



HD: Summary of Delivery Formats

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DQ Content Authority	Technology Controller Vision (Wes Curtis)		
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Description	<p>All programmes delivered to BBC HD are required to deliver to the specifications in the BBC High Definition Technical Standards documents.</p> <p>This document is a summary of the key requirements for High Definition delivery. Its aim is to highlight the changes made to the Standard Definition Standards document "Television Delivery for London".</p>		
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DELIVERY FOR BBC HD

Interim Delivery Guide for the BBC High Definition Channel (1st October to 31st January 2009)

All programmes for transmission on the BBC HD channel are required to deliver to the specifications laid out in this document **and** in the standard definition document "Television Delivery for London".

It is essential that high definition programmes fully meet the BBC's standard definition delivery requirements as well as those in this document. Full details for caption and action safe areas, audio and video levels, line up signals, programmes leader and paperwork requirements etc. are available in the "Television Delivery for London" document available from <http://www.bbc.co.uk/guidelines/dq>

This document is a summary of the key requirements for high definition delivery. Its aim is to highlight the differences between the requirements for high definition delivery and the requirements for standard definition as defined in the "Television Delivery for London" document.

BBC Worldwide (or other co-producers) may also require high definition delivery. Although every effort has been made to keep the BBC Television and the BBC Worldwide standards the same, there may be some variations. It is possible to discuss any variations that may cause unacceptable editorial or technical compromise with the high definition commissioner or via the Delivering Quality Manager.

This document is the responsibility of the Delivering Quality Manager, tel. +44(0) 20 8008 1971 or e-mail dqm@bbc.co.uk.

For BBC Worldwide contact Programme Operations on +44(0) 20 8433 2754 or +44(0) 20 8433 2408.

High Definition technology, formats and equipment are still relatively new. It is expected that changes and updates will occur regularly. The BBC's use of proprietary compression formats such as HDCam tape or Dolby E audio encoding should not be considered to be an endorsement of these products or that the implied compression techniques will always be acceptable for programme mastering. Both HDCam and Dolby E should be used with care and multi-generation copying should be avoided.

Section 10 of this document covers the delivery of live or as live programmes from studios or outside broadcasts. Like the rest of the document it should be read in conjunction with the main standard definition document "Television Delivery for London".

1. Delivery Format

- 1.1.** Programmes commissioned from the 1st April 2008 and delivered on or after 1st November 2008 must be delivered on HDCamSR tape. All other programmes may deliver either on HDCam or HDCamSR.
- 1.2.** High definition programmes must be acquired, post produced and delivered in high definition. Programmes must contain a minimum of 75% native high definition material. Up to 25% of the programmes duration can come from standard definition sources. Standard definition sources are defined in section 2.1 below.
- 1.3.** High definition programmes should in general be clean of noise, well lit and sharp (unless artistic considerations require otherwise)

- 1.4. It is not always possible to control the light levels of events in the open or in locations where there is only natural lighting or lighting is controlled by others. Wherever possible little or no camera gain should be used.
- 1.5. In studio and outside broadcast where the lighting levels are fully under the control of the programmes lighting director, camera gain should be limited to a maximum of 3dBs
- 1.6. Particular care should be taken up-converting standard definition material to include in high definition programmes. Only high quality up-conversion equipment should be used. Use of "in VTR" up converters or up conversion using non-linear editing software is not acceptable. This requirement protects the standard definition viewer who will see the standard definition material after multiple conversions.
- 1.7. When stereo sequences are included in surround programmes, it is acceptable to "up-mix" the audio. Any audio treated this way must down-mix without any noticeable degradation and must be fully stereo and mono compatible. It is not permissible to up-mix entire programmes

2. Standard Definition and 35mm Film

2.1. Standard definition

The following formats are considered to be standard definition:

- All standard definition video formats
- HDV from all manufactures
- Cameras with image sensors under 1/2"
- Frame based (intra-frame) recording formats below 100Mbps
- Inter-frame based recording formats below 50Mbps
- Super16 film whether transferred to tape in high definition or not
- 35mm film transferred to or copied from standard definition tape formats
- Non linear editing codecs with bit rates below 160Mbps
- Live contributions links of less than 60Mbps (MPEG2)
- 720 line equipment with the exception of the Panasonic Varicam AJ-HDC27 range and the Panasonic AJ-HDX900 range*

*Other 720 line equipment may be acceptable but must be discussed prior to use

2.2. 35mm Film for high definition acquisition

The following 35mm film types and stock are acceptable for high definition acquisition providing the original negative is clean and transferred directly to a high definition video format;

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

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

35mm film negative can be transferred to any high definition video format but it is advisable to use formats that have low compression.

