Version 4.4 - 2021

TECHNICAL STANDARDS FOR DELIVERY OF TELEVISION PROGRAMMES TO

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TECHNICAL STANDARDS FOR DELIVERY OF TELEVISION PROGRAMMES TO NRK

This document is a complete guide to the technical standards for Norsk rikskringkasting AS (Norwegian Broadcasting Corporation - NRK). The document is mostly based on the common UK delivery document (see: http://www.digitalproductionpartnership.co.uk/) and used with their kind permission.

The Standards include:

- Technical Specifications, ie the technical production methods which must be used, and the parameters which all material must meet to be acceptable by the broadcaster.
- Picture and Sound Quality requirements, which also form a binding obligation on producers of material. Assessment of quality is by nature subjective, and is highly dependent on the nature of the programme. Some of the Quality Requirements are expressed in relative terms ("reasonable", "not excessive" etc), and it will be necessary to make a judgement as to whether the quality expectations of the intended audience will be fulfilled, and whether the broadcaster will feel that value for money has been achieved.
- Delivery Requirements, which specify the form and layout of the programme material.

NOTE: Text in grey colour in this document is intended for information only. However, at a later stage this may become part of the requirements.

Every programme submitted for transmission must satisfy a Quality Control process specified by the broadcaster. Any programme failing the QC process on tape or file may be rejected and returned to the supplier for repair.

Please ensure you are using the current version of this document, available at:

https://www.nrk.no/eksternproduksjon/teknisk-standard-for-leveranser-til-nrk-1.11396727

Technical Responsibility and Contacts

The NRK's technical delivery team ensures that the technical quality of broadcast programmes is maintained to a satisfactory standard.

Contact	Email	Telephone
File/tape based delivery	nrkmaterials@nrk.no	Please use the e-mail address.
Live delivery	mcr@nrk.no	+47 2304 8690

Live Programme Delivery

Circuit Bookings

The NRK point of delivery is the Master Control Room. The production company is responsible for the costs of all communications and for ensuring all circuits are booked from the source to the point of delivery.

Contact	Hours	Telephone
NRK Master Control Room	05:30-01:30 Monday to Friday 07:00-01:30 Saturday 07:00-00:30 Sunday	+47 2304 8690

Schematic Diagram

When requested the Production companies should provide a schematic diagram to the NRK Master Control Room documenting the end to end signal path, including back up circuits, between the remote location and the NRK Master Control Room no later than 1 week before the transmission date. This should include circuit numbers and contact details for key Technical / Production Staff working on the live programme.

Codec Map

If requested a Codec Map documenting all codecs (including bit rates) through which a signal passes before arriving at the Point of Delivery, as referred to in section 6.4 of this document should be sent to the NRK Master Control Room (**mcr@nrk.no**).

Resilience Levels

Resilience levels will be discussed with each live programme during the commissioning stage however as a guide programmes will need to meet the following:

OPTION A: Programmes with a major national and international public interest

Main and Backup links are geographically and electrically separate as far as possible. Where satellite is used, there are two separately located uplink trucks, powered differently from each other. The source should be able to continue in some form, during a break down or power loss affecting some facilities. The programme producers must discuss the contingencies for alternate content should all facilities be affected.

OPTION B: Live Primetime Programmes

Main and Backup links and power supplies have some commonality, which creates an accepted single-point-of-failure risk. Reserve links could be lower quality or even SD. NRK may provide alternate content in the event of programme failure.

OPTION C: All other programmes including live links into studio programmes

A single link, with no backup is acceptable. There only need be minimal alternate power supply and mobile phones can be used as alternate comms. NRK may provide alternate content in the event of programme failure.

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1 General Quality Requirements

1.1 Picture Quality

The picture must be well lit and reasonably but not artificially sharp.

The picture must be free of excessive noise, grain and digital compression artefacts.

The picture must be free of excessive flare, reflections, lens dirt, markings and obstructions (e.g. lens hood), and lens aberrations.

Movement must appear reasonably smooth and continuous, and must not give rise to distortions or break-up to moving objects, or cause large changes in resolution.

The picture must be free of excessive black crushing and highlight compression. Hard clipping of highlights (e.g. by legalisers) must not cause visible artefacts on screen.

There must be no noticeable horizontal or vertical aliasing, i.e. jagged lines, field or frame rate fluctuations in fine detail.

Colour rendition, especially skin tones, must be consistent throughout, and a realistic representation of the scene portrayed unless it is altered as an editorially essential visual effect.

The picture must be stable and continuous - i.e. no jumps, movements, shifts in level or position.

There must be no visible contouring / artefacts caused by digital processing. Quantisation noise must not be apparent.

There must be no noticeable spurious signals or artefacts e.g. streaking, ringing, smear, echoes, overshoots, moiré, hum, cross-talk etc.

Note: EBU R118 is used to assess the suitability of cameras for HD use. In case of doubt contact the broadcaster.

1.2 Sound Quality

Sound must be recorded with appropriately placed microphones, giving minimum background noise and without peak distortion.

The audio must be free of spurious signals such as clicks, noise, hum and any analogue distortion.

The audio must be reasonably continuous and smoothly mixed and edited.

Audio levels must be appropriate to the scene portrayed and dynamic range must not be excessive. They must be suitable for the whole range of domestic listening situations.

Stereo audio must be appropriately balanced and free from phase differences which cause audible cancellation in mono.

The audio must not show dynamic and/or frequency response artefacts as a result of the action of noise reduction or low bit rate coding systems.

1.3 Access for People with Disabilities

Norwegian legislation (Act June 20 2008 No 42) relating to a prohibition against discrimination on the basis of disability (the Anti-Discrimination and Accessibility Act) requires service providers to take positive steps to make their services accessible to people with disabilities. It states that where a service provider offers or provides services to members of the public, the provider will have to take such steps as is reasonable to make it easier for disabled people to make use of the service. Broadcasters are service providers and this therefore applies to them.

Programme suppliers are therefore required to consider the needs of people with hearing or visual impairments while generating captions, subtitles and graphics, using voiceovers, and while mixing sound.

For further information, please refer to the appropriate technical contact on the front page of this document.

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2 Technical Requirements - Video

NOTE - This section is applicable to both file and tape deliveries. Specific requirements which are different for file and for tape are covered in separate sections 4 and 5.

2.1 High Definition Format

All material delivered for NRK HD TV transmission must be:

- **1920 x 1080 pixels in an aspect ratio of 16:9**
- **25 frames per second (50 fields) interlaced - now known as *1080i/25*.**
- **25 frames per second progressive, known as *1080psf/25 ("film mode")*.**
- **colour sub-sampled at a ratio of 4:2:2**

The HD format is fully specified in ITU-R BT.709-5 Part 2.

Note: 1920 x 1080p/50 can not at the moment be accepted.

2.1.1 Origination

Material may be originated with either interlaced or progressive scan.

Interlaced and progressive scan material may be mixed within a programme if it is required for editorial reasons or the nature of the programme requires material from varied sources.

2.1.2 Post-production

Electronically generated moving graphics and effects (such as rollers, DVE moves, wipes, fades and dissolves) must be generated and added as interlaced to prevent unacceptable judder.

2.1.3 Film motion or 'film effect'

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

2.1.4 Field dominance

Cuts in material must happen on frame boundaries (i.e. between field 2 and field 1). Motion on ***psf*** material must always occur between field 2 and field 1 (i.e. field 1 dominance).

Note - It is possible to shoot material at ***1080p/50***. If this is done, the correct 2-frame marker phasing must be maintained when down-converting to ***1080i/25*** or ***1080psf/25*** (SMPTE ST 2051).

2.2 Video Line-Up

Programme video levels must be accurately related to their associated line-up signals. Video line-up must be 100% colour bars (100/0/100/0) and filling the 16:9 raster. SMPTE pattern bars are not acceptable. For required durations, see Delivery Requirements below for Tape or File as appropriate.

2.3 Video Levels and Gamut (illegal signals)

High Definition digital signals will be assessed according to the recommendation **ITU-R BT709-5 Part 2.**

Video levels must be received within the specified limits so that the programme material can be used without adjustment. Any signal outside the specified limits is described as a gamut error.

2.3.1 Measuring signal levels

Digital video levels are usually measured with a device which displays a trace like a traditional waveform monitor. This gives readings in mV (emulating an analogue signal), or as a percentage of the allowable levels.

The limits of signal levels are defined by reference to a nominal black level and a nominal white level. Black level comprises R, G and B all at zero (or 0% or 0mV) and white level is all three components at 100 % or 700mV.

In a picture signal, each component is allowed to range between 0 and 100% (or 0mV and 700mV). This equates to digital sample levels 16 and 235 (8-bit systems) or 64 and 940 (10 bit systems).

2.3.2 Tolerance of out of gamut signals

In practice it is difficult to avoid generating signals slightly outside this range, and it is considered reasonable to allow a small tolerance, which has been defined as follows under **EBU Rec103**:

- **RGB components must be between -5 % and 105% (-35 and 735mV)**

and

- **Luminance (Y) must be between -1% and 103% (-7mV and 721mV)**

Slight transient overshoots and undershoots may be filtered out before measuring, and an error will only be registered where the out of gamut signals total at least 1% of picture area. Many monitoring devices are designed to detect errors to this specification.

2.4 'Blanking'

HD images must fill the active picture area (1920 x 1080 pixels). No 'blanking errors' are permitted on new, up-converted, or archive material.

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

2.5 Aspect Ratio

All high definition programmes (except as below) must be delivered in 16:9 Widescreen. This means that the active picture must fill a 16:9 screen vertically and horizontally without geometric distortion.

2.5.1 'Cinemascope ratio' letterbox

For delivery to dedicated movie channels or at the discretion of the broadcaster, programmes may be delivered with an active picture in the cinema ratios of 2.35:1 (21:9) or 1.85:1, centred vertically between black bars in a 16:9 frame, filling the width of the frame, and with no geometric distortion.

2.5.2 Floating images

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

2.5.3 'Pillarboxed' HD material

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

2.6 Archive Material

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

2.6.1 General quality - archive

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

2.6.2 Aspect ratio - archive

Archive material should be zoomed to fill the 16:9 raster where possible without compromising the image quality or composition, otherwise it may be presented in a pillar-box format, which:

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

Note however, that consumer TV sets operating in Auto Zoom / Auto mode may enlarge the picture to fill the screen horizontally. The resulting unpredictable zooming can be annoying for the viewer and undermine the artistic intent.

2.6.3 Safe areas - archive

Any captions or text already in the archive material should be kept within the caption safe area if possible, but if not, should be noted in the accompanying documents.

2.7 Use of Non-HD material

Some high definition programmes will contain some material from standard definition originals, and sources which are not considered to meet HD broadcast standards, such as domestic camcorders. This material is all called ‘non-HD’ in this document.

To maintain a high standard and meet audience expectations the amount of non-HD material is limited to **25%** of the programme’s total duration. Non-HD material must not be used for large uninterrupted sections of the programme, unless agreed by the broadcaster. This includes archive material.

2.7.1 Non-HD material

Material acquired using the following methods or formats is considered to be below the high definition standard and will therefore be treated as non-HD:

- HDV from all manufactures
- Most cameras with image sensors under ½”
- Frame based (intra-frame) recording formats below 100Mb/s
- Inter-frame based recording formats below 50Mb/s
- Material generated or processed on 720 line equipment
- Film not meeting the requirement for HD in section **2.8** below

2.7.2 Up-converted SD video material

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

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

Any VITC or switching signals visible at the top of SD material must be removed.

