EBU

OPERATING EUROVISION AND EURORADIO

R 153

PARAMETERS FOR LIVE CONTRIBUTION OF UHD/HDR PROGRAMMES

Version 2.0

SOURCE: EBU Video Systems Group

Geneva
June 2023

Document History

EBU Committee	TC	
Drafting Group	EBU Video Systems Group	
First published	2021	
Revised	June 2023	Version 2.0
Main changes since previous version	- Reference to EBU Tech 3320. - More detailed HDR production and workflows advice. - Clarification regarding the use of compression in contribution links. - At least 8 audio channels for channel-based production. - Use of EBU-TT / IMSC subtitling (instead of EBU STL). - Easier to read Broadcast Production Audio Template (Annex C). - Extended bibliography. - Glossary of key terms + pointer to online glossary.	

Publication Keywords: UHD, HDR, HLG, ADM, S-ADM, Contribution over IP, ADM Profile, NGA, MGA.

Intended use and area of application

This document recommends formats and parameters for live programmes where UHD/HDR content is exchanged between different partners. The document is intended as a ready-to-use guideline where no other bilateral agreements are in place and can therefore be considered as a basic set of recommendations for UHD/HDR live signal contribution via SDI or IP interfaces. These recommendations can also be used as a starting point by broadcasters and production companies just beginning in-house UHD/HDR content production or processing, and who need a simple and concise set of parameters and rules that can be used for tender and/or commissioning purposes.

Please note that this publication's application is for everyday UHD material contribution and playout from broadcast centres. It is not targeted towards distribution to end-users nor is it aimed at high-end UHD movie and feature film production.

The parameters stated in this recommendation may be altered for an individual programme exchange with the permission of the receiving broadcaster(s).

Contents

Parameters for Live Contribution of UHD/HDR Programmes

Recommendation

The EBU, considering that:

1. Digital television image formats for HDTV and UHDTV have been specified by the ITU-R in Recommendations ITU-R BT.709, ITU-R BT.2020 and ITU-R BT.2100.
2. Modern displays are capable of reproducing images at a higher luminance, greater contrast ratio and wider colour gamut than is conventionally employed in programme production.
3. High dynamic range television (HDR-TV) has been shown to increase viewer enjoyment of television pictures.
4. EBU Tech 3320 specifies minimum performance levels for both HDR and SDR monitors used in television production.
5. Audio signals for live contribution should be accurately and reliably described.
6. EBU R 151 encourages broadcasters to adopt Recommendation ITU-R BS.2076 'Audio Definition Model' (ADM) to describe the metadata of NGA[1] programmes.
7. S-ADM is specified in Recommendation ITU-R BS.2125 and is designed for use in linear workflows such as live or real-time production for broadcasting and streaming applications.
8. The standardized method to carry S-ADM is specified in SMPTE ST 2116:2019 and uses AES3 with SMPTE ST 337 formatting.
9. The EBU ADM Broadcast Production profile is described in EBU Tech 3392.

And recognising that

10. It strongly encourages innovation in personalised sound experiences within the 15 audio channels plus a descriptive metadata (S-ADM) track, providing added value to UHD programmes.

Recommends that,

The formats and parameters listed in Annex A shall be used for Live UHD-TV content contribution.

Annexes B & C are for additional guidance.

[1] SMPTE documents use the term Metadata Guided Audio (MGA)

Annex A: Parameters for Live UHD Contribution

Note: A glossary for UHDTV is available from the EBU web site at https://tech.ebu.ch/uhdtv/glossary. For convenience, a subset of terms is included on the last page of this document.

Video

Video Parameters

Image Container Shape	16:9
Container Pixel Count	3840 x 2160
Pixel Aspect Ratio	1:1
Frame Frequency	50 Hz or 60/1.001 Hz
Transfer Function	ITU-R BT.2100 Table 5 (Hybrid Log-Gamma)
Colour Primaries	ITU-R BT.2100 Table 2
Colour Matrices	ITU-R BT.2100 Table 6
Video Format	10-bit 4:2:2 $Y'C'_BC'_R$
Video Range	EBU R 103 Preferred Minimum/Maximum Range

NOTES FOR CLARIFICATION:

- Use of a Standard Dynamic Range (SDR) transfer function is not allowed,
- EBU TR 070 presents a method for the creation of both BT.2100 HLG and BT.709 compliant video feeds from a single production workflow by shading cameras using a down-mapped variant of the BT.2100 HLG and BT.1886 monitors (EBU Tech 3320 Grade 1 or 2),
- High Frame Rate (HFR >60 fps) content is NOT recommended at this time for baseline exchange,
- Hybrid Log-Gamma (HLG) is the recommended transfer function in this document,
- Resolutions greater than 3840 x 2160 (e.g., “8k”) are not recommended in this document.
- In certain cases, addressing challenging production conditions (low light, difficult camera positions, etc.) means that capturing in HD HDR then upscaling to UHD yields a better image than capturing natively in UHD HDR. For those special cases, it is essential that the format information is signalled adequately so the signal can be processed properly downstream. The use of 1080p must be communicated to receiving broadcasters.

