the footage, the proportion of asset containing it, and the context of use will be considered. In most instances, Sky will require delivery of a compliant file to review before confirmation can be made of the acceptability.

4.1.2.1.2 High Dynamic Range

- HDR grades must offer a perceptual increase in dynamic range over SDR. Transient overshoots that exceed SDR levels, which are detectable on equipment but barely perceivable to viewers, do not qualify.
- Automatic SDR-to-HDR up-conversions are not permitted.

See Appendix 4: Additional HDR Information for details on the HDR grade and HDR metadata.

4.1.2.2 Video Bit Depth

- Deliveries must not have an effective signal bit-depth that is lower than the deliverable's encoded bit-depth (e.g., deliver a 10-bit file that originates from an 8-bit source). Deliverables that do not contain *genuine* bit-depth of what is required – e.g., static assignment of lower significant bits or artificial dithering – will be rejected.

4.1.2.3 UHD Source Material

- Sky should be informed of the nature of the UHD source – 'Native', 'Film Scan' or 'Upscale' – for all deliverables. See Appendix 12: UHD Source for definitions.

4.1.3 Aspect Ratio for Licenced Acquisitions

- The image must utilise the maximum number of pixels available for its aspect ratio.
- Excessive windowboxing of archive footage may result in the rejection of content.
- Where mattes are used, it must result in the image being centred within the frame.
- Anamorphically incorrect images may result in the rejection of content.
- Content must be delivered in the appropriate Picture Format. In the case of SD content, 4:3 content delivered as SD 16:9 pillarbox, or 16:9 content delivered as SD 4:3 letterbox, will be rejected. SD content with an aspect ratio of 14:9 or wider must be delivered as 16:9. SD content with aspect ratios narrower than 14:9 should be delivered as 4:3.

4.1.4 Frame Rate and Scan Type

- Changes and conversions of scan type must not contain any conversion artefacts.
- As detail in the Conversion of 50 Progressive Frames Per Second to 50 Interlace Fields Per Second section, edits on 50fps content must occur after the odd frame / before the even frame, so that the cut occurs at the start of the first field in an interlace rendition.

Note that all UHD must be captured in progressive scan.

4.1.5 In-Vision Subtitling for Foreign Language

- Where Forced Narrative subtitles are used, they must be burnt into the vision of the delivered content – Sky does not currently support forced subtitles that are not burnt-in before delivery (including TTML in an IMF package).

- Subtitles must be free from spelling and grammatical errors and held for a sufficient time to be comfortably read.

- Subtitles must not obscure any on-screen graphics.

- Subtitles must always be clearly visible.
    - 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 must be used on all subtitles throughout the series or feature.
    - The font size must be big enough to retain well-defined clarity on compressed and lower resolution renditions.

- Subject to the context of what's in the frame and the neighbouring frames, Reference White (AKA diffuse white or graphics white) should sit around 100% in SDR, 58% (203 cd/m^2) in PQ and 75% in HLG, as per ITU-R BT.2408-3 (Table 2). This may differ where the established look and/or graphic colour justifies it.

4.1.6 Watermarking and Steganography on Licenced Acquisitions

- Content must not be delivered with watermarking or steganography copy protection technology which impairs playback on any devices.

4.1.7 Audio

- The essence of the audio mix must match the video (e.g., without a spot effect missing).

- The audio must remain in-sync with the video throughout.

4.1.7.1 Mixes

- All deliveries must have a Stereo mix delivered. Where only a mono mix is available, it must be delivered as phase-coherent dual mono.

- HD deliveries should have a 5.1 mix. Up-mixing stereo to 5.1 is not acceptable.

- UHD must include both a Stereo and a 5.1 mix. Dolby Atmos must also be provided where available.

- An audio mix (e.g., 5.1) should not be omitted from the delivery to Sky where it exists.

Note that with regards to License Acquisitions, Dolby Atmos is currently supported for movies only. Please contact Sky in advance if a License Acquisition series' is available with Dolby Atmos where we will assess the suitability of the content layout.

4.1.7.2 Audio Levels

- Audio levels and balance between dialogue, music and effects should be appropriate for home viewing environments, with clear and distinct dialogue where intended.

- With regards to Trailers and Movies intended for platforms or channels where the content is not segmented for commercial breaks to be added between its parts, (e.g., a Sky branded movie-only channels), the audio must be supplied with the same nearfield mix that is on the consumer DVD or Blu-ray, albeit with a maximum True Peak level that does not exceed -1dBTP. This may not necessarily be R128 compliant. Only where there is not a DVD or Blu-ray release, the audio supplied must be the same nearfield mix that is provided to other streaming services, albeit with a maximum True Peak level that does not exceed -1dBTP. This may not necessarily be R128 compliant.

- All other content is intended for channels with commercial breaks; therefore, it must be EBU R128 compliant.

See Appendix 10: Loudness Levels for further information.

4.1.7.3 Audio Phase

See Appendix 11: Audio Phase Considerations for further information.

4.1.7.4 Dolby Metadata

See table in Appendix 8: Dolby Audio Metadata for the downmix parameters which Sky will add to the AC-3 5.1 and Dolby Atmos E-AC-3 presented to viewers.

4.1.7.5 Audio Bit Depth

- Deliveries should be sourced from masters with 24-bit audio, without static assignment of lower significant bits or artificial dithering.

4.2 Content Layout

- Titles should be laid out as per the below. However, an alternative first frame of action timecode can be accepted when it is on the whole hour (e.g., 01:00:00:00) and alternative bars and tone can be accepted too.

Table 3. Line-Up & Post-Roll for Licensed Acquisitions

Timecode	Duration	Section	Video	Audio
09:59:30:00	00:00:20:00	Bars & Tone	The appropriate colour bar test pattern*	GLITS / BLITS / Silence on Dolby Atmos
09:59:50:00	00:00:07:00	Asset Info	Ident Clock or Slate	Silence
(09:59:57:00)	(00:00:00:02)	(*Optional* sync plop)	(2 frames of reference white)	(1kHz tone on the first white frame only)**
09:59:57:00	00:00:03:00	Break Pre-Start of Title	Black	Silence
10:00:00:00	-	Start of Asset	First frame of action	First frame of action
Feature / Programme (see the previous section for details on the layout of programme parts)				
After Feature / Programme	00:00:10:00	Break Before Textless	Black	Silence
-	(00:00:00:02)	(*Optional* sync plop)	(2 frames of reference white)	(1kHz tone on the first white frame only)
Textless Elements (entire textless version should be supplied only when there is heavy use of text/graphics throughout)				

*The appropriate colour bar test pattern must be used for the delivered format:

- SDR: ITU-R BT.471 Colour bars (a) 100 / 0 / 100 / 0
- Narrow Range HLG: ITU-R BT.2111-2 FIGURE 1
- Narrow Range PQ: ITU-R BT.2111-2 FIGURE 2
- Full Range PQ: ITU-R BT.2111-2 FIGURE 3

**** The 1kHz tone should measure -18 dBFS for each channel in the stereo mix. It should measure -24 dBFS in each channel of the 5.1, which when downmixed to stereo would produce a signal around -18 dBFS on each channel. The varied number of audio tracks available in Dolby Atmos makes it impractical to specify a per-channel dBFS level for the 1kHz tone. Therefore, the mixer can choose to apply a 1kHz tone to all tracks, only the bed(s), or only a single channel in the bed. The important aspect is to ensure that the cumulative 1kHz tone must be audible and not exceed -18dBFS when downmixed to stereo.

- Colour bars should appropriately match the video range representation (narrow/full range), transfer function and colourimetry of the content.

- Audio, including reverb, should come to a clean end before, or by, the end of the vision. Where this is not the case, a tolerance of up to 5 seconds will be given, but at this point all audio must be mute.

In most cases, content shall be delivered as a seamless part without breaks, however, breaks may be permitted, and it should be discussed with Sky ahead of delivery.

If available, textless elements can be included after the main Feature / Programme. A black and silence break must be included to separate it from the main texted version.

4.3 Clock/Slate for Licenced Acquisitions

A countdown clock or slate should clearly display the following information:

- Programme ID (AKA Media ID)
- Feature or Series Title
- If a series, it should also include:
  - Season Number / Year
  - Episode Name/Number
- Version / Descriptor (if applicable)

4.4 Access Services for Licenced Acquisitions

Sky is committed to providing Access Services to those with sensory impairments. Where available, supporting media should be supplied.

- The below files related to Captions for the Deaf and Hard-of-Hearing (SDH) should be supplied:
  - Preferably EBU-STL SDH files compliant with EBU TECH 3264-E. Ideally, these would comply with Sky's 'Subtitling Guide' and remain in sync with the video throughout, however, Sky recognises that this is not always practical with licensed titles.
  - Where the above files do not exist, alternative SDH/Closed Caption subtitle files should be supplied if available.

- In the absence of any SDH/Closed Caption subtitles, assisting files (e.g., scripts, Spotting List, CDSL or CCSL, etc.) must be supplied.

Audio Description (AD) is not a mandated requirement, however, where available it should be sent to Sky and preferably as a mono BWAV file, though other formats may be accepted.

Further information can be obtained from DL-Access.Services@sky.uk.

4.5 QC

- Although Licenced Acquisitions are pre-made, they must still satisfy Sky's QC assessment.

Content that does not appear to meet similar production and post-production standards detailed in this document may be rejected. It must be discussed with Sky in advance if there are concerns around meeting these standards.

To ensure the creation of compliant files that also meet quality expectations, it is recommended that Licensors of content carry out Auto-QC and 'Eyeball' assessments on the media that's delivered to Sky. Documentation (e.g., Auto-QC and 'Eyeball' QC reports) should be sent to DL-QCSpecialists@sky.uk.

See Appendix 1: Common Audio Faults and Appendix 2: Common Visual Faults for issues that must be avoided.

5 Delivery Requirements

- Any changes to content, even after delivery, must be addressed in all versions and redelivered to Sky (e.g., removal of an audio mute from one mix, must be addressed on all mixes, including the M&E/MMN, and on both the SDR and HDR versions).

Note that Live content is not covered in this document. If required, your Sky contact should be able to connect you with the correct technical specialist for your needs.

Video tape delivery is no longer acceptable. If Sky's Content Services department provide permission for tape deliver, Appendix 13: Tape Specification details the requirements.

Similarly, hard drive delivery is not acceptable unless pre-approved with Sky's Content Services department.

5.1 Key Contacts

Questions regarding the delivery of content can be directed to one of the applicable email addresses below:

- All SDR-UHD and HDR-UHD: DL-UHDMasterMaterials@bskyb.com
- Movies: DL-MoviesandTrailersMasterMaterials@bskyb.com
- Entertainment: DL-EntertainmentMasterMaterials@bskyb.com
- Sports: DL-SportsMasterMaterials@sky.uk
- Kids Content: DL-KidsMasterMaterials@sky.uk
- EST Boxsets: DL-BoxsetsMasterMaterials@sky.uk

5.2 Onboarding for File Delivery

New content suppliers need to be onboarded to deliver Sky. Either Aspera Faspex or a peered Aspera connection will be used.