3. Video Standards

- 3.1.** The BBC will accept high definition programmes acquired using either of the following:
- 1920 x 1080 interlace at 25 frames a second (now called 1080i25) or
 - 1920 x 1080 progressive at 25 frames a second (now called 1080p25)
- 3.2.** Cameras that pre-filter to 1440 x 1080 are currently acceptable but this document does *not* guarantee this format will always be acceptable for new high definition commissions.
- 3.3.** This document cannot be used as a guarantee that any camera using the 720 line high definition format will always be acceptable for acquisition of high definition programmes. It should be noted 720 line cameras will not be accepted for new commissions after the acceptance of an equivalent 1080 line camera. Contact the DQ Manager for details.
- 3.4.** All delivered high definition master tapes must be 1080i25 (whether the programme was acquired using 1080p25 or 1080i25). Rollers, moving captions and DVE moves must be added in 1080i25 to prevent unacceptable judder.
- 3.5.** Most High Definition cameras can capture in both Interlace and Progressive modes. It is *not* acceptable to add film effect to high definition images for high definition delivery. Where film motion is a requirement, progressive capture is the preferred method.
- 3.6.** Technical standards are fully detailed in the following documents;
- **EBU Tech 3299-E** (Systems 2 & 3) "High Definition (HD) Image Formats for Television Production.
 - **SMPTE S274-2008** "Television - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates" (Revision of SMPTE 274M-2005).
 - **ITU-R BT.709-5** "Parameter values for the HDTV standards for production and international programme exchange.

4. Action and Caption safe areas

Action and caption safe areas for High Definition programmes are the same as the safe areas for standard definition delivery:

- *Action* should be protected for 14:9 display.
- *Captions* should be protected for 4:3 display.

Action and caption measurements should be made using the down converted output

5. Audio

There are no changes to the general audio requirements for delivery. Line-up, levels and audio to video synchronisation remain the same as the requirements for standard definition delivery. There are two possible audio delivery options though:

5.1. Stereo delivery

- There is no change to the audio delivery requirements for high definition programmes delivered in stereo.
- Tracks 1&2 - Stereo main audio Left (A1) and Right (A2).
- Tracks 3&4 - Not required but may contain an M&E track.

5.2. Multi-channel (5.1) Delivery for HDCam and HDCamSR

- When multi-channel audio is required it must be encoded using Dolby E.
- Tracks 1&2 - Stereo main audio Left (A1) and Right (A2).
- Tracks 3&4 – Dolby E encoded.
- Within the Dolby E stream the tracks must be ordered as follows:

Dolby Track	Audio Track
1	Front Left
2	Front Right
3	Centre
4	LFE
5	Surround Left
6	Surround Right
7	Not Used
8	Not Used

- Dialnorm settings between -22 and -27 are acceptable.
- Tracks 5-10 on an HDCamSR tape must either be mute or may carry discrete surround sound in the order above.
- Tracks 11-12 on HDCamSR may carry audio description if it is required by other broadcasters.

This track layout will be subject to change as international standards for 8 and 12 track tape formats are agreed and implemented.

5.3. Multi-channel (5.1) timing on tape

- The Dolby E encoded signal should be in sync with the stereo signal ON TAPE. This positioning allows further processing to be done to the final tape if required. The DolbyE signal will be advanced by 1 frame in the playout chain to compensate for the Dolby decoder delay – see section 7 for more details.

5.4. Dolby E Stream

- The Dolby E stream on audio tracks 3 & 4 should be continuous from -30 seconds (30 seconds before start of programme) until 10 seconds after the end of the programme.

5.5. Surround Sound line-up

See section 9 for full details of BLITS..

- Where ever possible BLITS tone should be used as the line-up tone on surround sound programmes. If BLITS is used it must meet the specification in section 9 of this document and may only be used on the surround sound tracks.
- BLITS may be used on stereo track that have been created by down-mixing a surround sound track to stereo. In this case the mix-down option on a BLITS generator must be used.

6. Delivery and Technical Review

6.1. High definition delivery

From 1st May 2008 the digibeta SD clone will no longer be required or made during the technical review process. The HDCam master will be used for transmission on both standard definition and high definition channels.