Any line blanking from SD signals must not appear in the HD conversion.

For these reasons it is necessary that all SD material is zoomed in by a small amount on up-conversion.

2.8 Film for High Definition Acquisition

Super16 film is *not* considered to be high definition no matter what processing or transfer systems are used.

The following **35mm** film types and stock are acceptable for high definition acquisition;

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

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

2.9 Photosensitive Epilepsy (PSE)

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

In Norway there is no legislation regarding PSE. However, NRK encourages program producers to follow the UK Ofcom BROADCASTING CODE 2009 which states:

Section 2: Harm and Offence:

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

The Ofcom guidance is at: http://stakeholders.ofcom.org.uk/binaries/broadcast/guidance/813060/section22009.pdf

2.9.1 Testing for flashes and patterning

Note: As stated above, there is no legislation covering PSE in Norway and consequently no mandatory flash pattern tests to be performed on delivered programmes. However, should such tests become mandatory in the future suitable tests are described below.

Tape Delivery

Programmes delivered on tape must be tested using the Harding Flash Pattern Analyser Algorithm v2.5 on an SD (down-converted) SDI feed from playback of the TX tape itself. A test certificate must be printed and inserted into the tape box.

File Delivery

Programmes for file delivery must be tested using any file based PSE device that meets the guidance given by Ofcom. The DPP maintains a list of approved devices, available at: http://www.digitalproductionpartnership.co.uk/download/pse-approved-devices/

Broadcasters will, at their discretion, either test the programme during the Quality Control process, or will require a pass certificate to be delivered with the programme.

- *Test certificates for file delivered programmes must be in pdf form*
- *The relevant metadata details must be completed (see File Delivery Section 4.11.5)*

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

2.9.2 PSE-broadcast warnings

Verbal or on-screen text warnings at start of programme may only be used in exceptional circumstances when:

- The relevant content is completely integral and necessary to the context of the programme, and,
- permission to use the relevant content has been cleared by the broadcaster and documented in writing by those responsible for commissioning / editorial content.

2.10 Safe Areas for Captions

Captions and credits must be clear and legible and must be within the safe areas specified.

All font sizes must be legible as HD and also after down conversion for the SD viewer.

NRK follows the EBU Recommendation R-95 “Safe areas for 16:9 televison production”. This document states the following:

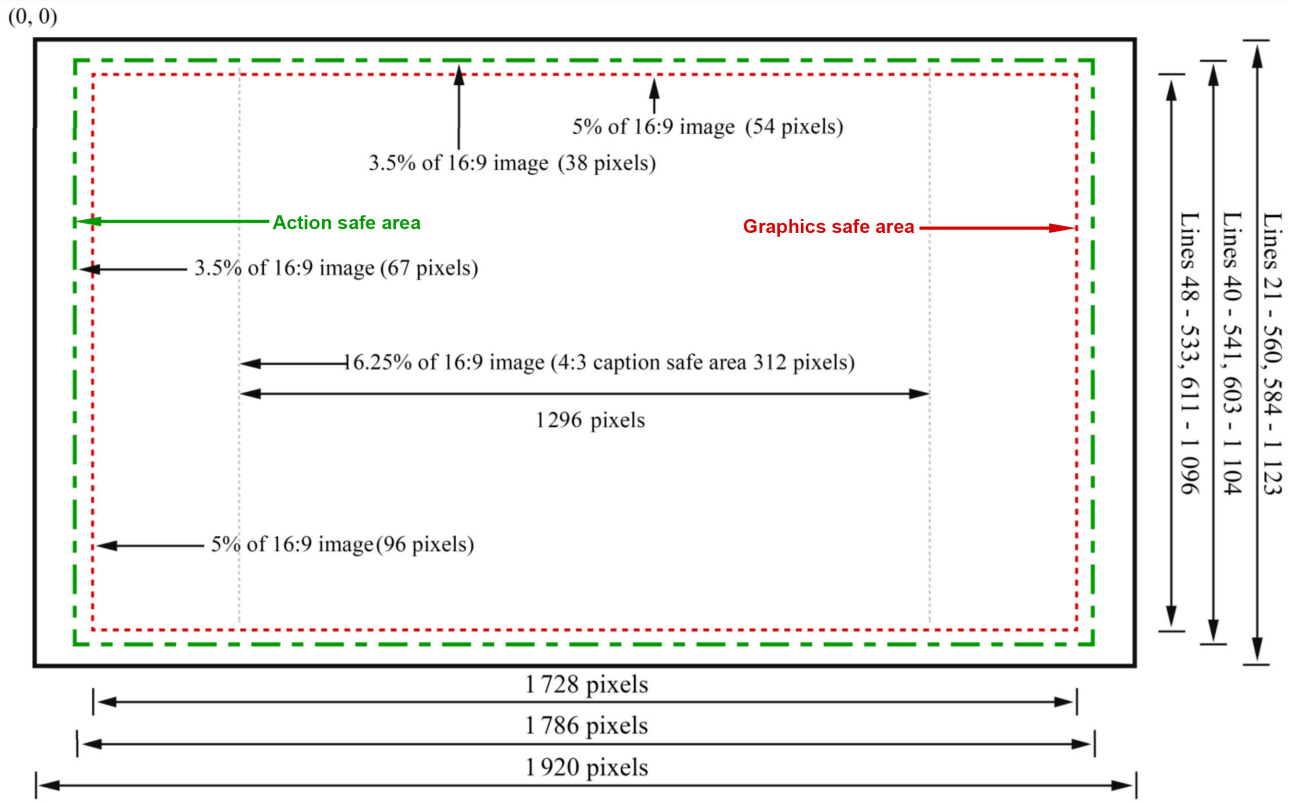
*“Two safe areas are needed; all essential action should be protected inside an **Action Safe Area**, and all graphics inside a **Graphics Safe Area**.*

The EBU recommends that all makers of 16:9 television programmes should frame pictures to ensure that:

- *all essential action takes place inside the Action Safe Area, and*
- *all graphics are framed in the Graphics Safe Area, and*
- *the centre of the image retains its position throughout all production processes unless there are creative reasons to deliberately do otherwise.”*

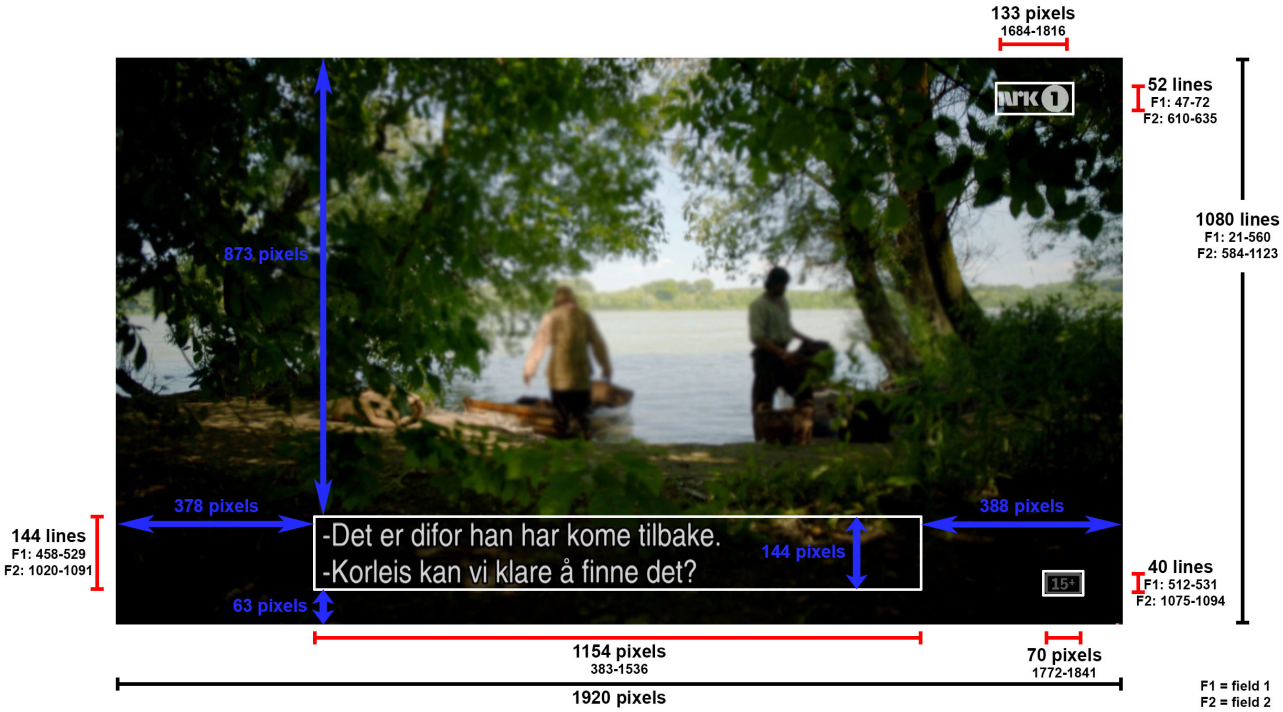
There are two primary caption safe areas defined for 16:9 material for NRK transmission:

2.10.1 Scanning raster 1080i/25 and 1080psf/25: 16:9 safe areas for 16:9 presentation



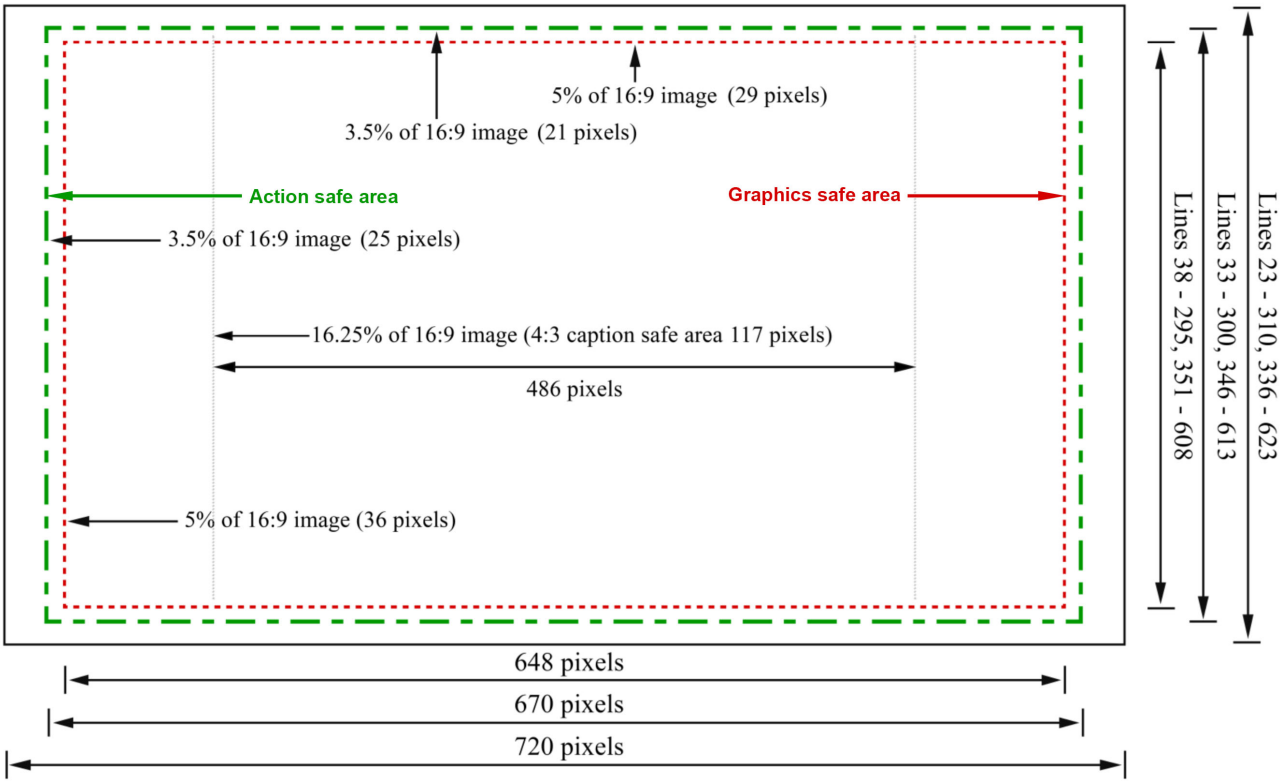
** Note: The total number of lines is 1125 (active lines from 21 to 560 and 584 to 1123 inclusive = 1080 lines).*
*** Note: The complete digital line comprises 2200 pixels. Of these, the “digital active line” comprises 1920 pixels (numbered from 0 - 1919 inclusive). All active pixels are included in the image active line.*

Below is an illustration showing where NRK puts the logo (upper right corner), captions/subtitles and content rating (lower right corner) in the image with a scanning raster of 1080i/25 and 1080psf/25 with an aspect ratio of 16:9. Additional graphics must not be placed in these areas.