Please contact SkyFileDeliveryOnboarding@sky.uk to be onboarded.

5.3 File Formats

- Files must be delivered as specified in this document. Alterative formats, including but not limited to zipped files, are not acceptable.
- Metadata intended to describe the properties of the video must be accurate, and consistent between both container and the codec headers/encoded bit-streams.
- Timecode must remain continuous from the very start of the file.

5.3.1 SD

An SD version is not required if a higher resolution (i.e., HD or SDR-UHD) version is also being delivered.

5.3.1.1 File Naming Requirement

- All files sent to Sky must be named as per the Media Identifier (AKA Delivery ID or Programme ID) supplied by Sky. This identifier will change for each delivery, including redeliveries of the same title (e.g., in the event a title fails QC, the redelivery will require a new ID).

For SD material, the identifier will be prefixed with an “M”, followed by a string of 7 unique numbers. The delivered MXF must be named as per this supplied Identifier, with the “M” in uppercase and file extension in lowercase (e.g., M1234567.mxf).

5.3.1.2 Descriptive Metadata

Descriptive Metadata may be included within the principle MXF file, as per the AS-11 DPP specification, or within a sidecar XML.

A list of tools that support the adding of AS-11 DPP Descriptive Metadata can be found here: thedpp.com/metadata-apps

Alternatively, a sidecar XML can be used. An example of this XML will be provided by SkyFileDeliveryOnboarding@sky.uk during the onboarding process.

In either case, all pertinent fields must be updated, and characters must be limited to ‘A-Z’, ‘0-9’, ‘-‘ and ‘_’. Failure to do so will result in an unsuccessful ingest and require a re-delivery.

5.3.1.3 SD Video Specification

- SD files must be encoded as compliant AMWA AS-11 UK DPP SD files. A summary of key attributes is included in Table 4 below.

Table 4. SD Video Specification

Component	Attribute
Resolution (active image)	720 x 576
Frame Rate	25
Scan Type	Interlace
Transfer function	BT.601
Colourimetry	BT.601
Matrix coefficients	BT.601
Colour space	Y’C’bC’r
Chroma subsampling	4:2:2
Video Range	Narrow*
Bit depth	8
Coding	D-10 Stream (SMPTE ST 0356:2004), Intra coded, MPEG-2, P@ML at 50Mbits/s.
Container	MXF OP1a

*Overshoots that exceed the video range of 16 – 235 bits, but within the tolerance detailed in EBU R103, will be accepted.

- The correct 16:9 or 4:3 Display Aspect Ratio must be included in the stream and container technical metadata.

- Cuts in the material must happen on frame boundaries (i.e., between field 2 and field 1).

- Material may be originated as progressive scan but must be delivered as interlaced scan in the PsF scan scheme, with motion occurring between field 2 and field 1 (i.e., field 1 dominance).

The file specification matches that of the DPP, therefore, toolsets that export SD AS-11 DPP files can be used to ensure the creation of compliant MXF files.

SD deliveries that contain unspecified transfer function, colourimetry and matrix coefficients container signalling will be assumed to be BT.601.

5.3.1.4 SD Audio Specification

- All 4 audio tracks must be encoded as Linear PCM, at a sample rate of 48kHz and a depth of 24-bits/sample, stored as little-endian integers.
- The audio must be frame interleaved with the video as described by AS-11.
- The track layout must be as per EBU R123-4b, with M&E/MMN on tracks 3 & 4 (see Table 5 for details).

Table 5. Audio Channel to Track Allocation for SD Content

Track	Channel Alignment
1	Main Stereo - Lo
2	Main Stereo - Ro
3	M&E/MMN/Mute Stereo - Lo
4	M&E/MMN/Mute Stereo - Ro

- Commissions must deliver M&E/MMN.
- Licensed Acquisitions should deliver M&E/MMN where available. Where M&E/MMN is not available, tracks 3 & 4 must still be present but contain mute tracks.

See Appendix 10: Loudness Levels which confirms EBU R128 requirements.

5.3.2 HD & 3D

An HD version is not required if an SDR-UHD version is also being delivered.

5.3.2.1 File Naming Requirement

- All files sent to Sky must be named as per the Media Identifier (AKA Delivery ID or Programme ID) supplied by Sky. This identifier will change for each delivery, including redeliveries of the same title (e.g., if a title fails QC and requires redelivery of an amended version).

For HD & 3D material, the identifier will be prefixed with an “M”, followed by a string of 7 unique numbers. The delivered MXF must be named as per this supplied Identifier, with the “M” in uppercase and file extension in lowercase (e.g., M1234567.mxf).

5.3.2.2 Descriptive Metadata

Descriptive Metadata can be delivered within the principle MXF file, as per the AS-11 DPP specification, or within a sidecar XML.

A list of tools that support the adding of AS-11 DPP Descriptive Metadata can be found here: thedpp.com/metadata-apps

Alternatively, a sidecar XML can be used. An example of this XML will be provided by SkyFileDeliveryOnboarding@sky.uk during the onboarding process.

In either case, all pertinent fields must be updated, and characters must be limited to ‘A-Z’, ‘0-9’, ‘-‘ and ‘_’. Failure to do so will result in an unsuccessful ingest and require a re-delivery.

5.3.2.3 HD Video Specification

- HD files must be encoded as compliant AMWA AS-11 UK DPP HD files. A summary of key attributes is included in Table 6 below.

Table 6. HD Video Specification

Component	Attribute
Resolution (active image)	1920 x 1080
Frame Rate	25
Scan Type	Interlace
Transfer function	BT.709
Colourimetry	BT.709
Matrix coefficients	BT.709
Colour space	Y'C'bC'r
Chroma subsampling	4:2:2
Video Range	Narrow*
Bit depth	10
Coding	AVC-Intra Class 100 (SMPTE RP 2027), High Profile, Level 4.1 at 113Mbits/s**.
Container	MXF OP1a

*Overshoots that exceed the video range of 64 – 940 bits, but within the tolerance detailed in EBU R103, will be accepted.
**AVC Intra Class 100 equates to a video essence data rate of approximately 113Mbits/s.

- Cuts in the material must happen on frame boundaries (i.e., between field 2 and field 1).

- Material may be originated as progressive scan but must be delivered as interlaced scan in the PsF scan scheme. Motion on PsF scan material must always occur between field 2 and field 1 (i.e., field 1 dominance).

The file specification matches that of the DPP, therefore, toolsets that export HD AS-11 DPP files can be used to ensure the creation of compliant MXF files.

HD deliveries that contain unspecified transfer function, colourimetry and matrix coefficients container signalling will be assumed to be BT.709.

5.3.2.4 3D Video Specification

3D content must be delivered as an HD file that conforms with this section, albeit in the side-by-side 3D format. See Appendix 14: 3D Requirements for further information.

5.3.2.5 HD Audio Specification

- All 16 tracks must be encoded as discrete Linear PCM, at a sample rate of 48kHz and a depth of 24-bits/sample, stored as little-endian integers.

- The audio must be frame interleaved with the video and carried within a BWF container as described by AS-11.

- The track layout must be as per EBU R123-16c (see Table 7 for details).

Table 7. Audio Channel to Track Allocation for HD Content

Track	Channel Alignment
1	Main Stereo - Lo
2	Main Stereo - Ro
3	M&E/MMN/Mute Stereo - Lo
4	M&E/MMN/Mute Stereo - Ro
5	Main 5.1 - Front L
6	Main 5.1 - Front R
7	Main 5.1 - Centre
8	Main 5.1 - LFE
9	Main 5.1 - Surround L
10	Main 5.1 - Surround R
11	M&E/MMN/Mute 5.1 - Front L
12	M&E/MMN/Mute 5.1 - Front R
13	M&E/MMN/Mute 5.1 - Centre
14	M&E/MMN/Mute 5.1 - LFE
15	M&E/MMN/Mute 5.1 - Surround L
16	M&E/MMN/Mute 5.1 - Surround R

- Commissions must deliver stereo, stereo M&E, 5.1 and 5.1 M&E.
- Licensed Acquisitions must deliver stereo and should deliver 5.1 and any M&E/MMN where available. Where M&E/MMN and/or 5.1 is not available, the relevant tracks must still be present but contain mute audio.

See Appendix 10: Loudness Levels which confirms EBU R128 requirements.

5.3.3 UHD

- When a title is commissioned or licenced in HDR-UHD, an SDR-UHD counterpart must also be delivered. Sky will not convert HDR versions to SDR.

5.3.3.1 HDR

The term HDR10 is not used in this document. HDR10 is a consumer format that is explicitly 10-bit, whilst deliverables sent to Sky can have a greater bit-depth. HDR10 is also often understood to have a chroma sub-sampling of 4:2:0, which is not acceptable for deliverables sent to Sky. The terms PQ (Perceptual Quantization) and HLG (Hybrid Log-Gamma), as defined in BT.2100, are used to denote the specific HDR formats which Sky can accept.

Unless otherwise agreed, HDR Commissioned Productions must be graded with a PQ Transfer Function and delivered as such. HDR licenced acquisitions can be delivered as either PQ or HLG.

At present, Sky shall conform all HDR deliverables to HLG for publication on its platforms.

5.3.3.2 UHD Framerates

Content will be presented across Sky's platforms in either 25p or 50p. Deliverables that run at either 24/1.001 or 24 fps will be re-sped to 25 fps by Sky, in-house.

- Titles that are in 30/1.001, 30, 60/1.001 and 60 frames per second are not accepted. This content must be frame rate converted to either 25fps or 50fps before delivery. See Appendix 3: Framerate Conversion Methods for details.

5.3.3.3 File Naming Requirement

- All files sent to Sky must be named as per the Media Identifier (AKA Delivery ID or Programme ID) supplied by Sky. This identifier will change for each delivery, including redeliveries of the same title (e.g., in the event a title fails QC and requires redelivery of an amended version). For UHD material, the Media Identifier will be prefixed with a "U", followed by a string of 7 unique numbers.

- For UHD only, a human readable name must also be included after the Media Identifier. However, assets with long titles names may require them to be shortened. The entire character count must not exceed 120 characters. The Production can choose to word this as they see fit, as long as it is clear and consistent across all episodes. This also applies to DAMF and IMF packages where the folder name, combined with any individual filename within it, must not exceed 120 characters.

There is currently no requirement for additional descriptive metadata to be included with the delivery of UHD files.