Exposure

Programme productions shall follow the exposure guidelines suggested in the signal level Tables 1 and 2 of Report ITU-R BT.2408 when creating video for exchange. Programme productions are recommended to use the workflow described in detail in EBU TR 070 (Single-Master). Productions that are produced in accordance with EBU TR 070 shall either:

- use a non-linear "gamma-adjusted" HDR to SDR down-mapping for camera adjustment as discussed in ITU-R BT.2408, or
- if using a “hybrid-linear” HDR to SDR down-mapping for camera adjustment, convert or provide a method of converting the HDR signal, to allow a non-linear “gamma adjusted” down-mapping to be used after the point of programme exchange.

A "hybrid-linear" single-master HDR Production workflow has been used by some sports host broadcasters at major events, whereby down-mapped camera adjustment SDR signals are shaded on a BT.1886 monitor at the 100 cd/m^2 specified in Recommendation ITU-R BT.2035.

An alternative "hybrid-linear" single-master HDR Production workflow is used by some US broadcasters, whereby SDR signals are shaded on a BT.1886 monitor at 203 cd/m^2. An example of this is described in Annex 10 of Report ITU-R BT.2408-6.

Methods of conversion between signals produced by this 203 cd/m^2 workflow and those produced by the EBU TR 070 (100 cd/m^2) workflows are being investigated. Care is required to ensure that the correct method of adapting signals is used.

Note: EBU TR 070 is a recommendation gathered from a number of major worldwide productions honed over several years. It highlights an issue caused by a difference in HDR to SDR conversions used worldwide.

Note: At the time of writing, the BT.709 HD signal is still of primary importance. The purpose of this tightening of the recommendation over version 1 is to ensure that a single "look" can be created for programme exchange to allow broadcasters whose transmission facilities use "gamma-adjusted" down-mappers can produce a desired SDR "look" without loss of detail. This may mean that whilst the BT.709 HD signal is of primary importance, users of this recommendation will have a slight divergence in the secondary BT.2100 HLG signal.

Note: The issues are now widely recognised by the industry and this recommendation may be updated after further research.

Object	Signal Level %
18% Grey Card[2]	38
Greyscale Chart Max (83% reflectance)	71
Greyscale Chart Max (90% reflectance)	73
HDR Reference White / Diffuse White / Graphics White	75
Light Skin Tone	55 – 65
Medium Skin Tone	45 – 60
Dark Skin Tone	25 – 45
Grass	40 – 55

Video Signalling and Metadata

Video data streams shall have signalling to enable equipment to correctly identify video formats and set their operational mode.

Where appropriate and to assist with signal format and conversion identification, the EBU HLG Colour Bars described in EBU Tech 3373 should be used.

Given the current state of UHD/HDR implementation, where an HD SDR version is required, Report ITU-R BT.2408 '*Guidance for operational practices in HDR television production*' provides guidance on conversion between HDR and SDR. Annexes also describe use cases where HDR and SDR images are monitored in close proximity.

[2] The actual signal levels for an 18% grey card may differ significantly where camera painting controls have been applied.

Graphics elements that have a CICP value indicating that they are HLG (*ITU-R BT.2100 Table 5)* compliant shall be directly overlaid in the Programme video data stream.

Video Transport

Compressed use

Contribution links between parties are typically compressed (*e.g., H.264, H.265, J2K based*). The hand-over point (interface, e.g., in an IBC) is typically uncompressed SDI/SMPTE ST 2110.

Uncompressed over SDI

- 12G-SDI (SMPTE ST 2082-10:2018) or Quad 3G-SDI (SMPTE ST 425-5:2019) may be used.
- If Quad 3G-SDI is in use, then Two Sample Interleave (2SI) pixel formatting and level A mapping shall be used.
- For both 12G-SDI and Quad 3G-SDI, Payload Identifiers in accordance with SMPTE ST 352 (V-PID) shall be present.

Uncompressed over IP (SMPTE ST 2110)

SMPTE ST 2110-20 (uncompressed active video over IP) shall be used. The Session Description Protocol (SDP) shall reflect the parameters of the video transport as described in SMPTE ST 2110-10 and SMPTE ST 2110-20.

Annex B gives Informative guidance on video as it is used for live contribution.

