

Sky's Technical Specification For Ultra High Definition Content



Contents	2
1 Objective	4
2 Pre-Production Consideration	5
2.1 Cameras	5
2.2 Shooting Resolutions	5
2.3 Shooting Aspect Ratio	5
2.3.1 Non-16x9 Considerations	5
2.3.2 Both 16x9 and Intended Image Aspect Ratio Fulfilment	5
2.4 Shooting Frame Rate	5
2.5 Shooting Formats	5
2.6 Different Editorial Version Shooting Requirements	6
3 Production Considerations	7
3.1 Video	7
3.2 Lens	7
3.3 Audio	7
4 Post Production Considerations	8
4.1 Archive Footage	8
4.1.1 Archive Aspect Ratio	8
4.1.2 Archive Frame Rate	8
4.1.3 Interlace source	8
4.1.4 Archive Up-Converting	8
4.1.5 Archive Audio Level	8
4.2 Use of Non-UHD	8
4.3 Edit	8
4.3.1 Edit Errors	8
4.3.2 Flash and Pattern Analyser (FPA)	8
4.4 Content Layout	9
4.4.1 Line Up	9
4.4.2 Part Breaks	9
4.4.3 End	9
4.5 Visuals	9
4.5.1 Colour Space Pipeline	9
4.5.2 Dynamic Range	9
4.5.3 Colour Grade	9
4.5.4 "Legal" Video Levels	10
4.6 Graphics	10

4.7	Online Conform	10
4.8	Post Production Audio.....	10
4.8.1	Dialogue	10
4.8.2	Mixes	10
5	Licensed Acquisitions	12
5.1	Video.....	12
5.1.1	UHD Source Material	12
5.1.2	Version & Aspect Ratio	13
5.1.3	Dynamic Range.....	13
5.2	Audio	13
5.2.1	Movies.....	13
5.3	Content Layout	13
6	Subtitling	14
6.1	In-Vision Subtitles for Foreign Language.....	14
6.2	Subtitles For Foreign Territories.....	14
7	Access Services.....	15
7.1	English Audio Description (AD).....	15
7.2	English Closed-Captions	15
8	Sky UK Deliverables.....	16
8.1	Digital Intermediate Deliverable	16
8.2	UK's Serviceable Deliverable	16
8.2.1	Audio	16
8.2.2	Video Standards	16
8.2.3	Interoperable Master Format (IMF).....	17
8.2.4	UK Delivery Method	18
9	Sky Germany Deliverables.....	19
9.1	CPL	19
9.2	Layout.....	19
9.3	Audio	19
9.3.1	Levels.....	19
9.3.2	Audio Channel To Track Allocation	19
9.3.3	Dolby Atmos.....	20
9.4	Closed captions (Subtitles)	20
10	Emerging Technologies	21
11	Changelog.....	22

1 Objective

This document covers UHD Commissioned Productions and Licenced Acquisitions content, in both SDR and HDR formats.

It is designed to ensure the delivery of technically complaint files, meet quality expectations and enable efficient processing. Failure to satisfy Sky's Quality Control may result in content being rejected or not qualifying as UHD.

For Commissioned Productions there may be scenarios where in addition to the [Serviceable Deliverable](#), the [Digital Intermediate \(DI\)](#) is also requested and this is to ensure Sky holds a superior copy which would lend itself to future technologies.

Licensed Acquisitions only need to comply with section 5 onwards.

As technology and knowledge evolves, this document may be updated as appropriate. Please ensure you are referencing the most up-to-date version. Further info can be found on DDP website; however this document is specific to Sky's current UHD requirements.

Questions regarding UHD can be emailed to DL-EntertainmentMasterMaterials@bskyb.com who will be able to answer them or escalate to the right individual(s) for you.

2 Pre-Production Consideration

2.1 Cameras

Cameras outputs must be compliant with the standards set out in EBU R118 for either UHD1 Tier 1 or UHD1 Tier 2. Film may be accepted but only with prior approval.