To help working with graphics this document has attached a Photoshop template file called “Template for placement of graphics - 1920x1080.psd” which may be of help when placing graphics. It is shown below. The raster of this template file is 1920x1080 and it contains the NRK logo, captions/subtitles, content rating and a rectangle for the graphics safe area. All other areas of the image have full opacity.

2.10.2 Scanning raster 576i/25: 16:9 safe areas for 16:9 presentation



** Note: The total number of lines is 625 (active lines from 23 to 310 and 336 to 623 inclusive = 576 lines).*

*** Note: The complete digital line comprises 864 samples. Of these, the "digital active line" comprises 720 samples or pixels (numbered from 0 - 719 inclusive) of which the image active line comprises pixels 9 to 710 inclusive (see EBU R92 concerning peculiarities of the 576i/25 (625/50) scanning raster).*

2.11 Standards Conversion

When standards converted material is included in a programme, Motion Compensation (sometimes known as Motion Predictive or Motion Vector) standards conversion is required.

Currently speed change is the preferred method of changing between 24fps (including 23.976fps) and 25fps standards. Due attention must be given to the audio.

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

2.12 Single Sensor HD cameras (including DSLR)

The minimum sensor resolution (pixel count) for single sensor cameras is 2880 x 1620 (Bayer patterned). EBU R118 has details of the minimum criteria for single sensor cameras.

DSLR cameras are acceptable for time-lapse sequences and stop-frame animation but are currently **not** suitable for use as video cameras. Exceptions can be made for covert shoots or dangerous locations at the discretion of the broadcaster. The broadcaster must agree to the use of DSLR cameras in advance of any shooting.

2.13 UHD (4K) cameras

Use of UHD cameras should be checked with the broadcaster before use on HD programmes. The EBU Recommendation EBU R118 has details of UHD cameras and acceptable sensor resolutions.

As general guidance UHD cameras should use the whole sensor (not just part of the sensor) to produce HD images.

If the camera does have the option to use part of the sensor, the minimum pixel count should be 2880 x 1620 where Bayer filtering is used.

HD images should preferably be produced electronically by either scaling from the full UHD image or resizing where part of the UHD image is being used in HD.

Images from UHD cameras with 4k (4096 x 2160) sensors must be cropped to 3840 x 2160 (16:9) before scaling to HD.

The EBU divides UHD cameras into two Tiers

- **UHD-1 Tier 1:** have a sensor that can give full UHD resolution and have a pixel count of 3840 x 2160 in each of R and G and B or, a minimum pixel count of 5760 x 3240 where Bayer filtering is used.
- **UHD-1 Tier 2:** have a sensor resolution that is below full UHD resolution (but greater than HD) and have a minimum sensor resolution of 3840 x 2160 where Bayer filtering is used.

Both Tiers are acceptable for HD production but UHD-1 Tier 2 cameras should be checked with any co-producer requiring a higher resolution master.

3 Technical Requirements – Audio

This section of the delivery documents gives guidance for the mixing and delivery of programmes using the EBU Recommendation on Loudness Measurement EBU R128

All programmes must be mixed to comply with the EBU Recommendation EBU R128. Programmes which have been mixed to the old standard will only be accepted by prior agreement with NRK.

To avoid doubt during the QC process, file metadata or tape paperwork should note whether the programme has been mixed to EBU R128 or to the old standard.

The old standard for measuring programme audio levels used Quasi Peak Programme Meters (Nordic Scale, IEC 60268-10 Type 1) where -18 dBFS corresponds to 0 dBu. Typical peak levels on speech were +3 dBu, maximum programme peak level + 6 dBu.

For track layout and allocations, see the relevant format delivery requirements sections:

File: Section 4

Tape: Section 5.4

Live: Section 6.7.3

3.1 Terms, Requirements and Guidelines

3.1.1 Terms and Requirements

R128 introduces new terms for the measurements of audio. The terms used in this document, how they are measured and the delivery requirements are listed below.

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

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

NRK Delivery Requirements

Term	Description	Measurement	NRK Requirement
Programme Loudness	The loudness measured over the duration of the programme.	LUFS	**-23.0 LUFS** **Note:** A tolerance of **±1.0LU** is accepted for live delivery
Maximum True Peak	The maximum value of the audio signal waveform.	dBTP (True Peak)	-3dBTP recommended. Programmes are deemed to have failed QC if level exceeds **-1dBTP**
Loudness Range (for guidance only)	This describes the perceptual dynamic range measured over the duration of the programme	LU	Programmes should *aim* for an LRA of no more than **18LU**
Loudness Range of Dialogue	Dialogue must be acquired and mixed so that it is clear and easy to understand	LU	Speech content in factual programmes should aim for an LRA of no more than **6LU.** A minimum separation of **4LU** between dialogue and background is recommended

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

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

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

Note: Short-Form Content is defined as a programme of short duration, typically shorter than 30s (but up to approximately 2 minutes duration). In addition to advertisements (commercials) and promotional items, interstitials, stingers, bumpers and similar very short items belong to this category.

3.1.2 Guidelines for True Peak audio levels

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

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

3.2 Metering Requirements

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

3.3 Stereo Audio Requirements

Stereo tracks must carry sound in the A/B (Left/Right) form.

If mono originated sound is used, it must be recorded as dual mono, so that it may be handled exactly as stereo. It must meet all the stereo standards regarding levels, balance and phase

3.3.1 Stereo line-up tones

Each stereo audio pair must have either EBU stereo **or** GLITS line-up tone (not a mix of both). Tone must be 1kHz, sinusoidal, free of distortion and phase coherent between channels). Audio files of GLITS and EBU stereo tones may be downloaded from the DPP web site (see Appendix 4).
Digital Audio Reference level is defined as 18dB below the maximum coding value (-18dBFS).

3.3.2 Stereo phase

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

3.4 Surround Sound Requirements

Surround sound is transmitted in the 5.1 format, and should normally be delivered as discrete tracks, except by agreement with the broadcaster.

Programmes delivering surround sound must also carry a stereo mix meeting all requirements for stereo delivery. This should generally be an automated down-mix of the surround channels, using the same down-mix parameters as are held in the surround metadata.

In order for both the surround mix and stereo down-mix to comply with EBU R128 the down-mix should be normalised before layback (for file or tape delivered programmes).

Stereo and surround audio tracks must be synchronous.

3.4.1 Surround line-up tones

Each group of surround tracks must carry BLITS tone. Tones must be sinusoidal; free of distortion and phase coherent between channels. Stereo tracks derived by down-mixing from the 5.1 audio should carry a down-mix of the BLITS tones, using the same down-mix parameters as those specified in the accompanying metadata. Any other stereo tracks delivered with the programme must carry stereo tone as per section 3.3.1.

An audio file of BLITS tone may be downloaded from the DPP web site (see Appendix 4).

3.4.2 AES Sample timing

This section refers to timing requirements for AES audio pairs embedded in HD SDI signals. Very small timing differences between audio tracks in a surround programme will not be heard unless the stereo down-mix is monitored acoustically. An error of as little as one or two samples between the Left, Right and Centre channels can cause phasing and comb filtering for those listening in stereo.

Timing differences between audio tracks in each AES pair in an SDI group and between each group containing a single audio programme must be no more than 0.2 samples (i.e. the timing between each track of the six audio tracks of a surround signal.)

Note: This error has not been noticed on devices that treat audio as multi mono channel audio (e.g. NLEs).

3.4.3 Dolby Metadata Settings

NRK does not support the use of dynamic Dolby Metadata. Where Dolby Digital is used for distribution, the following static metadata will be used:

Downmix: Lo = L + (C -3dB) + (Ls -3dB)

Ro = R + (C -3dB) + (Rs -3dB)

DRC profile: None

3.5 Surround Sound Mixing Requirements

Depending on platform, stereo or 5.1 may not be transmitted. On platforms that discard the stereo signal, it is vital that the 5.1 signal will mix down to stereo properly. It is essential to check the automated down-mix using the NRK standard downmix parameters.

3.6 Sound to Vision Synchronisation

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

3.6.1 Audio / Video sync markers

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

- The sync plop must be between timecode 09:59:57:06 and 09:59:57:08
- The audio plop must be 1kHz tone on all tracks at -24dBFS (-18dBFS is acceptable for stereo programmes)
- The duration of the vision flash must be 2 frames to allow it to pass through standards conversion successfully
- The audio plop must be synchronous across all audio PCM audio tracks and with the video flash (within +/- 5 ms)

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

4 File Delivery Requirements

All programmes delivered as files must comply with all the relevant video and audio requirements above.

Note: NRK is for the time being not ready to accept files conforming to the AMWA Specification AS-11 v1.0 constrained to the UK DPP AS-11 shim. However, the aim for the future is to conform to this specification.

The current specifications for program delivery as files to NRK are listed below.

4.1 High Definition (1080i/25)

XAVC Intra Class100 100 Mb/s (1080i/25) video with 2, 4 or 8x 24 bits linear PCM (Wave) audio channels each in an individual AES3 audio stream, all in an MXF OP1a wrapper.

Note 1: Dolby E on two tracks cannot be accepted.
Note 2: If international sound is required the audio will have to be at least four track delivery.

Two track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right

Four track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	M&E or I-Sound Stereo Left
	4	M&E or I-Sound Stereo Right

Eight track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Main MCA Front Left
	4	Main MCA Front Right
3	5	Main MCA Centre
	6	Main MCA LFE
4	7	Main MCA Surround Left
	8	Main MCA Surround Right

Sixteen track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Main MCA Front Left
	4	Main MCA Front Right
3	5	Main MCA Centre
	6	Main MCA LFE
4	7	Main MCA Surround Left
	8	Main MCA Surround Right
5	9	M&E or I-Sound Stereo Left
	10	M&E or I-Sound Stereo Right
6	11	M&E or I-Sound MCA Front Left
	12	M&E or I-Sound MCA Front Right
7	13	M&E or I-Sound MCA Centre
	14	M&E or I-Sound MCA LFE
8	15	M&E or I-Sound MCA Surround Left
	16	M&E or I-Sound MCA Surround Right

MCA = Multi Channel Audio

4.2 Standard Definition (576i/25) (if an HD master doesn't exist)

MPEG IMX intra-frame 50Mb/s (MPEG-2 4:2:2P@ML) (576i/25) video with 2 or 4x 24 bits linear PCM (Wave) audio channels in a single AES3 audio stream, all in an MXF OP1a,eVTR wrapper.