Audio

Audio Parameters

Conventional channel-based formats (if MGA[3] is not available)	minimum 8 channels, (e.g., stereo & 5.1)
For Metadata-Guided Audio (MGA) over SDI	up to 15 audio channels and 1 S-ADM track (full frame mode)
Format	PCM
Sampling Rate	48 kHz
Bit Depth	24 bit
Loudness Normalisation	EBU R 128

Synchronisation

To avoid audio "phasing" or even cancellation when multi-channel audio is downmixed, timing differences between correlated audio channels (i.e., the timing between each channel of the six audio tracks of a surround sound signal) must be no more than 0.2 sample periods.

[3] *Metadata Guided Audio - MGA* – is a term introduced by SMPTE, notably in ST 2127-1, to describe 'audio essences accompanied by descriptive metadata'. ADM/S-ADM are in this regard specific production formats of *MGA*. *Next Generation Audio – NGA* - in contrast is a term rather applied for specific delivery technologies and codecs.

Audio Transport

Conventional channel-based formats if MGA is not available.

Uncompressed over SDI

For programmes with Metadata-Guided Audio, one of the following templates should be used:

- The S-ADM & ADM template for production of Personalized Sound Experience (PSE) content with a focus on accessibility and personalisation use-cases, is described in Annex C as "Broadcast Production Template 1". It consists of a 0+5+0 Music & Effects (M&E) bed, at least one language channel, and, if required, an Audio Description channel. Template 1 should be the default template.
- The S-ADM & ADM template for production of immersive audio content is described in Annex C as "Broadcast Production Template 2". It consists of a 4+5+0 M&E bed, at least one language channel and, if required, an Audio Description channel.

Uncompressed over IP (SMPTE ST 2110)

- For conventional channel-based audio formats SMPTE ST 2110-30 (PCM digital audio over IP) shall be used.
- For Metadata-Guided Audio multiple streams over SMPTE ST 2110-30, using level A shall be used. Care should be taken to allocate the most closely related channels (e.g., those of a stereo or surround bed) together to the same stream: this reduces the effect on down-mix of synchronisation errors between streams.

SMPTE ST 2110-31 (AES3 transparent transport over IP) shall be used to transport the S-ADM metadata packed in accordance with SMPTE ST 2116 (S-ADM in AES3), however SMPTE ST 2110-41 is envisaged as the appropriate solution in the near future.

Further testing might be necessary to verify that this will work for the actual use-case.

Annex C gives Informative guidance on audio as it is used for live contribution.

Access Services

Subtitles

Subtitle carriage is not mandatory. Where required, subtitles shall be supplied according to EBU-TT-Live (EBU Tech 3370 and supporting documentation) if SDI is used, or ST 2110/43 if IP delivery is used, ensuring conformance with the W3C IMSC Text Profile. Currently there is no known requirement that the WCG/HDR colour space is fully used in subtitles; rather, SDR (e.g., RGB) colour space is fine, as long as the RGB colours are correctly mapped to the appropriate pixel colour values at display time. Colours used in Timed Text are defined in sRGB. It should be taken into account that 100% luminance RGB must not appear as 100% luminance in HLG but rather should be aligned to "Graphics White".

Signing

Signing carriage is not mandatory. Where required, the signing shall be delivered as a timecode synchronous separate UHD video stream with a monochromatic background to allow overlay.

Annex B: UHD-HDR Live Video Contribution (informative)

This Annex is a brief introduction to the requirements for live television programme production. For a full discussion on the production of UHD HDR video, ITU-R BT.2390-8 or later may be referenced.

Conversion of non-compliant video for use in Programmes

Video elements in accordance with ITU-R BT.709 or ITU-R BT.2020 can either be directly mapped such that their peak white value is mapped to HDR Reference White (75%) or they can be up-mapped with a highlight expansion which does not significantly affect skin tones.

Video elements in accordance with ITU-R BT.2100 Table 4 (Perceptual Quantization) can be converted in accordance with Reports ITU-R BT.2408 and ITU-R BT.2446

Conversion of graphics for use in Programme

Graphics elements in accordance with ITU-R BT.709 or sRGB can be directly mapped such that their peak white value is mapped to HDR Reference White (75%) in the Programme video data stream.

Exposure Guidelines Note

Exposure guidelines are taken from ITU-R BT.2408 and are important to ensure high quality conversion to standard dynamic range video with static down-mapping. Exposure guidelines may be revised when dynamic down-mapping equipment and HDR production monitors become prevalent.