2.2 Shooting Resolutions

Productions should capture at a minimum sensor resolution of 2880 x 1620 and comply with EBU R118. Where cameras capture different resolutions (e.g. 5k) and this resolution is retained during post production, Sky may the delivery of this DI at that resolution.

2.3 Shooting Aspect Ratio

Intended Image Aspect Ratios other than 16x9, must have pre-approval.

2.3.1 Non-16x9 Considerations

Programme makers should be mindful that mattes reduce the effective frame resolution of the actual image (e.g. an aspect ratio of 2.40:1 has 26% less resolution than a 16x9 full frame image) and some viewers find their presence annoying.

Furthermore, viewer's may have their displays set to rid the mattes which will compromise the framing by either cropping the picture or stretching its geometry (e.g. faces will look stretched and circular objects will look egg shaped). Both of these changes to the image introduce further detriments with the reduction of resolution through pixel interpolation and distracting jumps with the picture's shape and size when the video returns to 16x9 (e.g. at the junctions between commercial breaks and programmes).

2.3.2 Both 16x9 and Intended Image Aspect Ratio Fulfilment

Where the Intended Image Aspect Ratio isn't 16x9 and there is a requirement to also produce a 16x9 version – for example when Sky Vision require a 16x9 version for international distribution – both must versions must qualify as UHD (i.e. whichever the smallest resolution, must meet the UHD quality thresholds detailed in EBU R118).

Where content is to be delivered as a 16:9 frame from a non 16:9 shoot ratio, the delivered master should be cut from the edit master as a crop ensuring pixels are mapped to the UHD pixel count and not zoomed from the edit master which may result in detail loss.

Care must be taken to ensure the framing of both the Intended Image Aspect Ratio and 16x9 version does not result in unintended items (e.g. crew or equipment) being visible in the frame which has the greater field of view. Reframing/mattes should only be applied to the DI at the final stage of creating the deliverables and relevant subjects must remain present and framed suitably in both versions.

2.4 Shooting Frame Rate

Standard Frame Rate (SFR) production should shoot at 25 frames per a second (fps), however 24fps (incl. 24/1.001) is acceptable for Co-Commissioned Productions. Any High Frame Rate (HFR) Commissioned Productions must be discussed with Sky to confirm technical requirements.

2.5 Shooting Formats

All content should be captured in progressive scan, with 16-bit colour depth raw output (12-bit accepted with pre-approval). File metadata must also be captured.

As an exception, Intra-frame coding may be permitted for some non-Scripted Commissioned Productions due to certain shooting conditions. Colour sub-sampling, bitrate and bit-depth should be the highest achievable and agreed with Sky ahead of Production.

The appropriate colour space pipeline must be used, [ACES](#) is preferred, however the camera's Log colour space may be accepted where it can result in satisfactory HDR grade and where appropriate, utilising the extended colour space as defined within ITU-R BT.2020.

2.6 Different Editorial Version Shooting Requirements

There may be requirements to shoot footage for different versions commissioned, such as territorial re-versioning, which may necessitate the shooting of additional content for other language versions (e.g. relevant signage in German).

3 Production Considerations

3.1 Video

The image must be suitably lit and take into account High Dynamic Range (HDR) requirements.

The impact of the chosen Exposure Index (EI) should be considered when shooting UHD. Although noise or grain is often used for artistic intent, it may impair the image definition and compromise downstream delivery.

The recorded video must also be free from intrusions such as lens dirt, dead pixels or film dirt/scratches.

3.2 Lens

Lens must be free from aberrations and capable of delivering the optical resolution for the camera used.

3.3 Audio

Sound must be recorded with appropriately placed microphones, giving minimum background noise and without peak distortion. The audio must also not display any dynamic and/or frequency response artefacts as a result of recording at low quality codecs or data rates.