5.3.3.4 UHD Video Specification

- Sky offers more format options for Licensors of Acquisitions. These can be delivered in any of the UHD formats specified in Appendix 15: Alternative UHD Formats Accepted, particularly when it precludes additional transcoding. The various attributes will be discussed during the onboarding process and internal systems will be set accordingly. After being onboarded, Sky UK will need 60-days' notice if any part of the on-boarded spec needs to change to a permitted alternative attribute (e.g., the audio channel to track allocation or video codec).

- Commissioned Productions must be compliant with Table 8 below, along with the further specifications detailed in Apple's ProRes White Paper, including but not limited to the bitrates for the given frame rate.

Table 8. UHD ProRes Video Specification

Component	SDR Attribute	HDR Attribute
Resolution (active image)	3840x2160	
Frame Rate	(24/1.001, 24)*, 25 or 50	
Scan Type	Progressive	
Transfer Function index	See SDR & HDR Signalling section below	
Colourimetry		
Matrix coefficients		
Colour space	Y'C'bC'r	
Chroma subsampling	4:2:2	4:4:4
Video Range	Narrow**	
Bit depth	10	12
Coding	ProRes 422 HQ	ProRes 4444
Container	.MOV	

*Commissioned (non-movie) Productions must be delivered in 25 or 50 progressive frames per second. Commissioned Movies and Licensed Acquisitions can be delivered at 24 frames per second (incl. 24/1.001 – AKA 23.976).
**Overshoots that exceed the video range of 64 – 940 bits in a 10-bit signal or 256 – 3760 in a 12-bit signal, but within the tolerance detailed in EBU R103, will be accepted.

5.3.3.4.1 SDR Signalling

- The QuickTime "Color Parameters Atom" ('colr') should be used to provide colourimetry signalling within the container as specified in Table 9.
- The ProRes codec header must not contradict the essence within the container.

Table 9. SDR Signalling in a .MOV

Parameter	Value
Colour Parameter type	"nclc"
Primary index	1 (BT.709)
Transfer Function index	1 (BT.709)
Colour Matrix index	1 (BT.709)

UHD deliveries that contain unspecified transfer function, colourimetry and matrix coefficients container signalling will be assumed to be BT.709.

5.3.3.4.2 HDR Signalling

- The QuickTime "Color Parameters Atom" ('colr') must be used to provide colourimetry signalling within the container as specified in Table 10.
- The ProRes codec header must not contradict the signalling within the container.

Table 10. HDR Signalling in a .MOV

Parameter	Value For PQ	Value For HLG
Colour Parameter type	"nclc"	
Primary index	9 (BT.2020)	
Transfer Function index	16 (PQ)	18 (HLG)
Colour Matrix index	9 (BT.2020 Non-constant Luminance)	

For clarification, the above table should not be interpreted that both a PQ and HLG version needs to be supplied, but rather, *either* a PQ or HLG version needs to be supplied.

- Where a licenced acquisition has been graded using a mastering display configured with P3 colourimetry, the Sky deliverable must be provided within a BT.2020 encoded signal in the case of HDR (and a BT.709 encoded signal in the case of the SDR version).

Colour Primaries and Matrix Coefficients labels must be used to indicate the encoded colourimetry of the deliverable, not the colourimetry of the mastering display – a description of the mastering display characteristics should be included in the SMPTE ST 2086 metadata.

At present, Sky UK shall not use the below HDR metadata to drive internal conversions to HLG.

- SMPTE ST 2086 - Mastering Display Colour Volume Metadata
- MaxCLL and MaxFALL
- SMPTE ST 2094 – Dynamic Metadata for Colour Volume Transform

- However, SMPTE ST 2086, MaxCLL, and MaxFALL metadata must be included in the deliverable for Commissioned Productions.

See Appendix 4, 6.4.2 HDR Metadata, for further details.

5.3.3.5 UHD Audio Specification

- All tracks must be encoded as discrete Linear PCM, at a sample rate of 48kHz and a depth of 24-bits/sample, stored as little-endian integers.

- Sky offers more audio channel to track allocation options for Licensors of Acquisitions– see Appendix 6.15.1 Alternative Audio Channel to Track Allocation for UHD for details.

- Commissioned Productions must use the audio channel to track allocation in Table 11 below.

Table 11. Audio Channel to Track Allocation for UHD Content

Track	Channel Alignment
1	Main Stereo - Lo
2	Main Stereo - Ro
3	M&E Stereo - Lo
4	M&E Stereo - Ro
5	Main 5.1 - Front L
6	Main 5.1 - Front R
7	Main 5.1 - Centre
8	Main 5.1 - LFE
9	Main 5.1 - Surround L
10	Main 5.1 - Surround R
11	M&E 5.1 - Front L
12	M&E 5.1 - Front R
13	M&E 5.1 - Centre
14	M&E 5.1 - LFE
15	M&E 5.1 - Surround L
16	M&E 5.1 - Surround R

- Each of the audio tracks within a commissioned ProRes delivery should include accurate Channel Labels within their Audio Channel Layout atoms, as well as an accurate indication of the channel/mix language within their Media Headers.

See Appendix 10: Loudness Levels which confirms EBU R128 requirements.

5.3.4 Delivery of Dolby Atmos

Dolby Atmos is only required for UHD deliverables.

- Where Dolby Atmos has been commissioned or is available for a Licensed Acquisitions, it must be supplied to Sky as a Dolby Atmos Master File (DAMF).
- The DAMF must run at the same frame rate as the video file.
- The DAMFs First Frame of Action in the .atmos file (i.e., as entered into the Dolby RMU) must align with the video's whole hour FFOA timecode.
- The DAMF must be a valid rendition that is accepted by Dolby's toolset. The .atmos, .audio, and .metadata files must have the same filenames. The filename of the. audio file and .metadata file must match the filename entries in the .atmos file.

The .dbmd is an optional element and is not utilised within Sky's Dolby Atmos workflows.

See Appendix 10: Loudness Levels which confirms EBU R128 requirements.

5.3.5 Dolby Atmos Master File Naming Requirements

- The DAMF folder must be named with the same Media Identifier as the SDR-UHD deliverable followed by an underscore and then "Atmos". A human readable name must also be included after this. However, assets with long titles names may require them to be shortened. The entire character of the folder name, combined with any individual filename within it, must not exceed 120 characters.

5.3.6 Music and Effects / Mix Minus Narration Dolby Atmos Delivery

Where an additional M&E/MMN DAMF is required for a commission, the assigned Production Coordinator shall be in contact to discuss the delivery requirements.

6 Appendix

6.1 Appendix 1: Common Audio Faults

- The following audio faults must not be present on the deliverable supplied to Sky:
  - Artefacts, including but not limited to mutes, crackles, ticks, pops, clicks and distortion.
  - Dynamic and/or frequency response artefacts, for example, due to the action of noise reduction or low bit rate coding, including the use of music that has originated from an MP3 codec.
  - The dynamic range must be appropriate, without excessive compression (e.g., gunshots which are unnaturally quiet) or excessive use of dynamic range (e.g., dialogue at a low level such that it becomes difficult to hear in a domestic viewing environment).
  - Inaudible dialogue due to other reasons (e.g., excessive level of music and/or effects relative to dialogue).
  - It must be smoothly mixed and free from audible edits (e.g., beginning of dialogue clipped which sounds unnatural, or reverb not allowed to end naturally).
  - Audible rises or dips, without editorial justification, must not exist unless editorially justified.
  - Audio must be free from phasing characteristics, especially those which cause unwanted audible cancellation ('comb filtering') when downmixed.
  - Absent stereo, 5.1 or Dolby Atmos when it has been commissioned with these formats or it is expected from a Licensed Acquisitions (e.g., modern titles in monaural sound will be rejected), especially if a superior mix is available on other mediums (e.g., a title provided without Dolby Atmos when the Blu-ray release includes Dolby Atmos).
  - Marked inconsistencies between the different mixes (e.g., audio elements in the stereo mix that are missing from the 5.1 mix, or vice versa).
  - Unnatural or sustained channel imbalance, e.g., the left channel averaging louder than the right channel.
  - Incorrect audio channel to audio track allocation.
  - Audio that is out of sync with the video.

6.2 Appendix 2: Common Visual Faults

- The following visual faults must not be present on the deliverable to Sky:
  - Captured defects (e.g., dead pixels, film dirt/scratches, etc.).
  - Obtrusive video noise.
  - Aliasing, including moiré patterning.
  - Spurious signals or artefacts (e.g., streaking, ringing, smear, echoes, etc.).
  - Crushed blacks, burnt-out whites, raised black and/or limited luminance (e.g., effects induced by incorrect full range to narrow range conversion).
  - Visible contouring (AKA banding).
  - Perceivable coding artefacts (e.g., digital break-up, visible macroblocks, etc.).
  - Artefacts caused by digital processing (e.g., halo on edges from sharpening).
  - Luminance fluctuations.
  - Blanking changes.
  - Axis instability (e.g., film weave).
  - Motion compensation artefacts (e.g., misestimation of movement in synthesised frames).
  - Inconsistent cadence (e.g., merged/missing/duplicate frames).
  - Combing artefacts.

- Missing media (e.g., shots/media which is offline).
- Missing graphics (e.g., omitted subtitles).
- Spelling or grammatical errors on graphics (e.g., name spelt wrong on credits).

6.3 Appendix 3: Framerate Conversion Methods

- Framerate conversions must not show any avoidable artefacts and particular care must be taken when converting scan types (i.e., Progressive or Interlace).
- Edit timeline conversions are not acceptable where they do not meet the criteria in Tables 12, 13 and 14 below.
- Pitch correction can be applied but must not introduce any audio artefacts.
- The acceptable conversion methods vary depending on source frame rate, scan types and output framerate. The below methods should be followed. Deviations from the below methods may result in rejection. Samples of alternative methods can be sent to Sky for review before final delivery.