6.2. Technical Review process for HD programmes

- HD programmes will be reviewed using the same criteria as standard definition programmes. In addition the amount of standard definition content will be checked for compliance with the 25% limit.
- Captions and titles will be checked for compliance with the standard definition guidelines.
- PSE testing is carried out on the standard definition signal produced from the inbuilt HDCamSR down converter.
- Audio for programmes delivered in stereo will be reviewed to the same standards and requirements as standard definition programmes.
- Only the surround sound audio tracks will be fully reviewed for programmes required to deliver surround audio. The stereo audio will be checked as follows:
 - For programmes required to make a clone, the stereo audio will be fully monitored as the tape is copied. The stereo audio on the clone will be spot checked at the end of the booking.
 - For programmes not required to make a clone there are two options:
 - i. If the stereo audio is produced directly from a mix-down of the surround sound and monitored during layback the stereo need only be spot checked at the end of the technical review. An additional 15 minutes should be allowed to complete this properly.
 - ii. If the stereo is a separate mix the programme must undergo a full second technical review.

- For full details of cloning requirements see the commissioning web site at:

http://www.bbc.co.uk/commissioning/delivery/hd_reqs_delivery.pdf

7. Dolby E Specifications

This section is intended to guide facilities producing Dolby E streams for surround sound programmes.

7.1. Dolby E Encoder (DP571) Setup

- The originating encoder in the Dolby chain must be set to "internal" metadata source or "external" if controlled by an external device (DP570, PC software etc).
- Metadata from an external source cannot be edited in a DP571 if incoming metadata is incorrect - it must be rebuilt from scratch (this is only applicable to live programmes).
- A Dolby E stream uses 75ohm unbalanced connections - if the loop through connectors on a DP571 encoder are not feeding another device they should be terminated.
- The DP571 setup parameters:

The following DP571 setup parameters must be checked

- Program Config (should be 5.1 + 2 for most programmes).
- Frame Rate (The factory default is 29.97fps, UK default is 25fps).
- Bit Depth (should be 20 bits)
- Dolby E Metadata Source (internal or external)
- Dolby D metadata/AC3 metadata is enabled*

*This menu item has been removed from later versions of DP571 firmware.

- The "Bit Depth" setting does not refer to the number of bits used by the audio signals but rather 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 can be transmitted down a 20 bit link.
- The gain of a Dolby E stream must not be changed or the stream will be corrupted
- A Dolby E stream suffers one frame of delay on each encode and decode. It is a requirement that the stream be "in sync encoded" at each exchange point in the chain.
- The stream must be laid on the tape so that the encoded audio is in sync with the video and any stereo audio. The "Audio Advance" function or a video frame delay will be used to correct lip sync errors. The PCM stereo audio will also be delayed 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 disrupting Dolby Digital encoding.
- In the “Metadata Params” menu there are eight programs for which 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.

7.2. Error Condition lamps

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

7.3. Factory Reset

- The Dolby E encoder model DP571 can be reset to factory defaults by power cycling it while holding down the enter key until "factory defaults" appears on the LCD. Press the setup key when prompted to confirm.
- Pressing the Shift, → and Esc keys simultaneously will perform a soft reset.
- Unit settings will not be affected by a soft reset. It is suggested that a full reset is completed prior to setting up the encoder using this guide.

7.4. Stereo Mix down options

- 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 the other channels are mixed in at 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 out of phase 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.
- Lo/Ro is the preferred mix down option for television delivery.

7.5. DP571 Metadata Settings

- The table below gives the preferred setting for Dolby E metadata. Parameters in **BOLD** must be set as shown unless agreed in advance with the programme's HD commissioner.
- During the line up period for a live programme the incoming metadata will be checked and confirmed with the source. The following criteria will be used to query any parameter that varies from the table below:

(USER)	Parameters marked (USER) will not be queried
BOLD	Parameters in BOLD that do not match the settings below will be queried. If there is no good reason or agreement for the change the source will be asked to correct the settings. If this is not possible and the DEM believes the setting will adversely affect the output, the incoming metadata will be completely replaced with the standard settings below.
All other parameters	Variations of any other parameter from the preferred settings in the table below may be queried. If it is thought the settings could affect either the automated stereo mix down or the overall volume of the programme compared to the standard levels for the channel the DEM can ask if they can be changed. If that cannot be done, the incoming metadata will be completely replaced with the standard settings below.