Productions need also to consider the acquiring of audio elements to deliver multichannel surround and immersive audio where appropriate.

4 Post Production Considerations

4.1 Archive Footage

Where used must be of the highest quality obtainable and agreed with Sky ahead of production.

4.1.1 Archive Aspect Ratio

Where the aspect ratio of the archive is different, it must not exhibit incorrect geometry. It should sit within the frame with either a blur-fill or mattes filling the unoccupied area. Where the source quality allows it, zoomed in will be permitted if does not compromise the composition or image definition at the DI Deliverable's resolution.

4.1.2 Archive Frame Rate

When converting 24fps (incl. 24/1.001) to 25fps, speed change must be used and due attention must be given to the audio. Motion Compensation (sometimes known as Motion Predictive or Motion Vector) standards conversion should be used when standards converting other frame rates.

4.1.3 Interlace source

Care must be taken to avoid interlace artefacts visible on the progressive frame.

4.1.4 Archive Up-Converting

Particular care must be taken when up-converting and it should look no worse than the source if later down converted. VITC, switching signals and half lines at the top and bottom, part of the field blanking interval, on Standard Definition sourced content must not be visible when up-converted.

4.1.5 Archive Audio Level

Adjustments must be made to ensure audio is clear, and levels stay consistent with the rest of the programme unless editorially justified.

4.2 Use of Non-UHD

Content which does not meet the acquisition classification defined in EBU R118, for either UHD1 Tier 1 or UHD1 Tier 2, including but not exclusive to archive footage, will be classified as non-UHD. Any programmes must not contain more than 25% of non-UHD content; otherwise the entire asset will be reclassified as HD or less.

4.3 Edit

4.3.1 Edit Errors

Missing media, missing frames and duplicate frames will result in rejection. Flash frames or very short shots must also be avoided unless editorially essential. However, even intentional short edits must pass a [Flash and Pattern Analyser](#) test.

4.3.2 Flash and Pattern Analyser (FPA)

Flickering or intermittent lights and certain types of repetitive visual patterns can cause serious problems for some viewers with Photosensitive Epilepsy (PSE). So to not limit who can view the content, efforts must be made to reduce the inclusion of this footage as content must pass a FPA test, unless pre-approved by Sky.

4.4 Content Layout

4.4.1 Line Up

Section	Bars & Tone	Asset Info	Break Pre Start Of Media	Start Of Media
Time-code	09:59:30:00	09:59:50:00	09:59:57:00	10:00:00:00
Video	100% Bars (100/0/100/0)	Ident Clock or Slate	Black	First frame of content
Audio	BLITS / GLITS	Silence	Silence	First frame of content

4.4.2 Part Breaks

Section	End Of Part	Break
Duration	00:00:05:00	00:00:15:00
Video	Freeze or 'living hold' after end of part	Black
Audio	Fade or cut to silence by end of part	Silence

4.4.3 End

Section	End Of Programme
Duration	00:00:05:00
Video	Freeze or 'living hold' after end of part
Audio	Fade or cut to silence by end of part

No black/silence is needed after.

4.5 Visuals

4.5.1 Colour Space Pipeline

An ACES workflow should be implemented where a DI Deliverable is required and it is recommended for all other Commissioned Productions. Where an ACES workflow is not employed, the camera's Log colour space should be used.

4.5.2 Dynamic Range

Where a HDR deliverable has been requested, it must be an addition to the ITU-R BT.709 compliant, SDR grade.

The HDR must comply with ITU-R BT.2100 and conform to ITU-R BT.2020 colour space, using the PQ format to a minimum of 1000cd/m² and with associated SMPTE ST 2086:2014 metadata. Sky will conform PQ content to the broadcast format of HLG10 at 1000cd/m².

Where a HLG version is requested, it should be derived from the PQ master, graded to 1000cd/m².