Table 12. Frame Rate Conversion Method for 25fps Interlace (including PsF) Outputs

Source Frame Rate	Source Scan Type	Method
24 and 24/1.001	Progressive	Speed change then convert each progressive frame to a progressive segmented frame signal
25	Progressive	Convert each progressive frame to a progressive segmented frame signal
30 and 30/1.001	Interlace	Motion-Compensated Frame Interpolation maintaining an interlace scan signal
30 and 30/1.001	Progressive	Motion-Compensated Frame Interpolation to a progressive segmented frame signal
30 and 30/1.001	Progressive Segmented Frame	Motion-Compensated Frame Interpolation maintaining a progressive segmented frame signal
50	Progressive	1 progressive frame to 1 field conversion to maintain temporal resolution in an interlace scan signal. See 50p to 50i conversion section below for more details.
60 and 60/1.001	Progressive	Motion-Compensated Frame Interpolation, preserving some temporal resolution, in an interlace scan signal

Table 13. Frame Rate Conversion Method for 25fps Progressive Outputs

Source Frame Rate	Source Scan Type	Method
24 and 24/1.001	Progressive	Speed change
25	Interlace	Deinterlace via a multi-field (five-field or greater) motion-compensated deinterlacer
25	Progressive Segmented Frame	Combine fields to form a progressive frame
30 and 30/1.001	Interlace	Deinterlace via a multi-field (five-field or greater) motion-compensated deinterlacer
30 and 30/1.001	Progressive	Motion-Compensated Frame Interpolation
30 and 30/1.001	Progressive Segmented Frame	Combine fields to form a progressive frame then Motion-Compensated Frame Interpolation
50	Progressive	Motion-Compensated Frame Interpolation
60 and 60/1.001	Progressive	Motion-Compensated Frame Interpolation

Table 14. Frame Rate Conversion Method for 50fps Progressive Outputs

Source Frame Rate	Source Scan Type	Method
24 and 24/1.001	Progressive	Frame doubling then speed change
25	Interlace	1 field to 1 progressive frame conversion.
25	Progressive	Frame doubling
25	Progressive Segmented Frame	Combine fields to form a progressive frame then frame doubling
30 and 30/1.001	Interlace	Deinterlace via a multi-field (five-field or greater) motion-compensated deinterlacer
30 and 30/1.001	Progressive	Motion-Compensated Frame Interpolation
30 and 30/1.001	Progressive Segmented Frame	Combine fields to form a progressive frame then Motion-Compensated Frame Interpolation
60 and 60/1.001	Progressive	Motion-Compensated Frame Interpolation

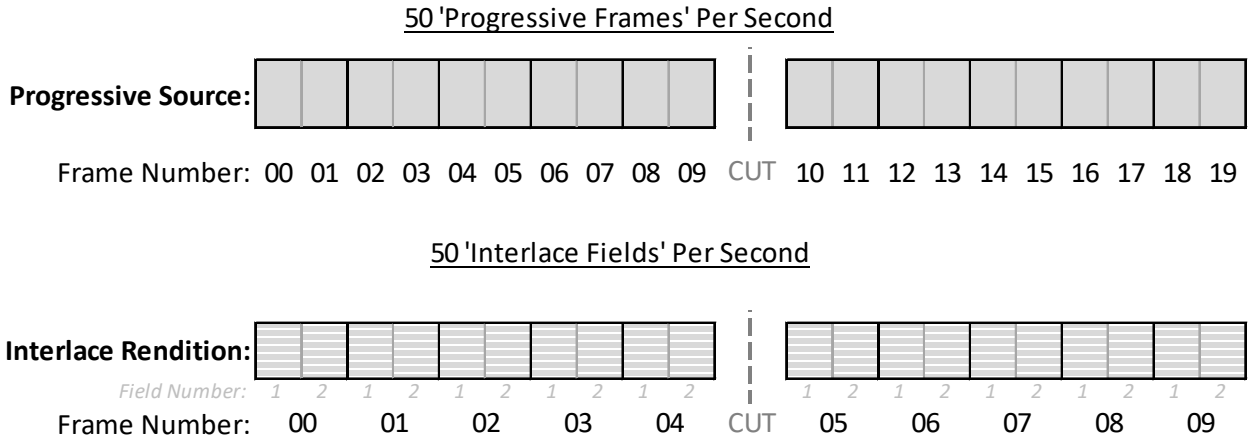
Note:

- Motion-Compensated Frame Interpolation is sometimes known as MCFI, Motion Compensated Conversion, Motion interpolation, Motion Predictive or Motion Vector Conversion.
- Conversions should take place from their original native framerate. Where that is not possible, visual and cadence artefacts must be removed – e.g., content acquired at 24fps, then converted to 60fps (or 24/1.001fps converted to 60/1.001fps) via the "2:3 pull-down" process, must have the repeated fields/frames removed for it to then be treated as 24 (24/1.001) fps.

6.3.1 Conversion of 50 Progressive Frames Per Second to 50 Interlace Fields Per Second

- Where content is 50 fps, edits must occur after the odd frame / before the even frame, so that the cut occurs at the start of the first field in an interlace rendition and therefore avoid interlacing artefacts. Note that the first frame is frame 0 and not 1.

Figure 4. Example of How 50 *Progressive Frames* Shall Be Mapped To 50 *Interlace Fields*



- This should be achieved by changing the 50fps project's timebase to 25fps. Extra effort may be required to ensure imported archive/library footage also complies.

6.4 Appendix 4: Additional HDR Information

6.4.1 HDR Grading Guidance

Consideration must be given to providing the optimum HDR image.

To avoid an overly reserved approach to what HDR offers, the initial grade should be completed on the HDR version, with the SDR grade being completed afterwards.

The full luminance range of the HDR grading monitor may be used. see Appendix 6: Display Requirements for details.

However, to reduce the risk of an unintended look on more advance displays, the grade should not exceed the capability of the grading monitor. Therefore, the luminance might not exceed 1,000 cd/m^2 or the chromaticity might not exceed the gamut available within the P3 colour primaries (though within a BT.2020 container).

Note that consumer TVs will typically display SDR images brighter than the intended grade. Whilst the same TV will reserve some of its brighter luminance capabilities for the highlights in an HDR image. This can result in a perceived dimer HDR image, particularly when comparing the midtones. The grade should not try to counter the limitations of current consumer TV's – the grading monitor must be the trusted reference – however, an awareness of this presentation attribute may help inform a more appropriate HDR grade.

Unless the impact on the viewer is intentional, care must be applied to ensure:

- Comfortable viewing, with appropriate use of the greater luminance available, for the duration of the title.
- Subjects are rendered at a suitable luminance level.
- Loss of detail in highlights and lowlights is minimised where possible – care should be taken when grading within the confines of the display's abilities and avoid pushing the signal to a point where the grading software may adversely hard clips the signal (unless the resultant look is intended).
- Bright elements do not cause discomfort to viewers, unintentionally distract, or compromise the perception of the main subject.
- A measured approach when transitioning from bright scenes/shots to dark ones, as the viewer's eye may require time to adjust.
- A measured approach when transitioning from dark scenes/shots to bright ones, as a sudden jump in luminance could cause discomfort.
- An appropriate reference white level is respected throughout. Subject to the context of what's in the frame, the neighbouring frames and the established look, Reference White (AKA diffuse white or graphics white) should sit around 100% in SDR, 58% (203 cd/m^2) in PQ and 75% in HLG, as per ITU-R BT.2408-3 (Table 2).

Inappropriate use of the dynamic range, without editorial justification, will result in content being rejected.

6.4.2 HDR Metadata

- Transfer Function, Colourimetry and Matrix Coefficients metadata are relied upon to correctly process content and therefore must be present and correct.

- For reasons documented in this section, Sky UK will not currently use the HDR metadata listed below to drive internal conversions to HLG.

6.4.2.1 SMPTE ST 2086 - Mastering Display Colour Volume Metadata

Sky UK has noted that the current interpretation of the intended use of ST 2086 is inconsistent amongst suppliers. This is true for both the Colour Primaries and Maximum Luminance.

ST 2086 metadata has also not always been delivered to Sky in a consistent form.

- SMPTE ST 2086 metadata within PQ deliverables must be supplied for Commissioned Productions and should be supplied for Licensed Acquisitions. When present, it must:
  - Reflect the actual effective colour primaries, and the actual luminance limit of the Mastering Display, taking into account any additional constraints configured during the mastering process.
  - Be written into the appropriate container descriptors.

> **Case Study:** *Some content suppliers use these fields to indicate the full potential of the display, without considering the restrictions applied as part of the mastering process.*
>
> *For example, a production can configure the grading software to cap the signal at 2,000 cd/m^2, grade on a 4,000cd/m2 display, and indicate a misleading Maximum Display Mastering Luminance of 4,000cd/m^2 in the ST2086 metadata. When the actual maximum mastering luminance, taking into account the additional restriction enforced within the grading software, is 2,000cd/m^2.*

6.4.2.2 MaxCLL and MaxFALL

Similarly, there is an inconsistent approach to how MaxCLL and MaxFALL are measured:

- Filtering out transient overshoots (or not)
- Application of the same default values to all titles, regardless of actual image characteristics
- The total absence of MaxCLL and MaxFALL

- MaxCLL and MaxFALL metadata must be written into the appropriate container descriptors for PQ Commissioned Productions. Its inclusion is encouraged for Licenced Acquisitions.
- They should not be arbitrary values but true measurements. However, meaningful deviation would be acceptable (e.g., to ensure labelling, and therefore the downstream presentation, remains consistent for all episodes within a series).
- The filtering of transient overshoots, that would have been captured in-camera, is encouraged.
- To avoid erroneous offshoots produced by compression artefacts, the measurements should be carried out at the final stage of the HDR grade, rather than on any downstream derivatives.

6.4.2.3 SMPTE ST 2094 – Dynamic Metadata for Colour Volume Transform

Sky UK will not require the delivery of additional SMPTE ST 2094 metadata which might be provided for use in Dolby Vision, HDR10+ or SL-HDR distribution. If delivered to Sky, this will not currently be utilised.

6.5 Appendix 5: Reference Environment for Critical Viewing

Table 15. Room Specification for Critical Viewing

Parameter	Values
Surround and periphery	Neutral grey at D65
Luminance of surround	5 cd/m^2
Luminance of periphery	≤ 5 cd/m^2
Ambient lighting	Avoid light falling on the screen
Viewing distance for 1,920 x 1,080	x3 picture heights
Viewing distance for 3,840 x 2,160	x1.5 to <3 picture heights

6.6 Appendix 6: Display Requirements

Table 16. Display Specification for Critical Viewing

Parameter	SDR	HDR
EOTF	BT.1886	BT.2100/PQ (HLG with pre-approval)
Capable Colour Primaries	BT.709	≥ 100% P3
Colour Primaries (AKA Colour Space) Setting	BT.709	BT.2020
Transfer Matrix (AKA Colour Matrix) Setting	BT.709	BT.2020NC
White Point	D65	D65
Peak Luminance	100 cd/m^2	≥ 1 000 cd/m^2
Maximum Black Level	0.05 cd/m^2	≤ 0.005 cd/m^2
Contrast Ratio	2,000:1	200,000:1

- Where a true BT.1886 setting is not an option, a gamma of 2.4 must be used.
- Colour Grading and QC must be carried out with an understanding of the monitor's behaviour. Care should be taken where some monitors will apply an ABL (Automatic Brightness Limiter) that will reduce the brightness of the monitor, as this behaviour will not be consistent on all displays.
- Monitors may provide an option to tone-map signal. For Grading, this should be disabled so that the monitor hard clips anything beyond its capabilities.
- Over scanning must be disabled.
- Whenever possible, pixel interpolation must be avoided. If necessary (e.g., HD viewed on a UHD display), scaling should be in integers.
- When measuring the screen diagonally, displays should be between:
    - 24 and 60 inches for HD
    - 30 and 60 inches for UHD

Since reference monitors are typically 30-inches, it is recommended that an additional ≥ 50-inch consumer TV is used where image definition is important (e.g., determining focus). The TV may also provide confidence with regards to how the image could be presented on consumer equipment.