Two track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right

Four track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	M&E or I-Sound Stereo Left
	4	M&E or I-Sound Stereo Right

The text below shows the AMWA Specification AS-11 v1.0 constrained to the UK DPP AS-11 shim which will be adopted in the future. This document will then be revised in order to comply with the AMWA AS-11 specification.

The files must conform to AMWA Specification AS-11 v1.0 constrained to the UK DPP AS-11 shim.

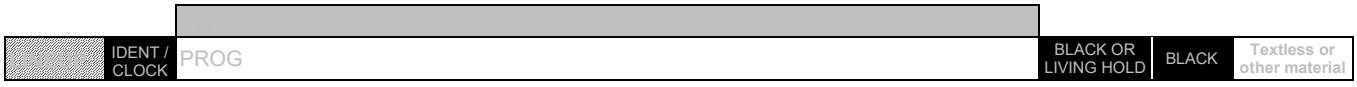
This document covers the requirements for transmission-ready files. There may be additional requirements for programmes intended for further editing, re-versioning or archiving.

The method of delivery to the broadcaster of programme files is to be agreed with the relevant broadcaster. Information on the options is available is available on the DPP website, http://www.digitalproductionpartnership.co.uk/

Each programme should be delivered as a single principal MXF file containing the audio and video. There must be only one programme in each file, although a programme may be either soft or hard-parted within that file, as specified by the broadcaster, according to the diagrams below. Only when agreed in advance with the relevant broadcaster, programmes in several parts may be delivered in more than one file, as shown in the third diagram below.

Single part or soft parted programme

A single part programme will always be played out from start point to end point without interruption. Soft parting is where a programme is provided as a single continuous programme, but the broadcaster may break the transmission of the programme at several points to insert commercials or for other reasons. IN and OUT points for continuous playback only must be included with the delivery metadata; suggested timecodes for breaks should not be included.



Hard - parted programme

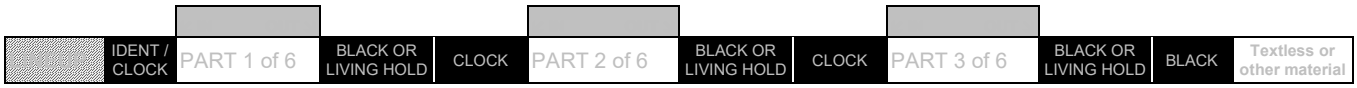
A hard-parted programme is billed and scheduled for transmission as a single entity, but is delivered as a

single file containing clearly separated parts between which adverts, trails etc. will be inserted.

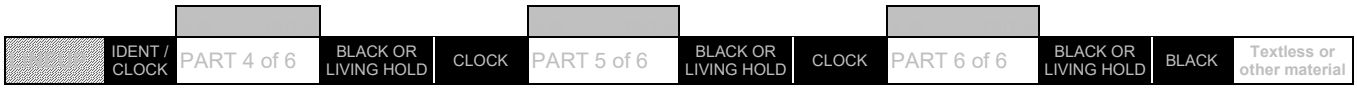
Multi - part programme delivered on multiple files

Where a programme's delivery must be split over more than one file, e.g. due to editing up to transmission.

FILE 1



FILE 2



For programme layout requirements with respect to timecode, see table in Section 4.5.

4.3 File format

Each high definition programme must be delivered as a single MXF OP1a file which conforms to the AMWA specification AS-11 v1.1. The AS-11 file must use the 'UK DPP shim specifications' that describe exactly how the file must be constructed to meet DPP requirements.

The AS-11 file must contain the metadata described in section 4.11 below

Note: AS-11 is an Application Specification published by the Advanced Media Workflow Association (www.amwa.tv) and applies to MXF OP1a files that are intended for delivery of finished programming. MXF provides an extensive 'toolkit' and this specification describes how it must be used to ensure that finished programmes are interoperable when exchanged between production companies, post houses, broadcasters and other organisations in the programme delivery workflow.

Although AS-11 restricts how the MXF file is constructed it does permit some variation to suit location or other specific requirements (differing frame rates between Europe and the USA, for example). The specification therefore includes the concept of a 'shim' that further refines (or constrains) the possible options to a single, carefully controlled set that meets an individual requirement. DPP has defined HD and SD AS-11 shims for HD file delivery in the UK.

The AS-11 specifications are provided here http://www.amwa.tv/projects/AS-11.shtml. Consult your systems suppliers to ensure they can provide AS-11 compliant files.

4.4 Video codec

As described by the AS-11 specification (and the UK DPP HD shim), the video essence in the file must be encoded at a nominal bitrate of 100Mbit/s using the 'AVC Intra' codec. It must use the High 4:2:2 Intra profile@level 4.1. AS-11 gives full technical details of how the file should be constructed.

4.5 Image format

HD video must be recorded with an active picture area of 1920 x 1080 pixels.

This must normally be structured as interlaced at 50 fields per second, described as System 2 in EBU-TECH 3299. Material may be originated as progressive scan, but should be delivered as interlaced. Also note the requirement in 2.1.2 above that moving graphics and effects, such as credit rollers, DVE moves etc, are always interlaced.

In some cases, only where specifically required by the broadcaster, material which has been originated entirely progressively, described as System 3 in EBU-TECH 3299, must be delivered as a progressive structured file.

4.6 Audio

The audio must be frame interleaved with the video as described by AS-11. All audio tracks must be encoded as PCM with a sample rate of 48kHz at a depth of 24bits/sample.

4.6.1 Track allocations

HD files must contain a group of either 4 or 16 tracks, with track allocations as on the table below. The EBU R48 or R123 code must be included in the metadata (see 4.11 below) to identify the track allocations.

		Audio track numbers															
EBU Reference code	Prog Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
R48: 2a	Stereo	St. Final Mix L	St. Final Mix R	Silence	Silence												
R123:4b	Stereo with M&E	St. Final Mix L	St. Final Mix R	St. M&E L	St. M&E R												
R123:4c	Stereo with Audio Description	St. Final Mix L	St. Final Mix R	St. Aud Desc L	St. Aud Desc R												
R123:16c Option 1	Stereo, 5.1 and M&E	St. Final Mix L	St. Final Mix R	St. M&E L	St. M&E R	5.1 Final Mix L	5.1 Final Mix R	5.1 Final Mix C	5.1 Final Mix LFE	5.1 Final Mix Ls	5.1 Final Mix Rs	5.1 M&E L	5.1 M&E R	5.1 M&E C	5.1 M&E LFE	5.1 M&E Ls	5.1 M&E Rs
R123:16c Option 2	Stereo, 5.1 and Audio Description	St. L Mix	St. R Mix	St. Aud Desc L	St. Aud Desc R	5.1 Final Mix L	5.1 Final Mix R	5.1 Final Mix C	5.1 Final Mix LFE	5.1 Final Mix Ls	5.1 Final Mix Rs	5.1 M&E L	5.1 M&E R	5.1 M&E C	5.1 M&E LFE	5.1 M&E Ls	5.1 M&E Rs
R123:16d	5.1 Two languages	5.1 Lang 1 L	5.1 Lang 1 R	5.1 Lang 1 C	5.1 Lang 1 LFE	5.1 Lang 1 Ls	5.1 Lang 1 Rs	Other	Other	5.1 Lang 2 L	5.1 Lang 2 R	5.1 Lang 2 C	5.1 Lang 2 LFE	5.1 Lang 2 Ls	5.1 Lang 2 Rs	Other	Other
R123:16f	Three Languages	St. Lang 1 L	St. Lang 1 R	Not Used	Not Used	St. Lang 2 L	St. Lang 2 R	Not Used	Not Used	St. Lang 3 L	St. Lang 3 R	Not Used	Not Used	Other	Other	Other	Other

Note:

- R123:16c is the normal layout.
- R48:2a, R48:4b, R123:4b, R123:4c, R123:16c must only be used for programmes with single language soundtracks
- R123:16d must only be used for programmes with dual language soundtracks
- R123:16f must only be used for programmes with 3 different language soundtracks

Any unused audio tracks in the 16 track groups above must contain digital silence and encoded as PCM audio.

For compatibility with stereo systems, any audio generated as mono must be presented on two phase-coherent tracks, and flagged as stereo.

Any additional audio tracks required by the broadcaster must be delivered separately as ‘B-WAV’ files. (See 4.9 below)

The naming conventions used in all related documentation and metadata (see 4.11 below) must match those specified above.

4.7 Programme Layout / Format

All programmes delivered on file must be laid out with elements in the following pattern relative to timecode:

Time-code	Duration	Picture	Sound
09.59.30.00	20”	100% Bars (100/0/100/0)	Lineup tone
09.59.50.00	between 7” 00fr and 7” 05fr *Note	Ident Clock or Slate	Silence
09.59.57.06 (optional)	*2fr*	*2 Frames peak white*	*1 Frame tone (on first video white frame)*
09.59.57.06	2” 19fr	Black	Silence
10.00.00.00	***Note*	Programme	Programme
end of part (multipart programmes)	5”	freeze or ‘living hold’ after end of part	fade or cut to silence by end of part
end of part + 5” (multipart programmes)	minimum 1”	Black	Silence
next whole minute minus 10” (optional for multipart progs)	*7”*	*Ident Clock or Slate – next part*	*Silence*
Start of part minus 3” (multipart programmes)	3”	Black	Silence
end of prog	5”	freeze or ‘living hold’	fade or cut to silence by end of prog
end of prog + 10” (optional)	*2fr*	*2 Frames peak white*	*1 Frame tone (on first video white frame)*

**Note: For legacy delivery the 90 second line-up and 30 second Ident Clock or Slate can be used*

***Note: For programmes delivered on multiple files, 2nd and subsequent files should have programme part starting at the next ‘whole hour’ T/C with lineup and ident laid out as above with appropriate offset.*

4.7.1 Start and end

Note that it is usual for sound and vision to be automatically cut to air on transmission, so early vision or sound is not normally required. Vision may fade up from black starting at 10.00.00.00 if desired.

All programmes must end with a fade or cut to silence **before** the intended end point. Any fade out or reverb must be allowed for within the programme duration.

Vision freeze or ‘living hold’ must be held for a further 5” after the end point.

Any other programme elements after the end of the programme should not start less than 1min after end of programme.

4.7.2 The Ident Clock or Slate

A countdown clock or slate clearly displaying the following information must precede the start of programme. A clock or slate is optional for subsequent parts of a multi-part programme:

- Programme I.D. number
- Programme title (and series number if applicable)
- Episode number (if applicable)
- Episode subtitle (if applicable)
- Version (Pre/post watershed etc if necessary)
- Part number (if applicable)

No technical information may be included. The clock or slate may display telephone contact numbers for the post-production facility and production company, and may display company branding.

Where a moving clock is used, it must provide a clear countdown of at least 7 seconds, including a hand moving in 1 sec steps (i.e. **not** smooth motion) around a circular clock face. Clocks with only digital countdown are not acceptable.