Care should be taken to ensure comfortable viewing with a measured approach to the extended dynamic range available. Unless the impact on the viewer is intentional, consideration should be given to:

- Dark scenes followed by very bright shots or scenes, as the sudden jump in luminance may cause discomfort.
- Bright scenes followed by dark ones as viewer's eye may require time to adjust.
- Prolonged harsh bright elements in dark scenes (e.g. torches in a dark environment) as it can compromise the visibility of the dark parts of the scene.

Excessive use of the dynamic range, without editorial justification, may result in content being rejected.

4.5.3 Colour Grade

Unless altered as an editorially effect, colour rendition, especially skin tones, must be consistent throughout, and a realistic representation of the scene portrayed.

Artificially sharpening, softening and noise should be minimised so to not impair the UHD image quality.

The picture must be free of excessive black crushing and/or burnt-out whites. Hard clipping (e.g. by legalisers) must not cause visible artefacts, loss of relevant details or impair the intended look.

4.5.4 "Legal" Video Levels

Although specular highlights may sit above SDR nominal white with HDR, the video levels, for both HDR and SDR, must sit within the preferred minimum and maximum range as per EBU R 103. Narrow range parameters should be used as denoted in ITU-BT.2100. Overshoots exceeding the total video signal range will result in the content being rejected.

4.6 Graphics

All graphics must comply with EBU R 95 and the end credits must sit within the middle 36% of the screen – see Sky's Production Pack for more information on end credit guidance.

If a DI Deliverable is required, it must be clean and sections with the graphics should be created as alpha channels.

4.7 Online Conform

Where the camera's raw output has been utilised, the online conform should be done as an uncompressed Image Sequence, preferably EXR (DPX or TIFF are acceptable) with a bit depth of 16-bit (12-bit accepted with pre-approval).

When a DI Deliverable is not required and with pre-approval, some productions may be permitted to perform the online conform as a compressed format (i.e. a non-Image Sequence). This must not have a detrimental impact to the image quality on the deliverable to Sky.

Productions, where permitted to shoot with a non-raw codec, must maintain that format, with no further conversion, throughout their post-production workflow.

Where shooting resolution is close to UHD (e.g. 4k), pixel interpolation must be avoided by cropping to UHD, 1:1 pixel mapped.

4.8 Post Production Audio

Audio must be in sync with the video at all times and mixed transparently with no audible edits. Spurious signals such as clicks, noise, hum and any other distortion must not be present.

Viewer listening equipment can vary from high-end home entertainment systems to cheap headphones, with most viewers listening through small screen integrated panel speakers and this should be considered when balancing the mix. Levels should be appropriate to the scene portrayed and where relevant make use of the available dynamic range, without being excessive. All mixes must be created as a near-field mixes.

4.8.1 Dialogue

Audio must be balanced to ensure dialogue, which is intended to be understood, always remains distinct, clear and intelligible. Where the 'sync sound' does not result in distinct and clear dialogue, ADR should be employed. Care must be taken to ensure ADR is not detectable, noticeable ADR is distracting and could result in the content being rejected.

4.8.2 Mixes

All content must have both a 5.1 and stereo mix. The 5.1 is the primary audio and should be mixed to a target level of -23 LUFS, with Maximum True Peaks not exceeding -1dBTP. The Stereo should derive from the 5.1 and both the stereo and 5.1 may require normalisation before delivery. An Immersive Audio mix may also be required.

4.8.2.1 Immersive Audio

If an Immersive Audio mix has been requested, it must be delivered as a Dolby Atmos Master File, separate from the main deliverable. Timecode references must ensure correct sync with the Serviceable Deliverable.

If a DI is required, the Immersive Audio Pro Tools session should also be included and in sync with the DI, however this Pro Tools session does not necessarily have to comply with EBU R128.

4.8.2.2 5.1 Audio

If a DI is required, the 5.1 Pro Tools session should also be included and in sync with the DI, however this Pro Tools session does not necessarily have to comply with EBU R128.