7.6. DP571 Recommended Metadata Settings

Parameter	Preferred Setting	Comments
Programme Config	5.1	5.1 + 2 can be used for Live
Frame Rate	25	
Bit depth	20	
Programme Description (USER)	Programme title and episode no	
Reversion Mode	Last used	Live programmes
Metadata Source 1st Unit in chain	Internal or external if metadata is set by an external device	Live programmes
Metadata Source subsequent units	External	Live programmes
Dolby D or AC3 Metadata	Enabled	Not available on latest firmware version
Dialogue Level (Dialnorm) (USER)	-22 to -27 permitted -31 allowed for "total" music performance	
Channel Mode	3/2	Indicates channels are in use

LFE Channel (USER)	On/Off	Enables or disables the LFE
Bit-stream Mode	Complete Main (CM)	Describes the audio service carried in the bit stream – information only
Line Mode Compression	Film Standard	Designates preset compression configuration for line mode decoding. Most high-end decoders allow the compression to be defeated.
RF Mode Compression	Film Standard	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	0.707 (-3.0dB) Recommended	The level of the centre channel in the L and R if the listener has no centre speaker.
Surround Down mix Level	0.707 (-3.0dB) Recommended	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	Disabled	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
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	0.707 (-3.0dB) Rec	Level of centre channel in Lt/Rt down mix
Lt/Rt Surround Down mix Level	0.707 (-3.0dB) Rec	Level of Surrounds in Lt/Rt down mix

Lo/Ro Centre Down mix Level	0.707 (-3.0dB) Rec	Level of Centre channel in Lo/Ro down mix
Lo/Ro Surround Down mix Level	0.707 (-3.0dB) Rec	Level of Surrounds in Lo/Ro down mix
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 (USER)	Enabled/Disabled	Used to preserve compatibility with older film formats – not used by the BBC
Surround Phase Shift:	Lo/Ro	Disable

8. Audio Sync markers

Surround sound, combined with the use of Dolby E encoding and programmes having multiple main audio tracks on the same tape, has increased the difficulty of maintaining A/V sync.

Traditionally broadcasters have required A/V sync to be within +10ms to -20ms. However as domestic equipment can also introduce A/V sync errors, broadcasters will either have to tighten the tolerance allowance or apply far more rigorous enforcement of the current tolerance allowance.

It is not a requirement of delivery that the leader includes a sync plop, but if a programme leader does contain one it must meet the following conditions:

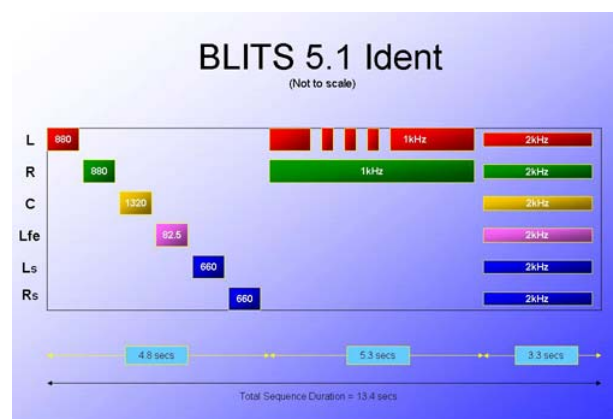
1. The sync plop must be between timecode 09:59:57:06 and 09:59:57:08 or 00:59:57:06 and 00:59:57:08
2. The audio tone must be 1kHz on all tracks at -18dB (standard zero level)
3. The duration of the vision flash must be 2 frames to allow it to pass through standards conversion successfully
4. The audio tone must be synchronous across all audio PCM audio tracks and with the video flash (within the +10ms -20ms tolerance allowance)
5. The Dolby E encoded audio tone must be synchronous across all Dolby E encoded audio tracks and the Dolby E encoded stream must be correctly positioned as previously described.
6. If an end sync plop is used it must be no closer than 10 seconds to the end of the programme and comply with 2-5 above

9. Surround Sound audio line-up

BLITS is a set of tones designed for television multi track audio line-up. BLITS tone has three distinct sections as shown in the diagram below.

The first section is made up from short tones at -18 dBFS to identify each channel.

Left and Right front - 880 Hz



Centre - 1320 Hz

LFE - 82.5 Hz

Left and right surrounds - 660Hz.

The second section identifies front left and right channels only. Tone at -18 dBFS is interrupted four times on the left channel and is constant on the right. This pattern of interrupts has been chosen to prevent confusion with GLITS tone after stereo mix down.