6.7 Appendix 7: Audio Room Requirements

6.7.1 Room Size

- Room size should be between 40 m^3 to 140 m^3, with controls in place which limit audible contamination, including isolation from other rooms and the appropriate acoustic treatment within.

6.7.2 Speaker Placement

- Where Dolby Atmos has been commissioned, there must be a minimal speaker layout of 7.1.4.
- Speaker placement must be compliant with Dolby's Speaker Setup Guides.
- Up-firing Dolby Atmos-enabled speakers are not acceptable, as the soft imaging will not provide sufficient resolution required when mixing Dolby Atmos.
- If the same speaker layout is used for both 5.1 and Dolby Atmos monitoring, the side surround speakers should be placed at 110° to avoid the need to reposition speakers when changing between 7.1.x and 5.1 monitoring.

6.7.3 Speaker Calibration

- The reference level must be determined by playing 500Hz – 2kHz band-limited pink noise at –20 dBFS, independently through each speaker, and adjusting the output to measure 79dB on an SPL meter set to measure slow C-weighted readings.
- The SPL meter must be positioned where the head will be of primary listening position and pointing at the speaker being measured.
- With reference to Dolby's Room Calibration recommendation: *Using a real-time analyser (RTA), each 1/3 octave band between 20Hz and 80Hz of the LFE channel should be 10 dB higher than the equivalent 1/3 octave band of the full-range speakers, assuming that the full-range speaker is flat.*
  Dolby (2018). Room Calibration. https://developer.dolby.com/tools-media/studio-resources/studio-design/room-calibration/.

6.8 Appendix 8: Dolby Audio Metadata

6.8.1 Metadata used for 5.1 Mixes

Delivery of Dolby metadata, as specified in SMPTE RDD 6, is not supported. The below settings shall be applied by Sky and should also be used when monitoring the mix.

Table 17. Dolby 5.1 Metadata

Parameter	Sport	Entertainment	Movies
Programme Config	5.1 or 5.1 + 2	5.1 or 5.1 + 2	5.1 or 5.1 + 2
Frame Rate	25	25	25
Bit Depth	20	20	20
Programme Description	Location and type of device originating the metadata	Location and type of device originating the metadata	Location and type of device originating the metadata
Dolby D Metadata	Enabled	Enabled	Enabled
Dialogue Level (Dialnorm)	-23dB	-23dB	-23dB
Channel Mode	3/2	3/2	3/2
LFE Channel	Enabled	Enabled	Enabled
Bit-Stream Mode	Complete Main (CM)	Complete Main (CM)	Complete Main (CM)
Line Mode Compression	Film Light	Film Standard	Film Standard
RF Mode Compression	Film Light	Film Standard	Film Standard
RF Over Modulation Protection	Disabled	Disabled	Disabled
Centre Down-Mix Level	-3dB	-3dB	-3dB
Surround Down-Mix Level	-6dB	-6dB	-3dB
Dolby Surround Mode	Disabled	Disabled	Disabled
Audio Production Information	No	No	No
Mix Level	80dB	80dB	80dB
Room Type	Small	Small	Small
Copyright Bit	Yes	Yes	Yes
Original Bit-Stream	On / Yes	On / Yes	On / Yes
Preferred Stereo Down-Mix	Lo/Ro*	Lo/Ro*	Lo/Ro*
Lt/Rt Centre Down-Mix Level	-3dB	-3dB	-3dB
Lt/Rt Surround Down-Mix Level	-6Db	-6Db	-3dB
Lo/Ro Centre Down-Mix Level	-3dB	-3dB	-3dB
Lo/Ro Surround Down-Mix Level	-6dB	-6dB	-3dB
Dolby Surround Ex Mode	Not Surround Ex	Not Surround Ex	Not Surround Ex
A/D Converter Type	Standard	Standard	Standard
Dc Filter	Enabled	Enabled	Enabled
Low Pass Filter	Enabled	Enabled	Enabled
LFE Low Pass Filter	Enabled	Enabled	Enabled
Surround 3 Db Attenuation	Disabled	Disabled	Enabled
Surround Phase Shift	Disabled	Disabled	Disabled

*The preferred stereo down-mix parameter has been migrated from Lt/Rt to Lo/Ro. However, some platforms may still carry the legacy Lt/Rt settings.

6.8.2 Metadata used for Dolby Atmos Mixes

The .dbmd file contained inside a Dolby Atmos Master File is not used at Sky. The following metadata will be used when the DAMF is processed:

Table 18. Dolby Digital Plus Encoding Settings

Section		Parameter	Setting
Channels		Channel Configuration	5.1 - L,R,C,LFE,Ls,Rs
		5.1 Core Type	5.1 Standard (Lo/Ro)
Encoder Setup	Encoder Settings	Loudness Metering Mode	ITU-R BS.1770-4
		Speech Threshold	0.2
		Dialogue Intelligence	Enabled
		Data Rate	640 kbps
		Bitstream mode	*greyed out*
		Late-night listening mode profile: Line Mode:	Film Standard
		Late-night listening mode profile: RF Mode:	Film Standard
	Downmix	Lt/Rt Center	-3.0 dB
		Lt/Rt Surround	-3.0 dB
		Lo/Ro Center	-3.0 dB
		Lo/Ro Surround	-3.0 dB
		Preferred Stereo Downmix	Stereo
	Preprocessing	LFE LPF	*greyed out*
		Surround Channel 90-Degree Phase Shift	Disabled
		Elements	16 (fixed)

6.9 Appendix 9: Audio Mixing Best Practices

6.9.1 Dialogue Positioning

The requirement to mix dialogue in each of the front three channels (AKA diverged dialogue) is being phased out.

- Dialogue may only be diverged across the front three audio channels of the 5.1 when this mixing style has been established in an earlier season and therefore it may be maintained for consistency, and only if the series has also not yet migrated to Dolby Atmos.
- When dialogue is diverged, the level of dialogue in the front left and front right channels must be no more than 6dB below the level in the centre channel.

If a new series is commissioned to now include a Dolby Atmos mix, when previous seasons did not, both the Dolby Atmos and the 5.1 of the new series must not be diverged, even if the previous season's 5.1 dialogue was diverged. Whilst this presents an inconstancy in the sound stage when comparing the 5.1 with a previous seasons' 5.1, it will ensure a consistent sound stage when comparing the 5.1 with the same title's Dolby Atmos mix.

The dialogue should be mixed to the centre channel. However, where editorially justified, this constraint can be disregard. Extra care and attention should be given when dialogue is placed in a moving audio object, particularly when it represents a character who then shares the frame with characters whose dialogue has remained on the centre channel. The presentation of characters' dialogue must remain balanced, without noticeable differences in clarity, level, or scale. In these instances, both the 5.1 and stereo downmixes must also be carefully monitored to ensure the presentation remains as intended and dialogue intelligibility isn't compromised.

6.9.2 Balance

- The audio mix must be near field in nature, suitable for viewing in a domestic environment, with levels that are appropriate to the scene being portrayed. Where relevant, the mix should make use of the available dynamic range, without being excessively dynamic.

Consideration must be given to the typical environment in which most viewers will be listening. A controlled audio suite environment differs drastically from a home viewing environment which has the potential for several audible disturbances (e.g., traffic, household equipment) and considerations of others (e.g., neighbours or sleeping children).

Additionally, viewer listening equipment can vary from high-end 'audiophile' sound systems to low-end consumer headphones, with many viewers listening through small speakers integrated into flat-panel TVs. Audio needs to be mixed so it can be experienced as intended in these varied environments.

It is common for the 5.1 to be rendered in the home environment as stereo and the Dolby Metadata (in Appendix 8: Dolby Audio Metadata) should be used when monitoring the stereo downmix.

Content that has an inappropriate dynamic range or an imbalanced relationship between the dialogue and other elements of the mix will be rejected.

6.9.3 Dialogue Intelligibility

- Particular care must be taken with dialogue intelligibility. Dialogue that is intended to be understood must always remain distinct and clear.

Whilst it may seem to be appealing to raise music and effects levels when mixing in an audio suite, this can compromise the dialogue, and irritate the viewer. Viewers expect the dialogue to be at similar levels across different genres of programmes and regardless of creative intent. An impact can be made without introducing a stark difference between the dialogue and the rest of the mix.

Speech will be more intelligible to anyone on the production who is familiar with an actor's voice and especially with the script – both of which may not be the case for viewers at home. Therefore, if there is any doubt around the dialogue intelligibility, it is recommended to seek second opinions from those not familiar with the production. If those people require a second listen to understand a phrase of dialogue, then it is self-evidently not clear and distinct.

- In some cases, ADR may be required. Care must be taken to ensure ADR is not detectable, as noticeable ADR is distracting and could result in the content being rejected.

Without consideration of these factors, the mix risks being an annoyance to viewers, who end up adjusting the volume throughout the programme in an attempt to ensure the dialogue, music and effects remain at a suitable level.

6.10 Appendix 10: Loudness Levels

- Audio levels of the Dolby Atmos mix must be consistent between all mixes (i.e., stereo, 5.1 and Dolby Atmos).

- Dolby Atmos Renderer version 3.4 and later includes loudness monitoring and this can be used to ensure the mix is EBU R128 compliant. Where this is not an option, the audio mixer or engineer must ensure that the 5.1 re-render of the DAMF, from the RMU, is EBU R128 compliant.

- With regards to Trailers and Movies intended for platforms or channels where the content is not segmented for commercial breaks to be added between its parts, (e.g., a Sky branded movie-only channels), the audio must be supplied with the same nearfield mix that is on the consumer DVD or Blu-ray, albeit with a maximum True Peak level that does not exceed -1dBTP. This may not necessarily be R128 compliant. Only where there is not a DVD or Blu-ray release, the audio supplied must be the same nearfield mix that is provided to other streaming services, albeit with a maximum True Peak level that does not exceed -1dBTP. This may not necessarily be R128 compliant.

6.10.1 Sky UK's EBU R128 parameters

Method:

- The measurement must be made with a loudness meter compliant with EBU Tech 3341 and ITU-R BS.1770-3 (or later publication).
- This measurement must include the gating method which excludes measurements below the threshold specified in ITU-R BS.1770-4 (and summarised in EBU Tech 3341). It must not use any other getting method (e.g., use of a dialogue-gated algorithm is not permitted).
- The LFE channel must be excluded from the measurement.
- Line-up tone must be excluded from the measurement.
- Other than the main programme/feature, there must be no other audio on the file (e.g., trailers, and other supplementary material, must not be added to the end).