4.8.2.3 Stereo Audio

The stereo mix should be an automated down-mix in Lt/Rt, created from the 5.1 mix.

5 Licenced Acquisitions

Although Licenced Acquisitions are pre-made, they must also satisfy a QC assessment.

5.1 Video

It is important that the UHD content when delivered to our customers meets the expectations of being noticeably better than HD when viewed on the same UHD screen where consumer upscaling is applied.

Video noise (including film grain), not only adds challenges to downstream encoding, the greater pixel count of UHD may render this noise more apparent and be perceived as intrusive. Efforts should be made to control such video noise in ensuring optimum image quality.

The picture must also be stable and continuous, without exhibiting:

- Frame rate fluctuations
- Aliasing
- Visible contouring
- Artefacts caused by digital processing
- Noticeable spurious signals or artefacts (e.g. streaking, ringing, smear, echoes, overshoots, moiré, hum, cross-talk etc.)

5.1.1 UHD Source Material

The first two categories below constitute as 'True UHD'. In exceptional circumstances where the quality does not meet expectations, content may be rejected or where appropriate, re-classified as 'Remastered For UHD'. Sky must be informed of the UHD source – 'Native', 'Film Scan' or 'Remastered For UHD' – for all deliverables.

5.1.1.1 Native

Native is defined as content shot digitally and conforming with EBU R118, which allows for shooting resolutions of 2880 horizontal pixels or greater. Where a resolution is close to UHD (e.g. 4k), pixel interpolation must be avoided by cropping to UHD, 1:1 pixel mapped.

It must also derive from a Progressive Frame (Interlace converted to Progressive is not acceptable) and of 10 Bit or greater.

5.1.1.2 Film Scan

The scanning must be of 10 Bit or greater and at a minimum of UHD resolution. To avoid pixel interpolation, 4K scans must be cropped to UHD (3840 x 2160), 1:1 pixel mapped. Higher resolution scans, with the intention to oversample, are acceptable but care must be taken to ensure pixel interpolation does not result in an otherwise softer image than a 4k/UHD scan.

Zooming in to fill the UHD frame is not acceptable where it results in a loss of effective resolution.

Each frame should be digitally treated to remove contaminations and other defects (e.g. dirt and scratches) and care should be taken in controlling noise and sharpening, as well as colour and contrast improvements.

The definition captured by film stock can vary greatly depending on many factors, such as age, film speed, number of perfs, its condition from storage and production values. To achieve the highest quality, scanning of film should start with the original print. Eligible UHD film stock should be of 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 also influences the picture quality and all play a part in whether the resulting image qualifies as UHD.

In the scenario where there is uncertainty 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, percentage of non-UHD footage etc.).

5.1.1.3 Remastered For UHD

Content sourced from resolutions lower than UHD must be of 2K resolution (2048×1080) or greater, 10 Bit or greater and from a Progressive Frame (Interlace converted to Progressive is not acceptable). It must be professionally up-scaled and care should be taken in controlling noise and sharpening, as well as colour and contrast improvements. This content will be labelled as 'Remastered For UHD' on the Sky EPG.

5.1.2 Version & Aspect Ratio

Sky must receive the same edit as the BBFC assessed consumer release. The aspect ratio should also match the current consumer release and where there are variants of aspect ratio or edits, Sky must be contacted to establish the desired version.

Where movies have been re-versioned (e.g. Directors Cut) or re-mastered (e.g. a later/improved restoration), Sky should be provided with all the options.

5.1.3 Dynamic Range

Where a HDR option is available, it must be delivered in addition to the SDR version. SDR must comply with ITU-R BT.709 and HDR must comply with ITU-R BT.2100.

PQ is the preferred delivery format and Sky will convert to HLG10 for playout. However, Licence Acquisitions are permitted to deliver HDR in the HLG10 format where stipulated by Licensor.