There must be no audio tone or ident over the clock.

4.8 Closed captions (Subtitles)

Closed captions or subtitles must be delivered as a separate file as required by each broadcaster. The separate file must be named identically to the principal MXF file, apart from the filename extension.

4.9 Timecode

Timecode must be as specified in the AMWA AS-11 specification (para 6.3.6). To ensure compatibility with downstream systems it is very important that timecode is inserted in the file exactly as specified.

4.10 Audio only files

Additional audio only files related to a programme, such as Audio Description files, must be supplied as BWF (sometimes called 'B-WAV') files, conforming to the specification in EBU-Tech 3285. File duration and timecode must exactly match the principal MXF file.

4.11 SD Files (Legacy programmes only)

Delivery of standard definition legacy programme files must be by agreement with the broadcaster. Those files must meet the following requirements:

4.11.1 File format

Each standard definition programme must be delivered as a single MXF OP1a file which conforms to the AS-11 specification v1.1 published by AMWA. The AS-11 file must use the 'UK DPP SD shim specification' that describes exactly how the file must be constructed to meet DPP requirements.

The AS-11 file must contain the metadata described in section 4.11 below

4.11.2 Video codec

As described by the AS-11 specification (and the UK DPP SD shim), the video essence in the file must be encoded at a nominal bitrate of 50Mbit/s using the SMPTE ST 0356:2001 D-10 stream specification. This is a constrained version of MPEG-2 4:2:2 P@ML. AS-11 gives full technical details of how the file should be constructed.

4.11.3 Image format

SD video files must be recorded with a picture area of 702 x 576 pixels, where the 702 pixel wide picture must be centred in the active 720 pixel wide line. The picture information may extend the full width of the 720 pixel wide line, providing the image shape is not distorted. In either case there must be an additional 32 lines corresponding to a Vertical Blanking Interval (VBI) making a total of 720 x 608. The VBI must not contain any data or image.

4.11.4 Audio essence

The audio must be frame interleaved with the video as described by AS-11. All audio tracks must be encoded as PCM in an AES stream with a sample rate of 48kHz at a depth of 24bits/sample.

4.12 Metadata

Metadata is the name for all the information which is not the audio or video essence, but which is required to ensure that contents of the file can be identified correctly, and can be played back or converted in various systems. The metadata required is specified below, and must be delivered wrapped within the file.

Metadata can usefully be divided into two categories:

Structural

Describes the technical format of the file itself, the audio and video essences, and the other metadata included with the file. Structural metadata is usually added automatically by systems which construct the file, and are relied on by systems which decode the file. It will include information about the compression codecs used and which audio tracks are present.

Descriptive

Descriptive metadata is usually added manually by the producer of the file. This includes information which will be read by the users of the file in order to identify the material and use the appropriate parts for further operations. It will include the titles and ID numbers for the programme, and the allocations of the audio tracks present.

4.12.1 Filenames

Filenames for the MXF files must be supplied as specified by each broadcaster, and should contain the relevant programme identifier information. Filenames must be in upper case, with filename extensions in lowercase. Allowable characters are 'A-Z', '0-9', '-' & '_' .

The Broadcaster specific naming convention is shown on page 1.

4.12.2 Required information (paperwork)

Please provide the following:

- Script/dialogue list, preferably with time code, caption information and end credits
- High resolution stills / episodic stills (minimum 3 per episode), JPEG, minimum 1920 x 1080 pixels and preferably 3840 x 2160 pixels
- High resolution Key Art when available (minimum 4 stills)
- Synopsis and other available written publicity material
- Running order with episode titles (series)
- Music cue sheet (with composer, titles and running time)

4.12.3 UK DPP Metadata application

Where no other option exists, metadata should be generated by the programme supplier using the **UK DPP Metadata application**, which is available for download from the DPP website (http://www.digitalproductionpartnership.co.uk/what-we-do/metadata-application-2/). This is an application which will allow entry and insertion of the metadata into the MXF programme file.

These must be done after all post-production is complete and the programme is ready for delivery to the broadcaster, as any changes to the file are likely to invalidate the metadata and cause the file to be rejected.

4.12.4 Delivery Requirements in MXF

Metadata within the principal MXF file must be as described by the AMWA AS-11 specification with DPP shims, and must correctly reflect the material contained in the file.

Descriptive metadata must be included in the relevant metadata tracks within the file.

4.12.5 Required Metadata

The table below gives an overview of the metadata required. It must be used in conjunction with the DPP Metadata spreadsheet v10, which is available here:
http://www.digitalproductionpartnership.co.uk/download/minimum-metadata-set/

The mandatory column indicates which fields must be entered before delivery of the file. The entries highlighted as ■ and bold in the Mandatory column should be entered by a production or technical representative. The remaining mandatory fields which are not highlighted will be derived by the DPP Metadata application from the MXF file structure.

Note that there is a character limit of 127 characters for free text fields.

Field Name	Definition and usage	Mandatory	Allowable values in bold *Examples in italics*
Editorial			
Series Title	The final title of a grouping of publishable assets with shared identification and branding linked by common characters, subject matter, style or story. • This could be a series, serial or themed grouping. • May include a series or season number, or a year. • One off programme titles must also be entered in this field		*Mad Dogs - Season 4 (2011)*
Programme Title	The final title of a Programme Version for a specific purpose. • One off programmes must repeat the title used as the Series Title. • May change between commission and delivery.		*Mad Dogs - UK TX*
Episode Title / Episode No	The final episode title used to identify an individual episode or an editorially distinct version, and / or a number representing its transmission order within the series.		*Basset Hounds*
Production Number	A unique number used to identify an individual Programme Version. • Also known as Clock Number, Programme number or Material ID. • The commissioning broadcaster will inform you of their required number.		*DRIB111P/01*
Synopsis	A brief descriptive summary of the content, in no more than 127 characters, suitable for EPG / billings purposes.		
Originator	Company responsible for creating the programme. • Programmes may also be delivered via a distributor - see below.		*Angst Productions*
Copyright Year	Year in which the production was completed.		**Year only, as yyyy**
Other Identifier	Usually a programme-specific code used by broadcasters for rights management or re-broadcast purposes, e.g. ISAN number, contract number, costing number or UMID.		
Other Identifier Type	Description of Other Identifier, e.g. ISAN number, costing number or contract number		
Genre	A genre categorising the whole asset.		*Comedy*
Distributor	The name of the person or company providing the content, if this is not the originator.		*Sony Pictures*

Field Name	Definition and usage	Mandatory	Allowable values in bold *Examples in italics*
Technical			
Shim name	The name of the AS-11 shim specification to which the associated MXF file conforms.	**Yes**	**UK DPP HD** **UK DPP SD**
Shim Version	The version of the shim used for the creation of the file	**Yes**	**1.1**
Video			
Video Bit Rate	Nominal video bit rate in megabits per second.	Yes	**100 (For HD)** **50 (For SD)**
Video Codec	Name of the video codec used for creation of the file.	Yes	**AVCI (For HD)** **AVC-Intra (For HD)** **D10 (For SD)** **IMX (For SD)**
Video Codec Parameters	The detailed codec profile and level information used to create the file.	Yes	**High 4:2:2 level 4.1(For HD)** **4:2:2 P@ML (For SD)**
Picture Format	This describes the picture structure, using pre-defined codes.	Yes	**1080i 50 16:9 (For HD)** **576i 16:9 (For SD)** **576i 4:3 (For SD)**
AFD	This will be used to determine the aspect ratio of the frame intended for display (including any safe action and caption areas).		**9** **10** **14**
Picture ratio	Used in addition to the AFD field to further determine the complete aspect ratio of the asset, e.g. where the image is letterboxed or pillarboxed.		**4:3** **14:9** **15:9** **16:9** **16.65:9** **21:9** **21.6:9**
3D	Whether the programme is made for 3D transmission.		**Yes / No**
3D type	This describes the type of 3D being delivered. A formal system of 3D type codes is being developed.		**Side by side** **Dual** **Left eye only** **Right eye only**
Product Placement	To be set if the content contains product placement.		**Yes / No**
PSE Pass	Status of any flashing and pattern analyser test carried out on the material for PSE.		**Yes** **No** **Not tested**
PSE Manufacturer	Product used to carry out the PSE analysis.		
PSE Version	Version of algorithm used to carry out the PSE analysis.		
Video Comments	The comments which illustrate the subjective quality and any known artefacts or defects (inc. intentional) within the video content discovered during production / post production / or any subsequent technical QC/Review process.		

Field Name	Definition and usage	Mandatory	Allowable values in bold *Examples in italics*
Audio			
Audio Sampling Frequency	The sampling frequency used in kHz (must be the same for all audio tracks).	Yes	**48**
Audio bit depth	No. of quantisation bits in the audio signal (must be the same for all audio tracks).	Yes	**24**
Audio Codec parameters	The audio codec employed for the creation of the file.	Yes	**PCM (For HD)** **AES3 (For SD)**
Audio Track Layout	Code in accordance with EBU R123 and R48 - See section 4.4.1 • The assumption is to always have 16 tracks (4 for SD) and align with tape spec definitions. • Digital silence must be encoded on tracks not used for audio		**R 48: 2a (4 ch. Only)** **R 123: 4b (4 ch. Only)** **R 123: 4c (4 ch. Only)** **R 123: 16c (16 ch. Only)** **R 123: 16d (16 ch. Only)** **R 123: 16f (16 ch. Only)**
Primary Audio Language	Main language used on primary audio tracks • Use ISO 639.2 values - three letter codes		*zxx* (none), *eng, ita, wel, etc.*
Secondary Audio Language	Main language used on secondary audio tracks • Use ISO 639.2 values - three letter codes		*zxx* (none), *eng, ita, wel, etc.*
Tertiary Audio Language	Main language used on tertiary audio tracks • Use ISO 639.2 values - three letter codes		*zxx* (none), *eng, ita, wel, etc.*
Compliant Audio Standard	Details of any compliant audio standard used to set the loudness level of the stereo audio tracks during programme production.		**EBU R128** **None**
Audio Comments	QC comments to illustrate subjective quality and any known artifacts or defects		
Timecodes			
Line-up start	Timecode for start of line-up test signals.		**09:58:00:00** **09:59:30:00**
Ident Clock Start	Timecode for start of the initial ident or countdown clock.		**09:59:30:00** *(if L/U start is 09:58:00:00)* **09:59:50:00** *(if L/U start is 09:59:30:00)*
Repeating Group: Timecode			
Part Number	Identifier for the hard part no. (Not required for soft parted materials)		*1, 2, 3*
Part Total	The total number of parts in the programme. (May be over more than one file) (Not required for soft parted materials)		*1, 3, 6*
Part SOM	SMPTE timecode for first frame of the part number.		*10:00:00:00*
Part Duration	SMPTE timecode for the duration of the part number.		*00:08:22:00*
End of repeating group: Timecode			
Total Number of Parts	The total no. of 'hard' parts contained within the file. (May not be the total for the programme, if on more than one file)		*1,3*
Total Programme duration	Total of all part durations	Yes	*00:57:22:00*
Access Services			
Audio Description Present	Whether the programme contains an Audio Description soundtrack		**Yes / No**

Field Name	Definition and usage	Mandatory	Allowable values in bold *Examples in italics*
Audio Description Type	Type of Audio Description soundtrack		**Control data / Narration AD Mix**
Closed Captions Present	Whether the programme contains closed captions.		**Yes / No**
Closed Captions Type	Type of closed captions used		**Hard of Hearing / Translation**
Closed Captions Language	Language used in closed captions • Use ISO 639.2 values - three letter codes		*eng, ita, wel, etc.*
Open Captions Present	Whether open captions are present		**Yes / No**
Open Captions Type	Type of open captions		**Hard of Hearing/ Translation**
Open Captions Language	Language used in open captions • Use ISO 639.2 values - three letter codes		*eng, ita, wel etc.*
Signing Present	Whether sign language interpreter is in vision		**Yes / No / Signer only**
Sign Language	The language used by a sign language interpreter e.g. BSL (British Sign Language) / Makaton		**BSL (British Sign Language)/ BSL (Makaton)**

Field Name	Definition and usage	Mandatory	Allowable values in bold *Examples in italics*
Additional			
Completion Date	Date of completion of the edit before delivery of the programme		**yyyy-mm-dd**
Textless Elements Exist	Whether clean textless elements are present after the main programme		**Yes / No**
Programme Has Text	Used to identify if the main programme is free of any text.		**Yes / No**
Programme Text Language	Use ISO 639.2 values		*eng, ita, wel etc.*
Contact Information			
Contact Email	The contact details for the person in the company responsible for delivering the completed commission.		
Contact telephone no.	The contact telephone number for the person in the company responsible for delivering the completed commission.		