Programme Loudness parameter:

- Programme Loudness Level must measure -23.0 LUFS.
- Contrary to EBU R128-2020 Recommendation J, Programme Loudness for content sent to Sky cannot be lower than -23.0 LUFS (other than where a movie has been supplied with an un-normalised mix which may be lower).
- A permitted tolerance of ±1.0 LU is offered for Live content.
- A permitted tolerance of ±0.2 LU for pre-recorded content is only offered to accommodate minor measurement errors, marginal inconsistencies between measurement tools or subsequent re-encoding discrepancies.
- Due to the lack of tools to normalise Dolby Atmos, a permitted tolerance of ±1.0 LU is offered for that mix.

Maximum Permitted True Peak parameter:

- Maximum Permitted True Peak Level should not exceed -3dBTP.
- Maximum Permitted True Peak Level must not exceed -1dBTP, otherwise, the title shall be rejected.

NB. Mixes that have been downmixed from EBU R128 compliant sources (e.g., an R128 compliant 5.1 mix downmixed to stereo) may require further normalisation.

6.11 Appendix 11: Audio Phase Considerations

- All mixes must be phase coherent with the ability to downmix to mono, and the different permutations of audio channels in between, without introducing audible artefacts.

- Timing differences between audio channels must be no more than 0.2 samples (e.g., the timing between each channel of a mix).

Note that very small timing differences between audio tracks will not be heard unless the down-mix is monitored acoustically. An error of as little as one or two sample between channels can cause phasing and comb filtering for those listening to the downmix.

6.12 Appendix 12: UHD Source

Sky recognises that UHD content is provided from 3 distinctly different sources, as defined below. Sky must be informed which category a deliverable comes under. Content obtained from any other source may not be accepted.

The first two categories – 'Native' and 'Film Scan' – constitute as 'True UHD'.

Upscales will be labelled as 'Enhanced for UHD' on Sky's EPG.

Content will be rejected where the image quality does not meet expectations.

6.12.1 Native UHD

Native is defined as content shot digitally and conforming with UHD1 Tier 2 of EBU R118. Care should be taken when rescaling images to 3840 x 2160. Where shooting resolution is 4k (4096 x 2160), the UHD deliverable (3840 x 2160) should not be rescaled but cropped – i.e., 1:1 pixel mapped – to avoid pixel interpolation.

It must also derive from a progressive frame (native interlace scan converted to progressive is not acceptable) and of 10-bit or greater.

6.12.2 Film Scan

The resolution captured on film can vary greatly and the quality depends on many factors, such as the age of stock, film speed, perfs per frame, its condition from storage and production standards.

To achieve the highest quality, scanning of the film should start with the original print or the fewest generations away as possible. Eligible film stock should be 35mm or greater, 3 perf or greater, of an ISO of 250 or less and without processes applied which would reduce definition (e.g., push processing/uprating or neg/print crops/push-ins). Age of film stock, condition from storage and level of restoration all influence the picture quality and play a part in whether the resulting image qualifies as UHD.

In the scenario where there is uncertainty as to whether the resulting image quality would qualify as UHD, samples should be submitted to Sky for review, along with all known factors (e.g., cameras, shooting format, exposure index, resolutions, post-production processes, etc.).

The scanning of the film must be at 10-bit or greater and at a minimum resolution of either 3840 horizontal pixels or 2160 vertical pixels.

Care should be taken if rescaling scanned images to 3840 x 2160. Where shooting resolution is 4k (4096 x 2160), the UHD deliverable (3840 x 2160) should not be rescaled but cropped – i.e., 1:1 pixel mapped – to avoid pixel interpolation. Cropping-in to fill the UHD frame is not acceptable where it results in a loss of effective resolution.

Note that film grain not only challenges downstream encoding (which can result in undesirable effects), but the greater pixel count of UHD may also render this noise more apparent to the extent of being intrusive. Efforts may be required to control such video noise in ensuring optimum image quality.

Each frame should be digitally treated to remove contaminations and other defects (e.g., dirt and scratches) and care should be taken when improving colour, contrast, and sharpness.

6.12.3 Upscale

Content sourced from resolutions lower than 'Native UHD' must be of 10-bit or greater and from a progressive frame (interlace converted to progressive will not be accepted). It must be professionally up-scaled – offering enhancements to fine detail and nothing which could be constituted as detrimental to the picture quality. Care should be taken in controlling noise and sharpening, as well as colour and contrast improvements.

This content must offer a perceivable improvement over HD and will be labelled as 'Enhanced For UHD' on Sky's EPG.

6.13 Appendix 13: Tape Specification

Tape delivery is no longer an option. This entry remains to avoid the numbering of sections changing.

6.14 Appendix 14: 3D Requirements

3D deliverables are no longer required. This entry remains to avoid the numbering of sections changing.

6.15 Appendix 15: Alternative UHD Formats Accepted For Licenced Acquisition

Sky offers the following alternative formats for Licenced Acquisition content when delivering UHD in either SDR or HDR.

These options can be used when it presents a benefit to either Sky or the supplier (e.g., removes an additional content processing requirement for the Licensor).

6.15.1 Alternative Audio Channel to Track Allocation for UHD

- All tracks must be encoded as discrete Linear PCM, at a sample rate of 48kHz and a depth of 24-bits/sample.

- The options in Table 20 can be exercised when the content supplier is onboarded for UHD file delivery. However, 60-days' notice is required if the onboarded Channel Alignment later needs to change to one of the alternatives.

Table 20. Alternative Audio Channel to Track Allocation for UHD Content

Track	Channel Alignment 1	Channel Alignment 2	Channel Alignment 3	Channel Alignment 4	Channel Alignment 5	Channel Alignment 6
1	Main Stereo - L	Main 5.1 - Front L	Main Stereo - L	Main 5.1 - Front L	Main Stereo - L	Main 5.1 - Front L
2	Main Stereo - R	Main 5.1 - Front R	Main Stereo - R	Main 5.1 - Front R	Main Stereo - R	Main 5.1 - Front R
3	M&E/MMN/Mute Stereo - L	Main 5.1 - Centre	M&E/MMN/Mute Stereo - L	Main 5.1 - Centre	Main 5.1 - Front L	Main 5.1 - Centre
4	M&E/MMN/Mute Stereo - R	Main 5.1 - LFE	M&E/MMN/Mute Stereo - R	Main 5.1 - LFE	Main 5.1 - Front R	Main 5.1 - LFE
5	Main 5.1 - Front L	Main 5.1 - Surround L	Main 5.1 - Front L	Main 5.1 - Surround L	Main 5.1 - Centre	Main 5.1 - Surround L
6	Main 5.1 - Front R	Main 5.1 - Surround R	Main 5.1 - Front R	Main 5.1 - Surround R	Main 5.1 - LFE	Main 5.1 - Surround R
7	Main 5.1 - Centre	Main Stereo - L	Main 5.1 - Centre	Main Stereo - L	Main 5.1 - Surround L	Main Stereo - L
8	Main 5.1 - LFE	Main Stereo - R	Main 5.1 - LFE	Main Stereo - R	Main 5.1 - Surround R	Main Stereo - R
9	Main 5.1 - Surround L	M&E/MMN/Mute 5.1 - Front L	Main 5.1 - Surround L	M&E/MMN/Mute Stereo - L		
10	Main 5.1 - Surround R	M&E/MMN/Mute 5.1 - Front R	Main 5.1 - Surround R	M&E/MMN/Mute Stereo - R		
11	M&E/MMN/Mute 5.1 - Front L	M&E/MMN/Mute 5.1 - Centre				
12	M&E/MMN/Mute 5.1 - Front R	M&E/MMN/Mute /Mute 5.1 - LFE				
13	M&E/MMN/Mute 5.1 - Centre	M&E/MMN/Mute 5.1 - Surround L				
14	M&E/MMN/Mute 5.1 - LFE	M&E/MMN/Mute 5.1 - Surround R				
15	M&E/MMN/Mute 5.1 - Surround L	M&E/MMN/Mute Stereo - L				
16	M&E/MMN/Mute 5.1 - Surround R	M&E/MMN/Mute Stereo - R				

- Licensed Acquisitions must deliver stereo and 5.1, any M&E/MMN should be delivered when available. Where M&E/MMN and/or 5.1 is not available, the relevant tracks must still be present but contain mute audio.

6.15.2 Alternative ProRes Options

Sky supports the following Apple ProRes formats for UHD deliverables:

- ProRes 422 LT
- ProRes 422
- ProRes 422 HQ
- ProRes 4444 – this can be 10-bit or 12-bit but must not include an alpha channel.

All other ProRes related requirements that are detailed in the main body of this document must be met, including but not limited to, narrow video range with a Y'C'bC'r colour space.

6.15.3 XAVC

- Content must not be reencode to, or from, XAVC for delivery to Sky.
- When XAVC is supplied, it must be as specified in Table 21 below.

Table 21. UHD XAVC Video Specification

Component	Attribute		
Resolution (active image)	3840x2160		
Frame Rate	24/1.001, 24, 25 or 50		
Scan Type	Progressive		
Transfer function	BT.709	PQ	HLG
Colourimetry	BT.709	ITU-R BT.2020	
Matrix coefficients	BT.709	BT.2020 Non-constant Luminance	
Colour space	Y'C'bC'r		
Chroma subsampling	4:2:2 or 4:2:0		
Video Range	Narrow*		
Bit depth	10		
Coding	XAVC Intra (SMPTE RP 2027) Class 480/16Mbits per frame (CBG)		
Container	MXF OP1a		

*Overshoots that exceed the video range of 64 – 940 bits, but within the tolerance detailed in EBU R103, will be accepted.

- Colour Primaries and Matrix Coefficients labels must be used to indicate the encoded colourimetry of the deliverable, not the colourimetry of the mastering display – a description of the mastering display characteristics should be included in the SMPTE ST 2086 metadata. See Appendix 4, 6.4.2 HDR Metadata, for further details.

- The XAVC file must be compliant with XAVC Specification Overview Revision 2.2 and XAVC Profiles and Operating Points Version 1.20 Amendment 1, including but not limited to, the bitrates for the given frame rate.

6.15.4 IMF

Application #2e IMFs, compliant with SMPTE ST 2067-21:2016 and the constraints listed in this appendix are accepted.

6.15.4.1 Composition Playlist (CPL)

Sky can support multiple CPLs in a single IMF package.

An IMF package should contain a CPL for each version of a programme intended to be derived from it – for example, the theatrical edit could be constructed by one CPL, and a director's cut, of the same title, could be constructed by another CPL.

- It must be clear which CPL(s) are intended for use by Sky UK. Sky must be contacted if there might be any ambiguity.

6.15.4.2 IMF Naming Requirements

Even though IMF allows the carriage of provider-specific identifiers inside the CPL, the state of IMF mastering tools and established practices make it impractical to mandate the use of such identification mechanism. We will review our position in due course. For now, CPL in-band identification information will be ignored.