5.2 Audio

Audio must be in sync with the video at all times and the mix should be appropriate for home viewing environments, with clear and distinct dialogue where intended.

All content should be delivered with both Stereo and 5.1 audio mixes. In addition, Dolby Atmos should also be provided where available as a Dolby Atmos Master File (DAMF) and with corresponding timecode to sync with the video.

All mixes must be phase coherent with the ability to downmix through 5.1 to stereo and mono without audible artefacts.

5.2.1 Movies

Movie content intended for channels or platforms without commercial breaks (e.g. a movie-only channel or VOD exclusive movie content) must be supplied with the same audio mix as the consumer DVD/Blu-Ray (AKA nearfield mix). This may not necessarily be R128 compliant. The Maximum True Peak Level should not exceed -1dBTP.

5.3 Content Layout

The first frame of action (i.e. first occurrence of video or audio, also known as Start Of Media) should start at 10:00:00:00.

6 Subtitling

6.1 In-Vision Subtitles for Foreign Language

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

6.2 Subtitles For Foreign Territories

Where subtitles are available for either Italy or Germany viewers, they should be emailed to DL-EntertainmentMasterMaterials@bskyb.com.

7 Access Services

Sky is committed to providing Access Services to those with sensory impairments. Commissioned Productions must supply Closed Captions (in-house facilities are available at a cost) and we encourage licensors to provide assisting files (scripts, subtitle files, Spotting List, CDSL, CCSL, etc.) where they are available. Further information can be obtained from Access.Services@sky.uk.

7.1 English Audio Description (AD)

AD is not a requirement but if available it should be sent to Sky and preferable as BWAV file, though other formats are accepted. Email DL-Access.Services@sky.uk for further information.

7.2 English Closed-Captions

Closed Caption subtitles for deaf or hard-of-hearing viewers must be supplied for all Commissioned Productions. If delivering an IMF, the subtitles should be included as TTML and EBU-TT should be used if delivering ProRes. Subtitles must also be supplied for licence acquisitions where available but they may not necessary have to be in the previously specified formats. Separate subtitle files should be sent via email to DL-Access.Services@sky.uk.

8 Sky UK Deliverables

All UHD content must have a HD counterpart delivered separately. Please see the [Digital Production Partnership's Technical Standards For Delivery Of Television Programmes To Sky](#) document for details on the HD deliverable, as well as SD and 3D.

8.1 Digital Intermediate Deliverable

For future proofing, Sky may require the delivery of the Digital Intermediate (DI). The DI should be a seamless version, with all graphic elements on an alpha channel and maintaining the Post Production colour space.

The video must be the final HDR grade, full-range, 16-bit floating-point and in the EXR format. Alternatives may be accepted where this is not achievable and is subject to pre-approval.

The audio projects (e.g. Pro Tools session or alternative software) for all mixes should also be included.

Digital Intermediate and the accompanying data Pro Tools Sessions should be delivered on LTO drives.

8.2 UK's Serviceable Deliverable

The Serviceable Deliverable should be parted, identical to the HD/Transmission counterpart. All bar HLG should be delivered as IMF Application #2e, compliant with SMPTE ST 2067-21:2016 and at BCP (Broadcast Contribution Single Tile Profile) Level 5. The IMF must be created directly from an uncompressed DI, with no interim conversion.

In the exception where HLG10 is the delivery format, it should be a ProRes 422 HQ. Sky can also accept ProRes 422 HQ for non-HLG content if a supplier can't create an IMF. Sky must be informed ahead of delivery to make the necessary provisions.

8.2.1 Audio

The audio bit depth must be 24 bits with a sample rate of 48kHz.

8.2.1.1 Audio Levels

Unless delivering movie content intended for channels or platforms without commercial breaks (e.g. a movie-only channel or VOD exclusive movie content) the audio must be compliant with EBU R128.