5 Tape Delivery Requirements

Note that programmes delivered on tape must comply with all the requirements of this document other than those for file or live delivery.

5.1 Videotape/disc recording

5.1.1 Tape format

HDCam SR is the only format acceptable for HD tape delivery. The recording must be fully compliant with the manufacturer's technical specification thereby ensuring format compatibility.

Digital Betacam is the **only** format accepted for SD tape delivery.

Tapes must be clean, new stock, in the manufacturer's case, protected by suitable packaging and clearly labelled. Note that flock filled padded envelopes are not suitable since a failure in the packaging can lead to contamination of the tape. All tapes must be supplied with the record lockout "on" and fully rewound. It is recommended to "double rewind" before shipping to ensure an even tape pack. Labels must be fixed to both the cassette case and cassette and must not obscure the spools or obstruct the flap mechanism.

Note 1: If there are both a 5.1 program mix and a 5.1 international mix (M&E), the 5.1 international mix (M&E) must be on a separate tape.

Note 2: Audio ch.3-8: 5.1 mix (if available), on individual tracks (highly preferred) or as Dolby E on two tracks.

5.1.2 Disc format

XDCAM HD422 @ 50Mb/s Professional Disc is the only format acceptable for HD disc delivery.

Note 1: Dolby E on two tracks cannot be accepted.

Note 2: If there are both a 5.1 program mix and a 5.1 international mix (M&E), the 5.1 international mix (M&E) must be in a separate file.

5.1.3 'i' and 'psf' Flags

All programmes must be delivered with flags set to ***'i'*** throughout the programme, even if the bulk of the programme has been originated progressively. This is because some equipment introduces processing to ***'psf'*** flagged material which degrades some material. Broadcasters may accept certain material with ***'psf'*** flags entirely at their discretion.

5.1.4 Time-code

LTC and ancillary timecode (referred to as VITC on HDCam SR VTRs) must be identical, contiguous and continuous throughout the recording.

It is recommended that assemble edits should not be used between the start of the clock and the end of the programme, as they may introduce LTC discontinuities.

5.2 Programme Layout / Format

All programmes delivered on tape must be laid out with elements in the following pattern relative to timecode:

Time-code	Duration	Picture	Sound
09.58.00.00	90"	100% colour bars (100/0/100/0)	Lineup tone
09.59.30.00	between 27" 00fr and 27" 05fr	Ident Clock	Silence
09.59.57.06 (optional)	*2fr*	*2 Frames peak white*	*1 Frame tone (on first video white frame)*
09.59.57.06	2" 19fr	Black	Silence
10.00.00.00		Programme	Programme

end of part (multipart programmes)	5”	freeze or ‘living hold’ after end of part	fade or cut to silence by end of part
end of part + 5” (multipart programmes)	15”	black	silence
end of prog	5”	freeze or ‘living hold’	fade or cut to silence
end of prog + 10” (optional)	*2fr*	*2 Frames peak white*	*1 Frame tone (on first video white frame)*

5.2.1 Start and end

Note that it is usual for sound and vision to be automatically cut to air on transmission, so early vision or sound is not normally required. Vision may fade up from black starting at 10.00.00.00 if desired.

All programmes must end with a fade or cut to silence **before** the intended end point. Any fade out or reverb must be allowed for within the programme duration.

Vision freeze or ‘living hold’ must be held for a further 5” after the end point.

Any other programme elements after the end of the programme should not start less than 1min after end of programme.

5.2.2 Programmes longer than a single tape

If a programme must be delivered on two or more tapes because it is longer than the capacity of a single HDCam SR tape, check with broadcaster which of the requirements below applies.

Either:

The second part must begin at the next whole hour timecode after the end of the first part - e.g. 12:00:00:00 or 13:00:00:00 with appropriate continuous timecode throughout the line-up and clock sequence above.

Or:

The second part must have timecode continuing from the first part with no overlap of programme material, with appropriate continuous timecode throughout the line-up and clock sequence above.

5.2.3 Compilation tapes

Where a broadcaster has agreed to accept short programmes on a compilation tape, there must be at least 15“ of black and silence between the end of one programme and the start of the clock for the following programme. (i.e. after the 10” hold)

Each programme must be recorded to begin at a ‘full minute’ - i.e. Timecode HH:MM:00:00

5.2.4 The Ident Clock

A countdown clock clearly displaying the following information must precede the start of programme and any subsequent part:

- Programme I.D. number
- Programme title (and series number if applicable)
- Episode number (if applicable)
- Episode subtitle (if applicable)
- Version (Pre/post watershed etc if necessary)
- Part number (if applicable)

No technical information may be included. This means HD format, tape format, aspect ratio, audio track allocations, safe area etc. Duration should not be included. The clock may display telephone contact numbers for the post-production facility and production company, and may display company branding.

The clock must provide a clear countdown of at least 20 seconds, including a hand moving in 1 sec steps (i.e. **not** smooth motion) around a circular clock face. Clocks with only digital countdown are not acceptable.

There must be no audio tone or ident over the clock.

5.3 Paperwork

Each tape must have the following information on its box and cassette labels and on a VTRR (videotape Recording Report) included in its box:

- Production company
- Contact person at the production company; Name, phone no and e-mail
- Contact person at the technical lab.; Name, phone no and e-mail
- Programme title (and series number if applicable)
- Episode number (if applicable)
- Episode subtitle (if applicable)
- Version (Pre/post watershed etc if necessary)

In addition, the VTRR must include further information as specified by the broadcaster, which will include:

- Log of tape contents by timecode
- Editor's technical comments
- Audio track allocation
- Confirmation of PSE test pass

5.3.1 Required information (paperwork)

Please provide the following:

- Script/dialogue list, preferably with time code, caption information and end credits
- High resolution stills / episodic stills (minimum 3 per episode), JPEG, minimum 1920 x 1080 pixels and preferably 3840 x 2160 pixels
- High resolution Key Art when available (minimum 4 stills)
- Synopsis and other available written publicity material
- Running order with episode titles (series)
- Music cue sheet (with composer, titles and running time)

5.4 Audio Track layout

Audio must be delivered with track layouts as specified by the broadcaster, and will generally be one of the options available in the following table.

Note: If international sound is required the audio will have to be at least four track delivery.

High Definition (1080i/25)
HDCAM SR

Two track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right

Four track delivery (dual stereo):

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	M&E or I-Sound Stereo Left
	4	M&E or I-Sound Stereo Right

Eight track delivery (highly preferred):

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Main Front Left
	4	Main Front Right
3	5	Main Centre
	6	Main LFE
4	7	Main Surround Left
	8	Main Surround Right

Four track delivery (stereo + 5.1) (5.1 on 2-track Dolby E is not recommended):

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Dolby E
	4	

XDCAM HD422 Professional Disc

Two track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right

Four track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	M&E or I-Sound Stereo Left
	4	M&E or I-Sound Stereo Right

Eight track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Main Front Left
	4	Main Front Right
3	5	Main Centre
	6	Main LFE
4	7	Main Surround Left
	8	Main Surround Right

Note: 5.1 coded as Dolby E is not acceptable.

Digital Betacam

Two track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right

Four track delivery (dual stereo):

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	M&E or I-Sound Stereo Left
	4	M&E or I-Sound Stereo Right

Four track delivery (stereo + 5.1) (5.1 on 2-track Dolby E is not recommended):

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Dolby E
	4	

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6 Live Delivery

6.1 Responsibilities of the Production

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

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

The technical contact for the programme is responsible for making sure;

- The programme meets the general overall Technical Standards outlined in Sections 2 and 3 of this document.
- The cue and communications circuits are adequate and fully operational.
- The video and audio signals are continuous and stable throughout the broadcast period.
- That resilience levels meet the broadcaster's requirements.
- That the signal leaving their site and incoming to the broadcaster can be passed through the playout and transmission chain without the need for further technical intervention unless previously agreed & using pre-booked facilities (excludes any synchronisation required at the broadcaster's point of delivery).
- That there is sufficient monitoring in place to confirm the signal quality from the location to the point of delivery.
- That any and all sources are stable and synchronous at all times.
- That pre-recorded inserts are the same aspect ratio, resolution and match the quality of the live material.
- Line-up signals are available at least 15 minutes prior to the programme start time although it is strongly recommended that contact on the day is made well in advance of line-up and all possible links are tested as soon as technically possible.

6.2 Definitions

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

These programmes will fall under the following sub-categories:

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

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

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

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

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

6.3 Link Specifications

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

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

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

In all instances, the delivered picture format shall be:

1920 pixels wide x 1080 pixels high

16:9 Aspect ratio

25 frames per second, delivered as 50 interlaced fields per second.*

*Programmes may use cameras and insert material using the 25 frame progressive option (1080p/25) delivered in psf mode - see section 2.1.3.

Any external reference source at a remote site should be locked to GPS.

The **types** of links used for any Live HD programmes shall fall into the following categories:

6.3.1 Uncompressed via Optical Fibre:

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

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

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

6.3.2 Compressed via Optical Fibre:

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

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

- **JPEG2000 - 140 Mbps.**
- **MPEG4, H.264, Long GOP 4:2:2 – 45 Mbps.**
- **MPEG2, Long GOP, 4:2:2 – 60 Mbps.**

NOTE: Today MPEG2 encoding for HD is not desirable. It is recommended to use JPEG2000 or H.264/AVC/MPEG4 part 10.

6.3.3 Compressed via Satellite Link:

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

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

- **27.5 Mbps MPEG4 H.264, Long GOP 4:2:2 or**
- **45 Mbps MPEG2, Long GOP 4:2:2**

NOTE: Today MPEG2 encoding for HD is not desirable. It is recommended to use H.264/AVC/MPEG4 part 10.