Session Description Protocol Example

Parameters dedicated to the transport of UHD/HDR are highlighted in the example below.

```
v=0
o=- 123456 11 IN IP4 192.168.100.2
s=Example of a SMPTE ST2110-20 signal
i=this example is for 2160p video at 50Hz
t=0 0
a=recvonly
a=group:DUP primary secondary
m=video 50000 RTP/AVP 112
c=IN IP4 239.100.9.10/32
a=source-filter:incl IN IP4 239.100.9.10 192.168.100.2
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=3840; height=2160; exactframerate=50; depth=10; TCS=HLG; colorimetry=BT2020;
PM=2110GPM; SSN=ST2110-20:2017;
a=ts-refclk:ptp=IEEE1588-2008:39-A7-94-FF-FE-07-CB-D0:37
a=mediaclk:direct=0
a=mid:primary
m=video 50020 RTP/AVP 112
c=IN IP4 239.101.9.10/32
a=source-filter:incl IN IP4 239.101.9.10 192.168.101.2
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=3840; height=2160; exactframerate=50; depth=10; TCS=HLG; colorimetry=BT2020;
PM=2110GPM; SSN=ST2110-20:2017;
a=ts-refclk:ptp=IEEE1588-2008:39-A7-94-FF-FE-07-CB-D0:37
a=mediaclk:direct=0
a=mid:secondary
```

Annex C: Broadcast Production Audio Templates for UHD Live Contribution applying MGA (informative)

Background notes on the use of MGA and NGA.

Metadata Guided Audio comes along with a fundamental paradigm shift in audio production: Instead of delivering one or multiple "baked" mixes in a production, all elements (IT/ME, Dialogue, AD, etc.) comprising this mix are provided as elements (beds/stems) along with the generated metadata (from the mixing console or DAW as ADM/S-ADM) so that a renderer can generate the desired output formats (2.0, 5.1, 4+5+0, binaural etc.).

This rendering process may take place at the broadcaster (host) before feeding this mix into different distribution channels, or – ideally, when NGA can be provided throughout the chain – on end user devices (TV sets, smartphones, browsers). Only there it unfolds the full potential of the technology, by enabling adaptive playout according to different listening situations (on the go, in the living room), playback set-ups (scalable loudspeaker set-ups, headphones) and even individual preferences and needs (languages, hearing capabilities or visual impairments) through interactive control options.

It has been agreed in several standardization bodies such as DVB and ATSC, that in UHDTV not only the picture will be enhanced, but also audio is to be delivered in a new way, to generate an encompassing media experience. Therefore, NGA solutions have been recommended as the new audio standards for UHDTV. As a consequence, some audio production constraints are to be defined anew applying MGA.

It is possible to accommodate familiar track allocations in the 16 audio channels (the minimum standard for option B audio for UHDTV, reflecting the channel-based audio production paradigm). With the introduction of object-based audio, scene-based audio ("Ambisonics") and hybrid solutions for "Next-Generation Audio" systems, the number of potentially different track allocations becomes very high indeed. This is addressed in the Audio Definition Model (ADM) and its derivative S-ADM (Serial-ADM) – which in generally referred to as *Metadata Guides Audio - MGA*.

The first step towards practical use cases for the ADM is to facilitate dialogue enhancement. This is generally achieved by keeping speech (for example, commentary or narration) separate from M&E for all content versions, not just when international clean audio is required. It is recommended to use at least a 5-channel surround M&E bed for UHD-TV.

The Audio Definition Model (ADM) is intentionally very generic, to support a wide variety of different application areas. The EBU "ADM broadcast production profile", specified in EBU Tech 3392, constrains the ADM to simplify implementations and to prevent interoperability problems in the production of Next Generation Audio broadcast programmes.

Figures C1 & C3 show the two specific configurations recommended in the context of this document, which can be accommodated in Level 1 of EBU Tech 3392.