The last section has 2kHz tone at -24dBFS on all six channels. When the tone summed to stereo using default down-mix values this section should produce tones of approximately -18 dBFS on each channel.

The BLITS sequence repeats roughly every 14 seconds.

Note: The BLITS signal is still going through the process of ratification as a standard for surround sound line-up. Changes may be made during the process and any changes agreed by the standards bodies must be applied to all programmes that have a *delivery* date after the standard document has been published. The BBC will make every effort to publicise these changes as soon as they are made but it is advisable to make sure the audio facility is aware of the possibility of changes being required.

10. Requirements for delivery of live programmes

10.1. Programme Types

Programmes in this section fall into the following categories:

1. Live programmes from within buildings with a fixed and permanent connection to CCA (e.g. Studios in Television Centre).
2. Live programmes within buildings with a direct and permanent connection to the Raman Ring.
3. Live programmes with links provided by third parties (e.g. satellite, fibre, microwave etc.).
4. Live programmes that use a remote source that is fed through or hosted by a studio in category 1 or 2 above.
5. Programmes on tape or server that are played directly into Red Bee via a fixed, Raman or contribution link from any facility other than Red Bee's own playout facilities.

Categories 1 – 3 also apply to programmes that are time-shifted by Red Bee to meet transmission slots.

Usually high definition programmes should only deliver a high definition signal. The programme will be down converted in CCA for transmission on standard definition channels.

Only programmes commissioned in high definition can be supplied in high definition

10.2. Circuit Bookings

The production company producing or commissioning the material shall be responsible for the costs of all necessary communications and for ensuring that all the necessary circuits are booked from the source to the point of recording or transmission. Where multiple agencies are involved, a collaborative approach is essential.

The London Television Centre (TVC) end of circuit bookings should be made through the Siemens Network Bookings Agency who should also be informed of the full route at least one week before the programme production date.

Siemens Network Booking Agency +44 (0)1386 420040

Hours: 09:00 - 22:00 Monday to Friday

09:00 – 19:30 Saturday, Sunday and Public Holidays

The point of delivery is **CCA** unless specifically stated otherwise.

Technical contact details **must** be supplied at the time of booking. The contact is required to be available prior to the event to confirm technical planning and for dealing with any queries and **must** be available at the source throughout the line-up period and during the feeding of material.

It is advisable to supply details of Dolby metadata settings to CCA in advance of the programme to speed the line-up process: <mailto:broadcast.comms@bbc.co.uk>

Facilities for down linking satellite circuits to Television Centre in London are available at commercial rates. The BBC also has permanent circuits to the BT tower and all other major broadcasters.

10.3. Point of contact

The Duty Engineering Managers (DEMS) in Red Bee Media, the BBC's play-out provider, are the main round-the-clock operational point of contact working closely with the play-out editors.

They are the point of contact for technical enquiries affecting delivery

Duty Engineering Managers (DEMS) +44 (0) 20 8495 5400

10.4. Image quality and camera gain

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

It is not always possible to control the light levels of events in the open or in locations where there is only natural lighting or lighting is controlled by others. Wherever possible little or no camera gain should be used. Gain in cameras where the lighting levels are fully under the control of the programmes lighting director should be limited to a maximum of 3dBs.

10.5. Technical Parameters for the Incoming Signal

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

- sufficient monitoring must be in place at all interfaces to ensure continuity of signal quality
- there must be agreement over the share of responsibility for each element in the chain(s).
- all parties must be able to monitor and assess the signals arriving and departing from their domain(s) of responsibility.
- audio and video must be sync arriving and departing from each area of responsibility. (Dolby E signals must be in sync encoded - see section 5.3)

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

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

- Stereo audio will be embedded on level 1
- Surround sound (when supplied) will be Dolby E encoded and embedded on level 2. The Dolby E encoded audio will be in-sync encoded (i.e. *not* advanced to accommodate the 1-frame decoder delay).

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

Required checks will include representative moving pictures and synchronous sound.

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

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

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

10.6. High Definition Contribution Links

Programmes from studios in Television Centre or using the BBC Raman Ring must supply an uncompressed 1.5Gbs signal compliant to ITU-R BT.709-5 with embedded audio to an agreed Siemens' access point (e.g. direct connection to CCA in Television Centre or Raman connection in BBC Nations and Regions)

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

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

10.7. Standards conversion from remote source

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