Since the stereo may not be compliant to EBU R128 when downmixed from a 5.1 mix which in itself is compliant, both the 5.1 and stereo mixes may require independent normalisation. The integrated loudness must measure -23 LUFS when using the algorithm specified in ITU-R BS.1770-2 (or later). A tolerance of ± 1.0 LU is to accommodate marginal inconsistencies with measurement tools and subsequent re-encoding discrepancies. Maximum True Peaks should not exceed -3dBTP and peaks exceeding -1dBTP, on any meter compliant with ITU-R BS.1770-2 (or later), will result in the content being rejected.

8.2.2 Video Standards

	SDR	HDR
Signal	ITU-R BT.709	ITU-R BT.2100
Video Bit Depth	10	
Chroma Subsampling	4:2:2	
Resolution	3840 × 2160	
Frame Rate	25	

8.2.2.1 Framerate

Co-Commissioned Productions which shoot at 24fps (incl. 24/1.001) can be delivered at their native framerate. Where a 24fps master needs to be converted to 25fps, speed change MUST be utilised to avoid frame interpolation.

Licensed Acquisition Movies which are mastered at 24fps are permitted to deliver at their native framerate with pre-approval. All other framerates (e.g. 30fps) must be converted using Motion Compensation (sometimes known as Motion Predictive or Motion Vector) standards conversion ahead of delivery. Due attention must be given to the audio.

8.2.3 Interoperable Master Format (IMF)

Based on DCP and developed by SMPTE, IMF is a standardised collection of media elements and XMLs. One of the XMLs will be a Composition Playlist (CPL) which describes the construction of media elements to form an editorial version. The benefit of IMF is the efficient ability to generate multiple versions of a title with minimal duplication of media.

An Interoperable Master Package (IMP) is a subset of the IMF, containing only the elements pertinent to that particular delivery.

A Supplemental IMP contains only new media elements and CPL(s) to generate new editorial versions. For example, the addition of a foreign language audio track and shots displaying foreign text, which when added to an IMF and conformed as per the Supplemental IMP's CPL, construct a new version for a different territory.

With these positive attributes in mind, Sky has adopted this as its primary delivery format for UHD.

8.2.3.1 IMP

The IMP must contain at least one CPL and this CPL must create a video asset compliant with this Technical Specification. OPLs are not currently utilised.

8.2.3.2 CPL Identifier

The CPL(s) must be renamed to the provided 'U' ID (e.g. *U1234567.xml*). Please contact DL-EntertainmentMasterMaterials@bskyb.com to be supplied a 'U' ID.

Please also inform Sky ahead of delivery if you intended to deliver multiple CPL IMPs (e.g. utilise localisation elements such as subtitles, translated graphics and alternative audio, or alternative edits like seamless versions and extended cuts).

8.2.3.3 Audio Channel To Track Allocation

The CPL should define the following audio channel to track allocation:

Audio Track	Channel
01	Main Stereo L
02	Main Stereo R
03	M&E Stereo L
04	M&E Stereo R
05	Main 5.1 Front L
06	Main 5.1 Front R
07	Main 5.1 Centre
08	Main 5.1 LFE
09	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

Stereo, 5.1 and their M&E counterparts are a requirement for all Commissioned Productions.
M&E mixes for Licenced Acquisitions should be provided where available.

8.2.4 UK Delivery Method

Email DL-EntertainmentMasterMaterials@bskyb.com for information to file deliver the UHD Serviceable Deliverable as well as posting the Digital Intermediate with accompanying data (e.g. Pro Tools Sessions).

9 Sky Germany Deliverables

These requirements are intended to supplement the full technical delivery requirements detailed in the Sky Germany Technical Specifications. Due to the evolving nature of UHD for Broadcast, guidelines may be updated in accordance with programme needs and technology maturity. Refer to Sky DE for guidance as to commissioned programme needs, where UHD/4k is utilized as an acquisition format and production toolset for the delivery of both HD and UHD.