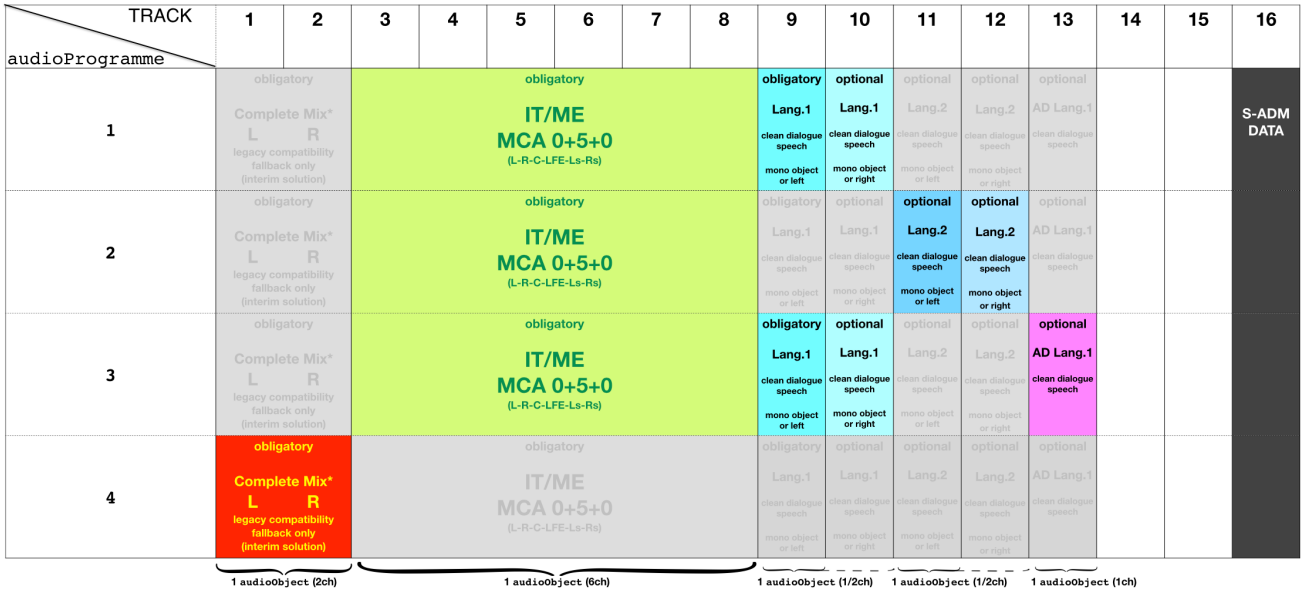
Note: these templates, based on EBU Tech 3392, are illustrative and reflect typical and simple standard use cases in broadcasting. They may be adapted to production needs and deployment scenarios - or others can be created.

Broadcast Production Template 1: 0+5+0 (aka 5.1) for two languages and one audio description

Based upon EBU Tech 3392 ADM Broadcast Production Profile Level 1:

- 4 audioProgrammes (presentations)
- 5 audioObjects
- 13 trackCount

Note: The amount and understanding of `audioProgrammes` *depends on the options actually used*



*Ideally created through 2.0 rendering from ADM-Mix. Alternatively, from legacy 2.0 manual mixing

Figure C1: Tracks allocation according to Template 1

Although there are only 11 channels used in Template 1 (ignoring the 2.0 fallback #4), the ADM description with three `audioProgrammes`) can create up to nine different mixes that could be relayed into current channel-based distribution options:

Three formats each with two languages plus one AD:

- 2.0
- 5.1
- binaural

In the purely channel-based world, this would add up to a total of 30 channels, and still would not have the capability of feeding an NGA distribution system to provide personalization and interactivity via SDI.

The graph of the ADM provides a similarly clear and comprehensive view of its structure.