- Media Identifier:
  - For Commissioned Productions:

- Each CPL intended for use by Sky UK, should be named as per the corresponding 'U' ID at the point of authoring. This ensures it matches the filename referenced within the Asset Map.
- The IMF package must be named as per the supplied ID, followed by an underscore and "IMF".
- Where the IMF package contains multiple CPLs for different versions, the supplied ID must be applied to the primary version that is intended to be used by Sky UK.

- For Licensed Acquisitions, when it might not be practical to rename the CPL to a specific ID without breaking the pre-authored IMF structure:
  - The IMF package must be named as per the supplied ID, followed by an underscore and "IMF".
  - Where the IMF package contains multiple CPLs for different versions, the supplied ID must be applied to the primary version that is intended to be used by Sky UK.

- A human readable name must also be included after the Media Identifier. However, assets with long titles names may require them to be shortened. The entire character of the folder name, combined with any individual filename within it, must not exceed 120 characters.

Please contact DL-EntertainmentMasterMaterials@bskyb.com to be supplied a 'U' ID.

6.15.4.3 Timecode in IMF

Sky recommends the best practice for handling timecode in IMF produced by the IMF User Group: https://www.imfug.com/TR/timecode-in-imf/. The optional element: CompositionTimecode should be omitted.

6.15.4.4 IMF Video Specification

- The following tables indicates the permittable options.

Table 22. UHD IMF Video Specification for 24/1.001, 24 or 25 fps Content

Component	Attribute					
Resolution	3840x2160					
Stereoscopy	Monoscopic					
Frame Structure (Scan Type)	Progressive					
Colourimetry	COLOR.3 (BT.709)		COLOR.7 (BT.2100-PQ)			
Colour Components	Y'C'bC'r		Y'C'bC'r		R'G'B'	
Chroma Subsampling*	4:2:2		4:2:2		4:4:4	
Quantisation	QE.1 (Narrow Range)		QE.1 (Narrow Range)		QE.1 (Narrow Range)	QE.2 (Full Range)
Pixel bit depth	10		10 or 12		10 or 12	10 or 12
Coding Profile*	Broadcast Contribution Single Tile	4K IMF Single Tile Lossy	Broadcast Contribution Single Tile	4K IMF Single Tile Lossy	4K IMF Single Tile Lossy	4K IMF Single Tile Lossy
Level*	Level 5-6	Mainlevel 5-6	Level 5-7	Mainlevel 5-7	Mainlevel 6 & 7	Mainlevel 6 & 7
Sublevel*	n/a	Sublevel 3-5	n/a	Sublevel 3-5	Sublevel 3-5	Sublevel 3-5

Table 23. IMF Video Specification for 50fps Content

Component	Attribute			
Resolution	3840x2160			
Stereoscopy	Monoscopic			
Frame Structure (Scan Type)	Progressive			
Colourimetry	COLOR.3 (BT.709)	COLOR.7 (BT.2100-PQ)		
Colour Components	Y'C'bC'r	Y'C'bC'r	R'G'B'	
Chroma Subsampling*	4:2:2	4:2:2	4:4:4	
Quantisation	QE.1 (Narrow Range)	QE.1 (Narrow Range)	QE.1 (Narrow Range)	QE.2 (Full Range)
Pixel bit depth	10	10 or 12	10 or 12	10 or 12
Coding Profile*	4K IMF Single Tile Lossy	4K IMF Single Tile Lossy	4K IMF Single Tile Lossy	4K IMF Single Tile Lossy
Level*	Mainlevel 6 & 7	Mainlevel 6 & 7	Mainlevel 7	Mainlevel 7
Sublevel*	Sublevel 4 & 5	Sublevel 4 & 5	Sublevel 5	Sublevel 5

*Alternative Chroma Subsampling, Coding Profiles, Mainlevels and Sublevel may be permitted, but only when the content is already in this format, therefore negating the need for reencoding, and acceptance shall be subject to the content passing a QC assessment.

For clarity, pertinent IMF requirements are specified in further detail, in the below sub-sections.

6.15.4.5 JPEG2000 Coding Profile

JPEG2000 encoding profiles, their operating level and sublevel must be selected based upon the characteristics that impact the required component sampling rate (e.g., resolution, subsampling, and frame rate).

Max. Components Sampling Rate = (*Horizontal Resolution* x *Vertical Resolution* x *Frame Rate* x *Average Number of Colour Components Per Pixel**) / 1,000,000
*4:2:2 = 2 and 4:4:4 = 3

Table 24. Permitted Broadcast Contribution Single Tile details

Broadcast Levels	Max. components sampling rate (MSample/s)	Max. compressed Bit Rate (Mbit/s)
Level 5	520	800
Level 6	1200	1600
Level 7	2400	3200

Table 25. Permitted 4K IMF Single Tile Lossy Mainlevel details

Levels	Max. Components Sampling Rate (MSamples/sec)	Maximum Sublevels
Mainlevel 5	520	3
Mainlevel 6	1200	4
Mainlevel 7	2400	5

Table 26. Permitted 4K IMF Single Tile Lossy Sublevel details

Sublevels	Max. Compressed Bit Rate (Mbit/s)
Sublevel 3	800
Sublevel 4	1600
Sublevel 5	3200

6.15.4.6 Colourimetry

- Colour Primaries and Matrix Coefficients labels must be used within the MXF 'Generic Picture Essence Descriptor' to indicate the encoded colourimetry of the deliverable, not the colourimetry of the mastering display – a description of the mastering display characteristics should be included in the SMPTE ST 2086 metadata. See Appendix 4, 6.4.2 HDR Metadata, for further details.

6.15.4.6.1 COLOR.3 (SDR)

"COLOR.3" is mapped as specified in Table 27 below and Section 1 of Recommendation ITU-R BT.709-6.

Table 27. COLOR.3 Settings

Item	Description	Universal Label Value	Parameter Setting
Transfer Characteristics	BT.709 Transfer Characteristics	060E2B34.04010101.04010101.01020000	1
Colour Primaries	ITU-R BT.709 Colour Primaries	060E2B34.04010106.04010101.03030000	1
Coding Equations	ITU-R BT.709 Coding Equations	060E2B34.04010101.04010101.02020000	1

6.15.4.6.2 COLOR.7 (HDR)

R'G'B' components are mapped using the colour primaries and white point specified in Recommendation ITU-R BT.2020 and the PQ transfer function as specified in SMPTE ST 2084.

R'G'B' components are mapped to Y'C'BC'R components using the (non-constant luminance) derivation of Y' and colour difference signals specified in Table 4 of Recommendation ITU-R BT.2020-2.

Table 28. COLOR.7 Settings

Item	Description	Universal Label Value	Parameter Setting
Transfer Characteristics	SMPTE ST 2084 Transfer Characteristic	060E2B34.0401010D.04010101.010A0000	16
Colour Primaries	ITU-R BT.2020 Colour Primaries	060E2B34.0401010D.04010101.03040000	9
Coding Equations*	ITU-R BT.2020 Coding Equations for Non-Constant Luminance	060E2B34.0401010D.04010101.02060000	9

*Only required in Y'C'bC'r deliveries

6.15.4.7 Quantisation

Sky support R'G'B' or Y'C'BC'R component signals being quantised according to one of the systems specified in Table 29.

Table 29. Quantisation Equations

	QE.1* (Narrow Range)	QE.2 (Full Range)
Component Triplet	Y'C'bC'r and R'G'B'	R'G'B'
Quantisation equations (n is the bit depth)	$D'R = INT(219 \cdot R' + 16) \cdot 2^{n-8})$ $D'G = INT(219 \cdot G' + 16) \cdot 2^{n-8})$ $D'B = INT(219 \cdot B' + 16) \cdot 2^{n-8})$ $D'Y = INT(219 \cdot Y' + 16) \cdot 2^{n-8})$ $D'CR = INT(224 \cdot C'R + 128) \cdot 2^{n-8})$ $D'CB = INT(224 \cdot C'B + 128) \cdot 2^{n-8})$	$D'R = INT(R' \cdot (2^{n} - 1))$ $D'G = INT(G' \cdot (2^{n} - 1))$ $D'B = INT(B' \cdot (2^{n} - 1))$
Notes	Equivalent to quantisation equations of Section 3 of Part 2 of ITU BT.709, and Table 3 and Table 4 of ITU BT.601	The mapping of components signals using the QE.2 system onto interfaces such as HD-SDI is defined in other specifications.

*Overshoots with Y'C'BC'R colour components which exceed the QE.1/ Narrow Range, but within the tolerance detailed in EBU R103, will be accepted.

- QE.2 (Full Range) Y'C'bC'r deliveries will not be accepted.

6.15.4.8 Picture Essence Descriptor

- The Top-Level File Package of Image Track File must reference one of the following SMPTE ST 377-1 Picture Essence Descriptors:

    - Y'C'bC'r signals must use CDCI Picture Essence Descriptors to reference the Black Ref Level, White Ref level and Colour Range according to the bit depth, as specified in Table 30.

Table 30. CDCI Picture Essence Descriptor

Quantisation	QE.1	
Bit Depth	10	12
Black Reference Level	64	256
White Reference / Nominal Peak Level	940	3760
Colour Range	897	3585

NB. The White Ref level item applies only to the Y' component, and the Colour Range item to the C'B and C'R components.

    - R'G'B' signals shall use RGBA Picture Essence Descriptors to reference the Component Min Reference and Component Max Reference according to the quantisation and bit depth, as specified in Table 31.

Table 31. RGBA Picture Essence Descriptor

Quantisation	QE.1		QE.2	
Bit Depth	10	12	10	12
Component Min Ref	64	256	0	0
Component Max Ref	940	3760	1023	4095

6.15.4.9 HDR Specific Metadata in IMF

At present, Sky UK shall not use the below HDR metadata to drive internal conversions to HLG. See Appendix 4, 6.4.2 HDR Metadata, for further details.

6.15.4.9.1 SMPTE ST 2086 - Mastering Display Colour Volume Metadata

If the grade conforms to PQ (COLOR.7), SMPTE ST 2086 metadata should be present within each Video Track-File's 'Generic Picture Essence Descriptor'. It must reflect the configured parameters of the mastering display and the actual mastering luminance capabilities, taking into account any additional constraints configured during the mastering process.

6.15.4.9.2 MaxCLL and MaxFALL

- If the grade conforms to PQ (COLOR.7), MaxCLL and MaxFALL metadata must be included in the Extension Properties element of the CPL for Commissioned Productions. Its inclusion is encouraged for Licenced Acquisitions.

6.15.4.10 Audio

- The CPL must map the audio tracks as per one of the predefined Audio Channel Alignments in Table 20.