9.1 CPL

The IMF must contain a CPL which creates a video asset compliant with this tech spec with exception to the below audio and layout requirements. OPLs are not currently utilised.

9.2 Layout

The CPL must describe a layout of Picture-to-Picture with no line-up – e.g. start with the first frame of the movies and end with the last frame of the movie.

9.3 Audio

9.3.1 Levels

Both Stereo and 5.1 for Programmes and Movies must be mixed to a Dialogue Normalisation level of -23dB, compliant with EBU R128, and with the associated metadata. To avoid doubt during the QC process, file metadata or tape paperwork should note whether the programme has been mixed to EBU R128.

9.3.2 Audio Channel To Track Allocation

The CPL should define the following audio channel to track allocation:

Audio Track	Channel
1	German Stereo L
2	German Stereo R
3	OV Stereo L
4	OV Stereo R
5	German 5.1 Front L
6	German 5.1 Front R
7	German 5.1 Centre
8	German 5.1 LFE
9	German 5.1 Surround L
10	German 5.1 Surround R
11	OV 5.1 Front L
12	OV 5.1 Front R
13	OV 5.1 Centre
14	OV 5.1 LFE
15	OV 5.1 Surround L
16	OV 5.1 Surround R

In the event that an alternative delivery format is permitted, the below audio configuration is preferred with audio encoded in 24 Bit AES/PCM:

Audio Track	Channel
1	German Stereo L
2	German Stereo R
3	OV Stereo L
4	OV Stereo R

5	German 5.1 - Dolby E (5.1 + 2)
6	German 5.1 - Dolby E (5.1 + 2)
7	OV 5.1 - Dolby E (5.1 + 2)
8	OV 5.1 - Dolby E (5.1 + 2)

The Dolby E must comply with the below channel configuration:

Track	Channel
1	5.1 Front L
2	5.1 Front R
3	5.1 Centre
4	5.1 LFE
5	5.1 Surround L
6	5.1 Surround R
7	Stereo L / Mute
8	Stereo R / Mute

9.3.3 Dolby Atmos

Dolby Atmos audio shall be delivered as a separate encoded E-AC3 file (*.ec3) file. It must be named identically to the principal deliverable, baring the file extension. The E-AC3 file has to be in sync with the content i.e. the same starting timecode and at the same framerate.

9.4 Closed captions (Subtitles)

Closed captions or subtitles must be delivered as a separate STL file. The separate file must be named identically to the principal deliverable, baring the file extension. The STL file has to be in sync with the content i.e. the same starting timecode and at the same framerate. The language signalization within the STL file has to be conformant to ISO 639.2.

10 Emerging Technologies

This document specifically covers UHD – i.e. the delivery of assets with a pixel resolution of 3840 x 2160, sometimes referred to as Quad Full High Definition (QFHD), UHD-1, 2160p or 4k (however 4k is not accurate as it specifically refers to a different resolution which Serviceable Deliverable must not be).

However where Licence Acquisitions are available in other formats, including but not exclusive to the below, this should be discussed with Sky and Sky may require them in the format held by the licensor, unless both parties agree an alternative.

- Advance 1080p (HFR, HDR and/or WCG).
- Immersive Video (including 360-degree videos/spherical videos, Virtual Reality (VR) and stereoscopic/3D VR).
- UHD-2 (specifically a resolution of 7680x4320, sometimes referred to as Super H-Vision, 4320p or 8K).
- High Frame Rate (HFR) (including but not exclusive to 120, 100, 50, 60 progressive frames per a second).

11 Changelog

Version	Date	Section	Update
Updates listed below are in relation to the UHD Launch Specification which this document supersedes			
1.0	Feb '17	4.5.2	ITU references for HDR
		4.8.2.1	Addition requirement for Immersive Audio
		8.1	Commissioned Productions to deliver Digital Intermediates
		10	Emerging Technologies section added