Codec requirements are listed in Appendix 1

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

Stereo audio should be carried as MPEG1 Layer II (stereo) at 384kbs. Multi-channel audio may need to be carried as Dolby E. (see Audio Track Layout 6.7.3 Audio Track Allocation)

6.3.4 Compressed via Microwave Point-to-Point Link:

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

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

- **45 Mbps MPEG4, H.264, Long GOP 4:2:2, or**
- **60 Mbps MPEG2, Long GOP 4:2:2**

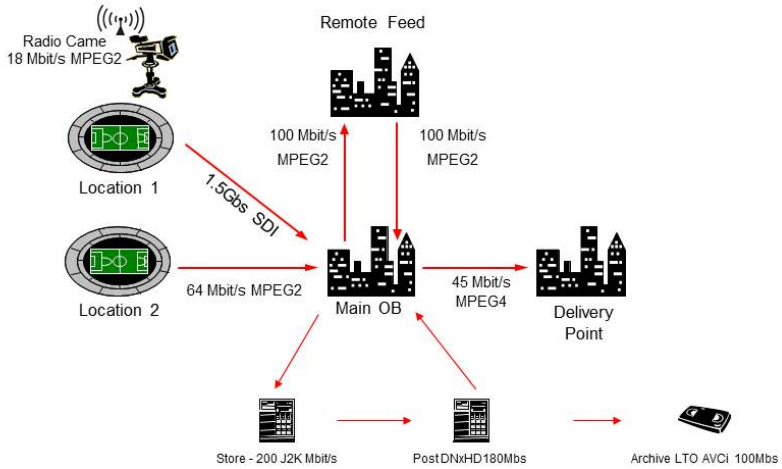
NOTE: Today MPEG2 encoding for HD is not desirable. It is recommended to use H.264/AVC/MPEG4 part 10.

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

Stereo audio should be carried as MPEG1 Layer II (stereo) at 384kbs. Multi-channel audio should be carried as phase aligned stereo channels, alternatively as Dolby-E (not preferred) (see Audio Track Layout 6.7.3 Audio Track Allocation)

6.4 Picture Quality & Bit Rates (concatenation issues)

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



Example of a codec map

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

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

To allow further processing (recording, editing etc.) especially if the signal is comprised of any additional

contribution links, the highest bit rate possible must be used.

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

Note: With the current encoding technology (MPEG2, MPEG4/H.264 and JPEG2000) use of lower bitrates than indicated in section 6.3 and longer GOPs than indicated in Appendix 1 may visibly impair picture quality.

6.5 Standards Conversion

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

6.6 Standard Definition

In some instances, some contributions may have to be delivered in Standard Definition by exception.

Where Compressed Standard Definition contribution is used, it should have a video bit rate of at least 25Mbs MPEG2 Long GOP. The GOP structure and encoder setup is the same as the HD requirements in Appendix 1.

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

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

6.7 Audio

6.7.1 Stereo Audio

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

6.7.2 Multi-channel Audio (when required);

Multichannel (surround sound) should normally be discrete PCM where there is sufficient bandwidth available in the link to the point of delivery.

Phase-aligned stereo or Dolby E should be used for multi-channel audio when bandwidth is limited or at the request of the broadcaster. Settings for Dolby E encoding are in Appendix 3

Use of the Low Frequency Effect Channel (LFE) channel is optional. Use of the LFE channel should comply with Recommendation ITU-R BS.775.

There should no sample timing differences between the individual channels of a surround signal.

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

6.7.3 Audio Track Allocation

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

Some possible audio track allocations are listed here:

Two track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right

Four track delivery (dual stereo):

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	M&E or I-Sound Stereo Left
	4	M&E or I-Sound Stereo Right

Four track delivery (stereo + coded 5.1) :

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Dolby E
	4	

Eight track delivery:

AES	Track	Content
1	1	Main Stereo Left
	2	Main Stereo Right
2	3	Main Front Left
	4	Main Front Right
3	5	Main Centre
	6	Main LFE
4	7	Main Surround Left
	8	Main Surround Right

6.7.4 AV Synchronisation

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

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

AV sync timing through the audio desk to the point of delivery should be ±5ms.

AV sync timing should also be within ±5ms from any remote sources into a studio or an OB including non-live inserts from tape or file.

Any external reference source at a remote site should be locked to GPS.

6.7.5 AV Synchronisation - Radio Link Cameras

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

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

6.8 TOD timecode

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

6.9 Cue and Communication

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

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

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

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

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

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

6.10 Photosensitive Epilepsy (PSE) and Live Programmes

Live programmes must meet the Ofcom PSE requirements (see section 2.9 of this document).

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

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

6.11 Ancillary Data (VANC)

Where required the following lines must be used for ancillary data

Line	Data	Comments
9	SMPTE ST 2020	Main use: Surround sound metadata
11	SMPTE ST2016	Main use: AFD
12	OP47	Subtitles if required

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

6.12 UPS & Generator Provision

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

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Appendix 1 –
Encoders used for Live Delivery –
Additional Requirements

MPEG 2 Encoders – additional requirements

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

MPEG 4 Encoders – additional requirements

MPEG4 encoder testing is still on-going but the following is recommended:

- 10-bit video is preferred. There is no bitrate penalty.
- GOP length should be a minimum of 15, in line with MPEG2
- Tests suggest MPEG4 encoders do not suffer from the poor quality B-frames. Currently B- and hierarchical B-frames are permitted.
- 4:2:2 colour subsampling is preferred but 4:2:0 may be acceptable whilst encoder technology is developing.

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Appendix 3 - Dolby E

Dolby DP571 (or equivalent Dolby E encoder)

- The first DP571 in the chain must be set to "internal" metadata source.
- Metadata from an external source cannot be edited in a DP571 - you have to set the metadata source to internal and rebuild it from scratch if this is required.
- Dolby equipment generally uses 75Ω-unbalanced connections - if the loop-through connectors on a DP571 are not feeding another device they should be terminated.
- The most important DP571 setup parameters to check are:
  - Program Config (should be 5.1 + 2 for most things).
  - The Frame Rate (The factory default is 29.97fps, should be 25fps).
  - The Bit Depth (should be 20 bits)
  - The Dolby E Metadata Source (internal or external)
  - Dolby D metadata is enabled (note – if this setting appears in the DP571 menu the unit is running out of date firmware and *MUST* be updated.
- The “Bit Depth” setting does not refer to the number of bits used by the audio signals but the number of bits available in the AES-3 channel used to transmit the Dolby E signal. Six channels of audio can be transmitted down a 16bit link while 8 channels must be transmitted down a 20bit link.
- The gain of a Dolby E stream must not be changed - it will break.
- A Dolby E stream suffers one frame of delay on each encode and decode. The UK Broadcaster standard is to align the stream to be “sync encoded” at each point in the chain.
- For tape delivery the stream must be laid so that the encoded audio is in sync with the video and any stereo audio. The Audio Advance function will be used to move the stream 1 frame ahead of the video before decoding. As Audio Advance applies to all audio tracks, the stereo audio will be delayed by 1 frame to compensate.
- For live or as live programmes the stream must be timed so that the encoded audio is in sync with the video and any stereo audio. It is the responsibility of the area receiving the stream to compensate for the decoding delay.
- The DP571 has a “reversion mode” which tells the unit what Dolby E and Dolby Digital metadata parameters to use in the event of a metadata failure. This should be set to “last used”. This setting guards against temporary metadata failure – if failures occur the Dolby Digital encoding should not be affected.
- In the “Metadata Params” menu there are eight programs where metadata can be changed. The number of active programs depends on the “Program Config” setting. If Program Config is set to the default 5.1+2 value then Program 1 will contain the metadata for the 5.1 stream. Program 2 will set the metadata for the additional stereo pair. If the Program Config is set to 8X1 then Program 1 will set the metadata for channel 1, Program 2 for channel 2, Program 3 for channel 3 etc. It is worth noting that all eight programs remain viewable even if the selected channel configuration does not make use of them.

Troubleshooting

The DP571 gives some indication of error conditions the following table explains the meaning of the front panel error indication lights.

Light	Indication	
TC	Green: Yellow: Off:	Valid timecode signal Frame rate does not match video reference No TC signal detected
Fault	Red: Off:	Hardware-related fault condition No fault condition
Remote	Not used	
PCM Dly	Green: Yellow: Off:	Valid PCM signal non 48kHz signal no PCM signal
Error	Red: Off:	Input not valid for current settings No error condition
V Ref	Green: Yellow: Flashing Red:	Lock with a valid analogue composite video signal Video ref doesn’t match the selected frame rate in the DP571 The internal clock is not locked to the incoming reference

Factory Reset

The Dolby E encoder model DP571 can be reset to factory defaults by power cycling the unit while holding down the ENTER key until “FACTORY DEFAULTS” appears on the LCD. Press the SETUP key when prompted to confirm.

A soft reset can be performed by pressing the SHIFT, → and ESC keys simultaneously. The unit’s settings will not be affected by a soft reset.

It is recommended a full reset is carried out when a unit is first used before entering the settings below

Notes:

- The three key parameters changed during a factory reset are DIALNORM (reverts to -27), Dolby Srnd EX parameter and the Srnd 3dB Attn.
- Lo/Ro stands for Left only / Right Only. This down-mix is the best suited for reproduction from stereo speakers or headphones. It is created by mixing the Ls and Rs channels into the front L and R channels. The Centre is split between the L and R channels. The levels at which the other channels are mixed in are set by the metadata. LFE is ignored. The Lo/Ro mix preserves left/right separation and allows a mono compatible down-mix.
- **Lt/Rt stands for Left total/Right Total. Ls, Rs and Centre are folded down into the left / right pair using parameters set by the metadata. LFE is ignored. In an Lt/Rt mix the surrounds are summed and added to the left channel; they are also added to the right channel with a 180^{o} phase shift, which allows a Pro Logic decoder to reconstruct the surrounds. This is a stereo compatible Dolby down-mix and is not the ideal down-mix for stereo reproduction.