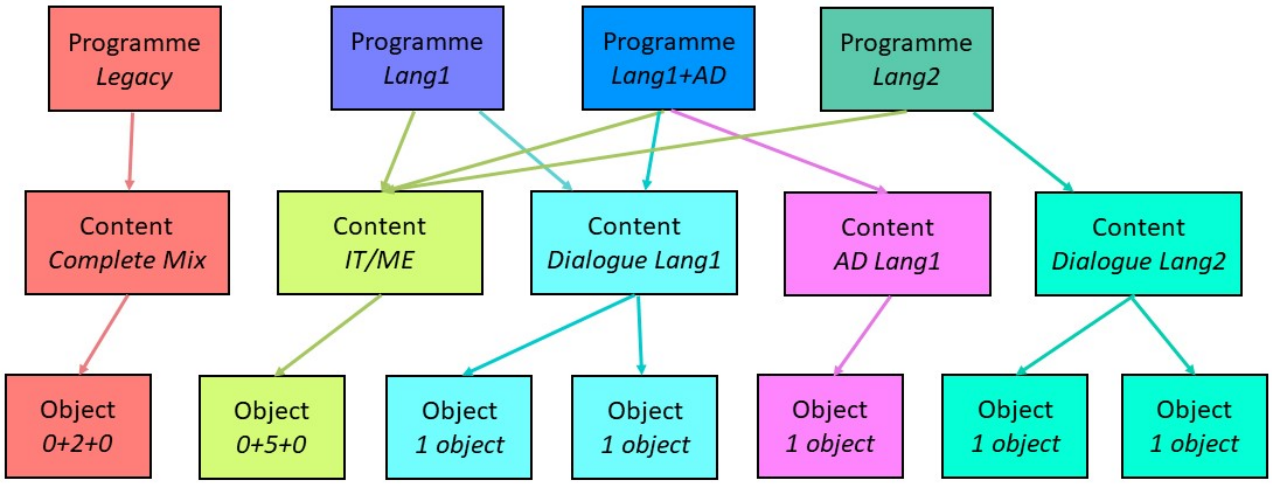


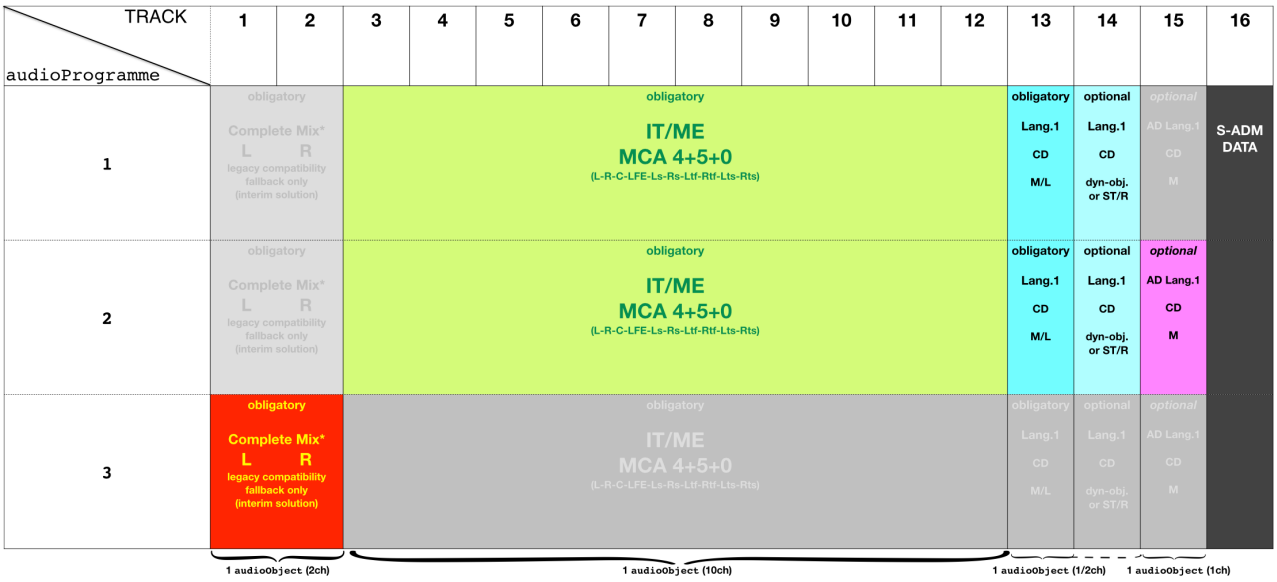
Figure C2: ADM for Template 1

Broadcast Production Template 2: 4+5+0 for one language plus audio description

Based upon EBU Tech 3392 ADM Broadcast Production Profile Level 1:

- 3 audioProgrammes (presentations)
- 4 audioObjects
- 15 trackCount

Note: The amount and understanding of `audioProgrammes` *depends on the options actually used.*



*Ideally created through 2.0 rendering from ADM-Mix. Alternatively, from legacy 2.0 manual mixing

Figure C3: Tracks allocation according to Template 2

The graph of the AXML provide a similar clear and comprehensive view of its structure.