- Each audio track should contain accurate common and multichannel audio channel labels and audio language tags conformant with SMPTE ST.377-4:2012, ST.428-12:2013 and ST.2067-8:2013. These

labels should be included within Audio Channel Label and MCA Label sub-descriptors within each of the audio MXF track files.

6.15.4.11 Unsupported IMF Features

At present, Sky does not support:

- Subtitle tracks. This is due to inconsistent use of the “Forced” and non-forced tagging. Forced subtitles must be burnt into the image.
- Supplementary packages. Each IMF package must be a complete 'Original Version'.
- Output Profile Lists (OPL). Any inclusion of OPLs will be ignored.
- Alpha channels.
- HLG within an IMF.
- IMF deliveries containing video encoded in anything other than JPEG2000 – e.g., ProRes Applications conforming to SMPTE TSP 2121-1: 2018, SMPTE RDD 45:2017 and SMPTE RDD 59-1:2021 are not supported.

6.16 MP4 Proxy

Like MXF, the term MP4 is ambiguous since it is a container that can include only audio, only video, still images and text, and these can be encoded in a multitude of codecs and bitrates. The term MP4 is used in this section because it is the common term used by many when requesting proxy copies of content for stakeholder review, promotional screeners, and/or early access to material for localising activities. MP4s will not be used for critical reviews, such as QC.

- MP4s are not an option for the main deliverable intended for linear transmission or VOD platforms.

The below sub-sections cover the expected specification if someone requests an MP4, in addition to the main deliverable.

6.16.1 Editorial of MP4 Proxy

- It must be made clear to the requester at Sky which of elements are finished and which are still work in progress. Elements such as:
  - Picture locked edit.
  - Final audio mix.
  - Finished grade.
  - Completed VFXs.

The clock/slate should be excluded. Any requirement for burnt-in timecode and/or watermarks will be confirmed by the requester at Sky.

6.16.2 MP4 Filenames

- Unless otherwise agreed, the files must be named as per the following naming convention:
  - [Feature_Title]-[DateOfRender:DD.MM.YY]
    e.g., Save_the_Cinema-13.01.24.mp4
  - [Series_Name]-[“S”+SeasonNumber##]+[“E”+EpisodeNumber##]-[DateOfRender:DD.MM.YY]
    e.g., Gangs_of_London-S04E03-13.01.24.mp4

6.16.3 MP4 Video Specification

Table 32. MP4 Video Specification

Component	Attribute
Resolution (active image)	1920 x 1080
Frame Rate	25
Scan Type	Progressive
Transfer function	BT.709
Colourimetry	BT.709
Matrix coefficients	BT.709
Colour space	Y'C'bC'r
Chroma subsampling	4:2:0
Video Range	Narrow
Bit depth	8
Coding	AVC*, High Profile, Level 4, 5-6Mbits/s
Container	MXF OP1a

*NB. AVC (Advanced Video Coding) is the same as H.264 and MPEG-4 Part 10

6.16.4 MP4 Audio Specification

- Stereo audio must be included and encoded as AAC LC (Advanced Audio Codec Low Complexity), at a bit rate of 128 kb/s, with a sample rate of 44.1 kHz.

7 Change Log & Acknowledgments

New requirements are marked with an asterisk at the front. The re-wording of pre-existing requirements (e.g., for clarity or to include a reference a technical document) are listed in the table below but not marked with an asterisk. Minor tweaks (e.g., grammar corrections) are not listed.

Version	Date	Section	Update
1.0	Jan-2022	1.1	The use of "Must", "Should" and "May" in this document has been defined to qualify each provision.
		1.2	Confirming that requirements related to Contribution Feeds / Live Productions are not covered in this document.
		1.3	An explanation of the layout of this document, which includes clarification that Acquisitions only need to comply with a subset of the requirements in this document.
		2.2.1	*Defining new minimum camera requirements, which no longer refer to EBU R118.
		2.2.1.1	Clarification that reframing in post-production may necessitate the need to capture at higher resolution.
		2.2.2	Reference white point, for tight-turnaround HDR, must be accurate for any planned SDR outputs.
		2.2.3.2	Confirmation that vignetting should not be present and the resolution should not be compromised in meeting this requirement.
		2.2.3.3	Guidance added around the use of Anamorphic lenses.
		2.2.4 & 3.1	*Revised constraints around the use of "non-qualifying footage".
		2.2.5	All commission must be delivered at 25fps (NB. UHD may deliver at 50fps). Only Acquisitions may be delivered at 23.976 or 24 fps.
		2.2.5, 3.1.1, 3.2.1, 4.1.4 & 6.3.1	Clarifying that edits on 50 fps content must occur after the odd frame / before the even frame.
		2.2.6	Confirmation that Windowboxing an image must be avoided.
		3.1.1.2	Archive must not exhibit incorrect geometry
		3.1.1.3	Specifying that video range representation, transfer function and colourimetry must be converted correctly.
		3.2.3	Updated requirements relating to the post-production visual pipeline
		3.2.5.2	Guidance added around any dependency of shadow detail in low luminance images.
		3.2.5.3 & 6.4.1	Further details on what is required from a HDR grade.
		3.3.1	*Graphic Safe Area is increased to 90%.
		3.3.2	Specifying that the luminance levels of graphics must be suitable.
		3.3.4	Specifying the End Credits must be presented as static cards.
		3.4.2 & 6.9.1	*Confirmation that any requirement for diverged dialogue mixes is being phased out where appropriate
		3.4.2 & 6.8	*Lo Ro now preferred for stereo.
		3.4.5	Updated information for Dolby Atmos requirements. Including the reduction of pre-roll to 30-seconds, to align with the video requirements.
		3.4.5.1	Confirming that the Dolby Atmos must start at the same timecode and run at the same framerate.
		3.4.8 & 3.4.10	Since the last published specs, the Programme Layout has been updated, along with the required Clock/Slate information – note that this is the same requirement as detailed in the "Bumper-To-Bumper" supplement that has been shared with select Commissions.
		4.1.2.1	Stating that there must be observable benefits between different formats (e.g., HD and UHD, SDR and HDR).
		4.1.2.1.2	Explicitly specifying that HDR must offer a perceptual increase in dynamic range.
		4.1.2.2	Deliverables must contain genuine bit-depth of what is required.
		4.1.8	Dolby Atoms for License Acquisition series' needs to be discussed in advance of delivery to confirm its suitability.

		5	Tape delivery is not acceptable unless pre-approved by Sky.
		5.1	Updated contact details
		5.3.2	An HD version is not required if an SDR-UHD is also delivered.
		5.3.6	Confirming that the assigned Production Coordinator shall be in contact to discuss the delivery requirements, when an additional M&E/MMN DAMF is required for a Commission.
		6.3	Framerate conversion methods are now detailed for different framerates.
		6.4	Additional HDR Information.
		6.4.2	Clarifying Sky UK's expectations of HDR Metadata.
		6.5	Defined the Reference Viewing Environment that should be used for QC and Colour Grading.
		6.6	Defined the Display Requirements for QC and Colour Grading.
		6.7	Defined Room Requirements for Mixing and Monitoring Audio.
		6.8	Dolby Metadata updated to include the metadata added to Dolby Digital Plus encodes of Dolby Atmos.
		6.10.1	Detailed Sky UK's Loudness requirements.
		6.15	Specifying which alternative UHD video codecs are acceptable for Commissions and which are only acceptable for Licenced Acquisitions.
1.1	Mar-2022	6.2	Reference to combing artefacts has been moved from 4.1.4 to 6.2.
		3.2.5.3, 6.4.2.2 & 6.15.4.9.2	*Inclusion of MaxCLL and MaxFALL metadata which is now mandatory for all PQ Commissioned Productions.
1.2	Mar-2023	1.2	An option to be added to a mailing list to be informed each time the Technical Specification is updated.
		3.3.3 & 4.1.5	First bullet point about Forced Narrative subtitles has been reworded for clarity.
		3.3.5	Text under the first bullet point about Textless Elements has been reworded for clarity.
		3.4.2	Diverged dialogue section has been re-worded to make our position clearer on phasing it out.
		3.4.3	*Mix Minus Narration (MMN) has been explicitly referenced as a requirement for Non-Scripted Commissions. All references to M&E now include MMN.
		3.4.4, 4.1.7.2 & 6.10	Streaming services are referenced, for situations where content isn't released on Blu-ray/DVD, when specifying that movies do not need to be R128 compliant.
		3.4.8	References to 'Bumpers' have been changed to 'Programme Bumpers' to provide further clarity.
		3.4.9 & 4.2	Colour bar requirements now include explicit reference to the relevant ITU documents. Section 3.4.9 also has a reference to "holding frame" that has been updated for clarity.
		3.4.10	*Framerate information is now required on the clock/slate.
		5.3.1.2 & 5.3.2.2	List of permissible characters that can be used in the metadata has been included.
		5.3.3.4 & 6.15.1	An option has been added where a supplier can change part of their delivery spec for UHD, however, 60-days' notice is required.
		6.9.1	Guidance added that when dialogue is mixed diverged, it must be no more than 6dB below the level in the centre channel.
		General	Although prefixed with unique section numbers, some sections were named the same as others. These have been renamed to be unique.
		3.3	Specifying that graphics must match the scan type of the footage.

1.3	Feb-2024	3.3.5	Specifying that textless elements must be mute.
		3.4.2	Further guidance to monitor downmixes.
		3.4.8	*Changing from bumper-to-pumper to soft parting programme layouts.
		3.4.9 & 4.2	Updated requirements for the optional sync plop.
		4.4	The AD and SDH Captions subsections have been combined.
		5.3.1.3 & 5.3.2.3	Specifying that SD and HD content must be encoded as compliant AMWA AS-11 files.
		5.3.3.4	*Mandating ProRes 422 HQ and ProRes 4444 for SDR and HDR Commissions
		5.3.3.4.2	Reiterating that HDR Metadata must be included in Commissioned Productions.
		5.3.3.5	Mandating that Commissioned Productions are delivered with the same audio layout, and only Licensed Acquisitions can choose different audio layouts.
		6.8.1	Confirming that SMPTE RDD 6, is not supported
		6.8.2	Reiteration that the .dbmd file, contained inside a Dolby Atmos Master File, is not used at Sky
		6.10.1	Confirming that the R128 measurement and correction must be of the main programme and no other audio.
		6.15	General tweaking of wording to emphasis these are the alternative formats are not an option for Commissioned programmes.
		6.16	New section covering MP4s, should Sky request one in addition
1.4	Oct-2024	3.3	Reference to spelling and grammar, text size, and positioning, has been moved from 3.3.3 to 3.3 to cover all on screen text, and not only subtitles.
		4.2	Provides tolerance for licensed material to include black frames at the end when audio, including reverb, is still playing.
		6.13	Details pertaining to tape delivery have been removed as this is no longer an option.
		6.14	Details pertaining to 3D deliveries have been removed as this is no longer an option.

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