Dolby Metadata Settings

Settings in **BOLD** are required

Parameter	Recommendations	
DOLBY E STREAM	CONTINUOUS FROM START OF LINEUP TO END OF TRANSMISSION. EDITS IN INSERTED MATERIAL AND CONTRIBUTIONS FROM OTHER SOURCES MUST BE CAPABLE OF SUCCESSFUL DECODING ON DOLBY LICENSED AS WELL AS DOLBY BRANDED DECODERS	
PROGRAMME CONFIG	**5.1 or 5.1 + 2**	
FRAME RATE	**25**	
BIT DEPTH	**20**	
PROGRAMME DESCRIPTION	**LOCATION AND TYPE OF DEVICE ORIGINATING THE METADATA**	E.G. TVC STUDIO X, DP571 or DUBBING COMPANY THEATRE 2 Device X or OB COMPANY TRUCK 10 Device Y
REVERSION MODE	LAST USED (FOR LIVE PROGRAMMES)	
METADATA SOURCE 1ST UNIT IN CHAIN	INTERNAL (FOR LIVE PROGRAMMES)	
METADATA SOURCE OTHER UNITS	EXTERNAL (FOR LIVE PROGRAMMES)	
DOLBY D METADATA	**ENABLED**	IF THIS PARAMETER IS PRESENT THE UNIT'S FIRMWARE *MUST* BE UPDATED
DIALOGUE LEVEL (DIALNORM)	**-23dB**	
CHANNEL MODE	**3/2**	INDICATES WHICH CHANNELS ARE IN USE
LFE CHANNEL	**ON or ENABLED**	ENABLES OR DISABLES THE LFE CHANNEL
BIT-STREAM MODE	COMPLETE MAIN (CM)	DESCRIBES THE AUDIO SERVICE CARRIED IN THE BIT STREAM – INFORMATION ONLY
LINE MODE COMPRESSION	**SEE CHAPTER 3.4.3**	DESIGNATES PRESET COMPRESSION CONFIGURATION FOR LINE MODE DECODING. MOST HIGH END DECODERS ALLOW THE COMPRESSION TO BE DEFEATED.
RF MODE COMPRESSION	**SEE CHAPTER 3.4.3**	DESIGNATES PRESET COMPRESSION CONFIGURATION FOR RF MODE DECODING, CANNOT BE DEFEATED.
RF OVER MODULATION PROTECTION	DISABLED	PROTECTS AGAINST OVER MODULATION BY ADDING PRE-EMPHASIS WHEN A DOLBY DIGITAL STREAM IS RF MODULATED.
CENTRE DOWN-MIX LEVEL	**SEE CHAPTER 3.4.3**	THE LEVEL OF THE CENTRE CHANNEL IN THE L AND R IF THE LISTENER HAS NO CENTRE SPEAKER.
SURROUND DOWN-MIX LEVEL	**SEE CHAPTER 3.4.3**	THE LEVEL OF THE SURROUNDS IN THE L AND R IF THE LISTENER HAS NO REAR SPEAKERS. IF THE SURROUND CONTENT IS VERY IMPORTANT USE A HIGHER LEVEL. THE SURROUND CONTENT MAY INTERFERE WITH THE MAIN MIX
DOLBY SURROUND MODE	**LO/RO**	INDICATES WHETHER A TWO CHANNEL ENCODED BIT STREAM CONTAINS A DOLBY SURROUND LT/RT PROGRAM AND REQUIRES PRO LOGIC DECODING
AUDIO PRODUCTION INFORMATION	NO	INDICATES WHETHER THE MIXING LEVEL AND ROOM TYPE PARAMETERS ARE SET – NOT REQUIRED.
MIX LEVEL	80DB	INDICATES THE APPROX MIXING LEVEL IN THE CONTROL ROOM – INFORMATION ONLY.
ROOM TYPE	SMALL	INDICATES THE CONTROL ROOM TYPE – INFORMATION ONLY.
COPYRIGHT BIT	YES	INDICATES THE MATERIAL IS COPYRIGHT PROTECTED – INFORMATION ONLY, NOT COPY PROTECTION
ORIGINAL BIT-STREAM	ON	INDICATES WHETHER THE ENCODED DOLBY DIGITAL STREAM IS THE MASTER – INFORMATION ONLY
PREFERRED STEREO DOWN-MIX	**LO/RO**	DESIGNATES PREFERENCE FOR LT/RT (PRO LOGIC – STEREO COMPATIBLE) OR LO/RO (STEREO) DOWN-MIX
LT/RT CENTRE DOWN-MIX LEVEL	**SAME AS CENTRE DOWN-MIX LEVEL**	LEVEL OF CENTRE CHANNEL IN LT/RT DOWN-MIX
LT/RT SURROUND DOWN-MIX LEVEL	**SAME AS SURROUND DOWN-MIX LEVEL**	LEVEL OF SURROUNDS IN LT/RT DOWN-MIX
LO/RO CENTRE DOWN-MIX LEVEL	**SAME AS CENTRE DOWN-MIX LEVEL**	LEVEL OF CENTRE CHANNEL IN LO/RO DOWN-MIX
LO/RO SURROUND DOWN-MIX LEVEL	**SAME AS SURROUND DOWN-MIX LEVEL**	LEVEL OF SURROUNDS IN LO/RO DOWN-MIX

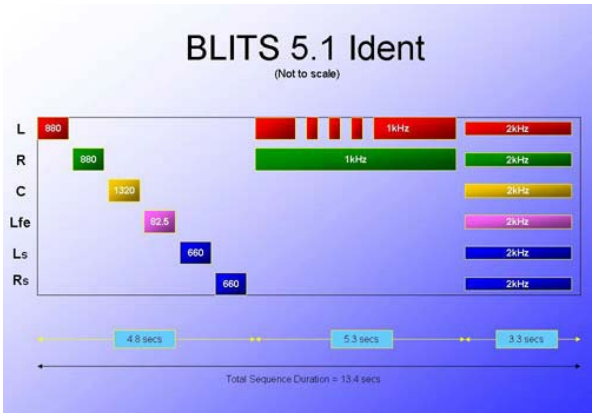
Parameter	Recommendations	
DOLBY SURROUND EX MODE	NOT SURROUND EX	IDENTIFIES THE STREAM AS BEING CODED FOR 6.1 DOLBY EX. N.B. THE DEFAULT IS NOT INDICATED WHICH **MUST BE CHANGED.**
A/D CONVERTER TYPE	STANDARD	INFORMATION ONLY
DC FILTER	ENABLED	APPLIES A 3HZ DC BLOCKING FILTER BEFORE ENCODING.
LOW PASS FILTER	ENABLED	PRE ENCODER ANTI-ALIASING FILTER.
LFE LOW PASS FILTER	ENABLED	APPLIES A 120 HZ 8^{TH} ORDER LOW PASS FILTER TO THE LFE CHANNEL BEFORE ENCODING
SURROUND 3 DB ATTENUATION	**DISABLED**	USED TO PRESERVE COMPATIBILITY WITH OLDER FILM FORMATS

Appendix 4 – Line-up tones

This section gives details of the line-up tones that may be used for File, Tape and Live programmes

1.1 BLITS – Surround Line-up

BLITS tone is defined in EBU Tech 3304 (http://tech.ebu.ch/docs/tech/tech3304.pdf)



The BLITS tone sequence has three sections;

The first is made up of short tones at -18dBFS, to identify each channel individually:

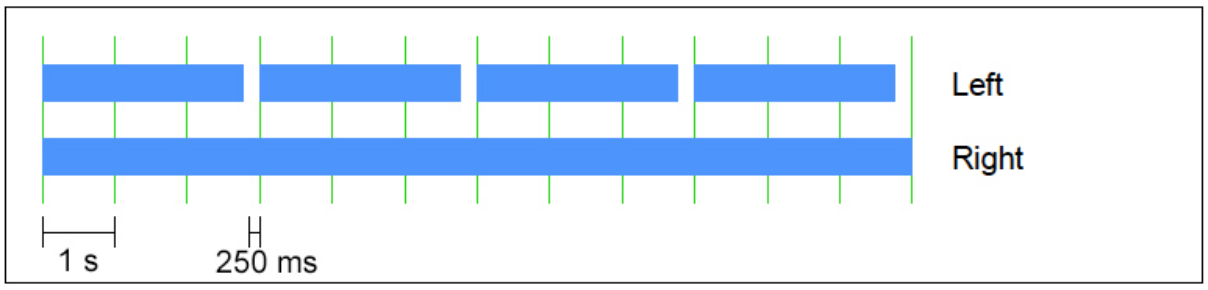
- L/R: Front LEFT and Front RIGHT - 880 Hz
- C: CENTRE - 1320 Hz
- LFE: (Low Frequency Effects) - 82.5 Hz
- Ls/Rs: Surround LEFT and Surround RIGHT - 660Hz.

The second section identifies front left and right channels (L/R) only. 1kHz tone at -18dBfs is interrupted four times on the left channel and is continuous on the right.

The last section consists of 2kHz tone at -24dBFS on all six channels. This can be used to check phase-reversal between any of the 5.1 legs. When the tone is summed to stereo using default - down-mix values this section should produce tones of approximately -18dBfs on the L & R channels.

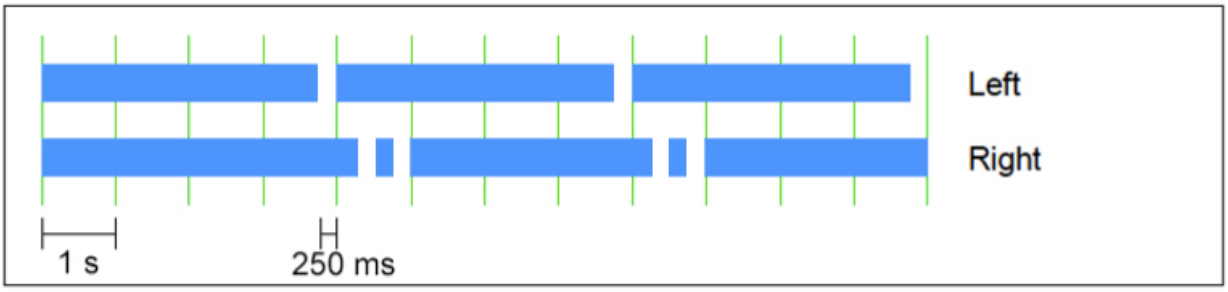
The BLITS sequence repeats approximately every 14 seconds.

1.2 EBU – Stereo Line-up



The EBU stereo tone sequence is a 1KHz tone at -18dBFS on Left and Right channels.
The Left channel is interrupted for 250ms every 3 seconds

It is acceptable to use 440Hz EBU tone to identify international audio channels in a multi-channel bundle



1.3 GLITS – Stereo Line-up

The GLITS stereo tone sequence is a 1KHz tone at -18dBFS on Left and Right channels. The Left channel is interrupted for 250ms every 4 seconds and the Right channel interrupted twice 250ms after the Left channel. Each Right channel interruption lasts 250ms and the separation is also 250ms.

It is acceptable to use 2KHz GLITS tone to identify international audio channels in a multi-channel bundle

1.4 Line-up tone downloads

BLITS can be downloaded here:

http://dpp-assets.s3.amazonaws.com/wp-content/uploads/specs/generic/Surround Programmes BLITS -18dBfs.wav

EBU can be downloaded here:

http://dpp-assets.s3.amazonaws.com/wp-content/uploads/specs/generic/Stereo Programmes 1kHz EBU Lineup.wav

GLITS can be downloaded here:

1kHz: http://dpp-assets.s3.amazonaws.com/wp-content/uploads/specs/generic/Stereo Programmes 1kHz GLITS Lineup.wav

2kHz: http://dpp-assets.s3.amazonaws.com/wp-content/uploads/specs/generic/Stereo Programmes 2kHz GLITS Lineup.wav

Appendix 5 - Version Control

UK DPP VERSION

VERSION	DATE	SECTION	REQUIRED / INFORMATION	UPDATE	OWNER
UK 4.0 - 2013	**08/10/13**	2.2	Required	100/0/100/0 Colour Bars only (EBU 75/0/75/0 option dropped)	K.BURROWS
		2.9.1	Information	Change of PSE device requirements	
		2.10	Information	Addition of 16:9 caption safe	
		2.12 (NEW)	Information	Advice on use and type of Single Sensor cameras	
		2.13 (NEW)	Information	Advice on use of UHD (4K) cameras	
		3 All sections	Required	Change to audio loudness measurement (EBU R-128)	
		4	Required	Dropped requirement for separate xml file	
		4.5	Required	New line-up durations for file delivered programmes and colour bars change (see 2.2)	
		4.11	Required	File Metadata table updated to match DPP Metadata spreadsheet v10	
		5.2.2	Required	Change for Timecode on progs longer than single tape	
		Appendix 2	Required	Audio Track Layout table updated	
		Appendix 3	Information	Dolby metadata settings	
		Appendix 4 (NEW)	Information	Line-up tones	
		Appendix 5 (NEW)	Information	Version Control	

NRK BROADCASTER VERSION

VERSION	DATE	SECTION	REQUIRED / INFORMATION	UPDATE	OWNER
NRK 4.0 - 2013	**03/12/2013**				NRK
NRK 4.0 - 2014	**21/01/2014**	4.12.2 and 5.3.1	Required	Small changes to required information (paperwork)	NRK