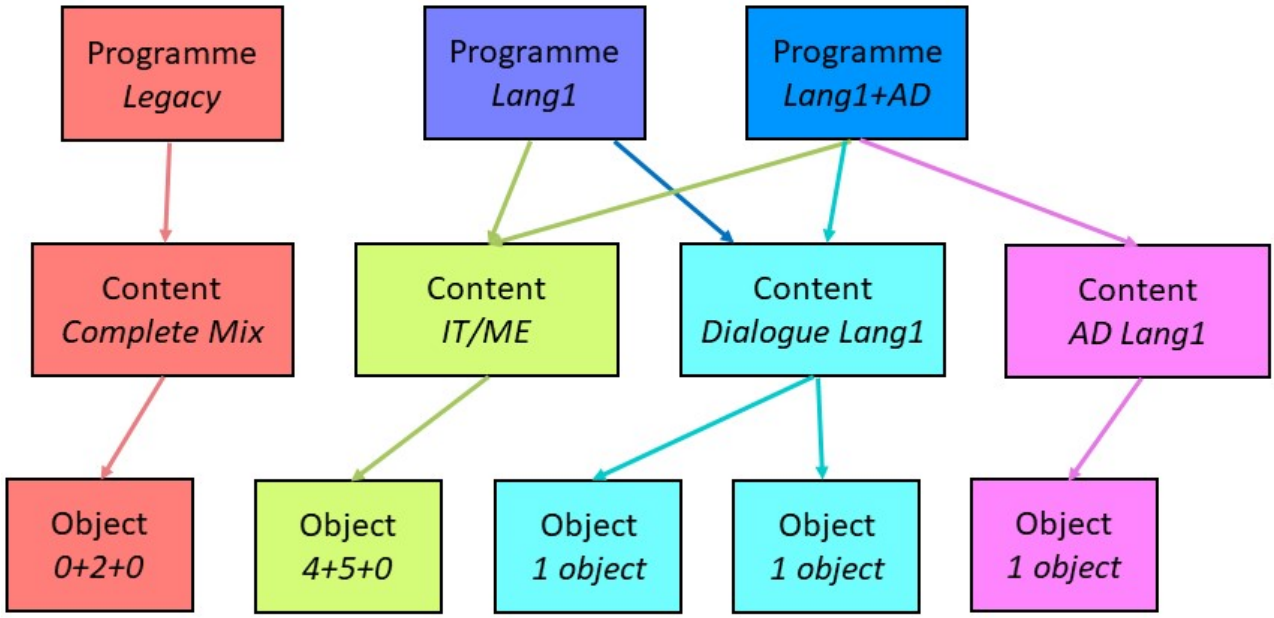


Figure C4: ADM graph for Template 2

For consistency within the production and distribution chain and to ensure compatibility and interoperability between ADM and NGA solutions, ITU Working Party 6B/Rapporteur Group 13 is currently working on a specific ITU-R BS Recommendation establishing an *Advanced Sound System emission ADM and S-ADM profile*. Results are to be expected in the near future.

As a first practical implementation, the EBU and BBC R&D have recently published *EAT – EBU ADM Toolbox*, a framework that enables multiple processes to manipulate and convert between different flavours and formats of ADM.

The resources are available at Github:

https://github.com/ebu/ebu-adm-toolbox

Bibliography

EBU R 103	Video Signal Tolerance in Digital Television Systems	https://tech.ebu.ch/publications/r103
EBU R 128	Loudness Normalisation and Permitted Maximum Level of Audio Signals	https://tech.ebu.ch/publications/r128
EBU R 151	Recommended Strategy for Adoption of Next-Generation Audio (NGA) Technology	https://tech.ebu.ch/publications/r151
EBU Tech 3320	User requirements for Video Monitors in Television Production	https://tech.ebu.ch/publications/tech3320
EBU Tech 3364	Audio Definition Model	https://tech.ebu.ch/publications/tech3364
EBU Tech 3370	EBU-TT Part 3 Live Subtitling	https://tech.ebu.ch/publications/tech3370
EBU Tech 3372	UHD / HDR service parameters	https://tech.ebu.ch/publications/tech3372
EBU Tech 3373	Colour Bars for use in the Production of Hybrid-Log Gamma (HDR) UHDTV	https://tech.ebu.ch/publications/tech3373
EBU Tech 3285	A format for audio data files in broadcasting	https://tech.ebu.ch/publications/tech3285
EBU Tech 3285-s7	A format for audio data files in broadcasting (Supplement 7 <chna> chunk)	https://tech.ebu.ch/publications/tech3285s7
EBU Tech 3388	ADM Renderer for use in next generation audio broadcasting	https://tech.ebu.ch/publications/tech3388
EBU Tech 3392	ADM Broadcast Production Profile	https://tech.ebu.ch/publications/tech3392
EBU TR 002	Advice on the use of 3 Gbit/s HD-SDI interfaces	https://tech.ebu.ch/publications/tr002
EBU TR 042	Example of an End-to-End OBA Broadcast Architecture and Workflow	https://tech.ebu.ch/publications/tr042
EBU TR 045	Why broadcasters need an open, codec-independent workflow for NGA production deployment	https://tech.ebu.ch/publications/tr045
EBU TR 070	EBU HDR Workshop 2022 - FAQ	https://tech.ebu.ch/publications/tr070
ITU-R BS.2076	Audio definition model	https://www.itu.int/rec/R-REC-BS.2076
ITU-R BS.2088	Long-form file format for the international exchange of audio programme materials with metadata	https://www.itu.int/rec/R-REC-BS.2088/en
ITU-R BS.2094	Common definitions for the Audio Definition Model	https://www.itu.int/rec/R-REC-BS.2094/en
ITU-R BT.2100	Image parameter values for high dynamic range television for use in production and international programme exchange	https://www.itu.int/rec/R-REC-BT.2100
ITU-R BS.2125	A serial representation of the Audio Definition Model	https://www.itu.int/rec/R-REC-BS.2125/en
ITU-R BS.2127	Audio Definition Model renderer for advanced sound systems	https://www.itu.int/rec/R-REC-BS.2127/en
ITU-R BT.709	Parameter values for the HDTV standards for production and international programme exchange	https://www.itu.int/rec/R-REC-BT.709
ITU-R BT.2390	High dynamic range television for production and international programme exchange	https://www.itu.int/pub/R-REP-BT.2390
ITU-R BT.2408	Guidance for operational practices in HDR television production	https://www.itu.int/pub/R-REP-BT.2408
ITU-R BT.2446	Methods for conversion of high dynamic range content to standard dynamic range content and vice-versa	https://www.itu.int/pub/R-REP-BT.2446
ITU-T H.273	Coding-independent code points for video signal type identification	https://www.itu.int/rec/T-REC-H.273
SMPTE RDD 32	XAVC MXF Mapping and Operating Points	https://ieeexplore.ieee.org/document/8058105
SMPTE Registry	Video Payload ID Codes for Serial Digital Interfaces (SMPTE ST 352)	https://smpte-ra.org/video-payload-id-codes-serial-digital-interfaces
SMPTE ST 381-3	Material Exchange Format—Mapping AVC Streams into the MXF Generic Container	https://ieeexplore.ieee.org/document/8058102

SMPTE ST 2110-10	Professional Media Over Managed IP Networks: System Timing and Definitions	https://ieeexplore.ieee.org/document/8165974
SMPTE ST 2110-20	Professional Media Over Managed IP Networks: Uncompressed Active Video	https://ieeexplore.ieee.org/document/8165974
SMPTE ST 2110-30	Professional Media Over Managed IP Networks: PCM Digital Audio	https://ieeexplore.ieee.org/document/8167392
SMPTE ST 2110-31	Professional Media Over Managed IP Networks: AES3 Transparent Transport	https://ieeexplore.ieee.org/document/8454952
SMPTE ST 2116	Format for Non-PCM Audio and Data in AES3 - Carriage of Metadata of Serial ADM (Audio Definition Model)	https://ieeexplore.ieee.org/document/8984678
SMPTE ST 2127-10	Mapping Metadata-Guided Audio (MGA) signals with S-ADM Metadata into the MXF Constrained Generic Container	https://doi.org/10.5594/SMPTE.ST2127-10.2022
SMPTE ST 2127-1	Mapping Metadata-Guided Audio (MGA) signals into the MXF Constrained Generic Container	https://doi.org/10.5594/SMPTE.ST2127-1.2022
W3C IMSC	TTML Profiles for Internet Media Subtitles and Captions	https://www.w3.org/TR/ttml-imsc/rec

Glossary

ADM Audio Definition Model. A metadata scheme defined in ITU-R BS.2076 for file based (ADM) and ITU-R BS.2125 for serial (S-ADM) description of audio essences and their relationships.

HDR High Dynamic Range. Describes the ability of a television system to produce, transmit and display a higher contrast range and in particular a higher peak luminance. As a result, more details can be displayed in dark and bright areas of the picture.

HFR High Frame Rate. Term for a frame rate of more than 50 or 60 progressive frames/second (50/60 Hz). With the development of UHD two high frame rates were specified: 100 Hz (for 50 Hz countries) and 120 Hz (for 60 Hz countries). In the cinema sector, 48 Hz is already considered to be HFR.

HLG Hybrid Log-Gamma. HDR camera characteristic (Opto-Electrical Transfer Function OETF) developed by the BBC and NHK. HLG is specified in ITU-R BT.2100 and ARIB STD-B67 (ARIB is a Japanese standards body). The goal in the development of HLG was backward compatibility with SDR (full backwards compatibility requires the same colour space to be used).

MGA Metadata Guided Audio. Term to describe audio essences accompanied by descriptive metadata'. Rather applied for production. E.g., ADM/S-ADM.

NGA Next Generation Audio. Generic term applied for specific delivery technologies and codecs that may transport different audio technologies like Object-Based Audio (OBA), Scene-Based Audio (Ambisonics) and Channel-Based Audio, also in hybrid configurations. Current commercial solutions on the market are MPEG-H and AC-4.

OBA Object-Based Audio. Generic term applied for audio including at least one or multiple 'audio objects', defined and controlled by metadata and potentially interactive.

SDI Serial Digital Interface. A set of digital interfaces specified by the SMPTE for the transport of video signals over coaxial or optical cables.

SDR Standard Dynamic Range. The camera characteristic (OETF) for SDR is defined in ITU-R BT.709 and in ITU-R BT.2020, the corresponding monitor characteristic (EOTF) is specified in ITU-R BT.1886.