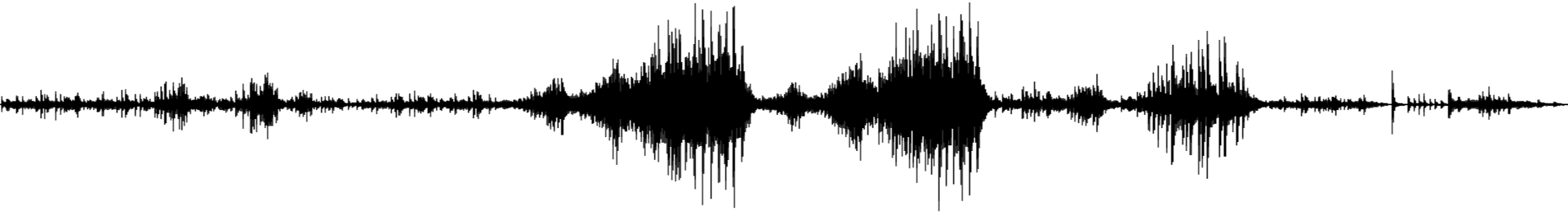# Next Generation Audio – NGA

- Facts for selection of NGA codec
- Discussion and selection NGA
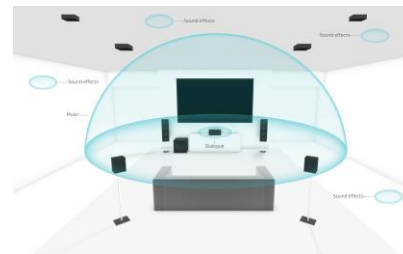
This Presentation is an updated NGA presentation from Excom meeting October 2017

Accessibility & Reach   **Personalized**   **Immersive**   **Universal delivery**

Johan Lindroos, SVT, chair NorDig Audio subgroup

Background information NGA:

• Mixed results from questionnaire (winter 2017). Dialogue Enhancement and Accessibility features the broadcasters. Little or no interest in immersive sound with more than 5.1 channels.

• NGA can be used in channel based audio, <u>does not need</u> to be object based audio in the beginning. "Soft start" is possible.

• Remember that with HEVC, a new Audio codec will prolong for the next 10 – 15 years or even more. <u>A wise decision that consider the future</u> would be great.

• Manufacturers <u>need</u> to have truly representative reference test streams and test specifications to be able to validate potential services,

• Manufactures wants to have <u>early</u> commitment from broadcasters

NorDig is the leading specification of the world for IRD´s!

Phased introduction of NGA

- Simplest: Just codec change. Same production environment as today. You gain some NGA advantages such as Dialogue Enhancement (on existing content), bit rate savings

- More evolved: Spoken subtitles mixing in NGA. Not so big investments. Could possibly be made with adjustments in existing contintuity chain

- Most evolved: Complete NGA with Object Based Audio. Needs new/upgraded audio production environment, new continuity chain. New type of audio work flow

Summary of outcome from NorDig ExCom October 2017

- **ExCom Oct 2017, typical use cases whenever NGA is used:**

- 1) HEVC + NGA (no legacy audio)

- 2) HEVC + NGA + legacy audio

- **Decision became: No decision of NGA yet**

- → OK with simulcast and legacy audio + NGA (legacy HEVC IRD´s already on the market, and now NorDig HEVC IRD´s without NGA)

- → New main use case

- **ExCom March 2018, typical use case whenever NGA is used:**

- ~~1) HEVC + NGA (no legacy audio)~~

- 2) HEVC + NGA + legacy audio

- Example scenarios:

- Legacy audio normal/HQ + NGA HQ

  100 – 448 kbps   +   NGA

- Legacy audio Low Q/BC + NGA HQ
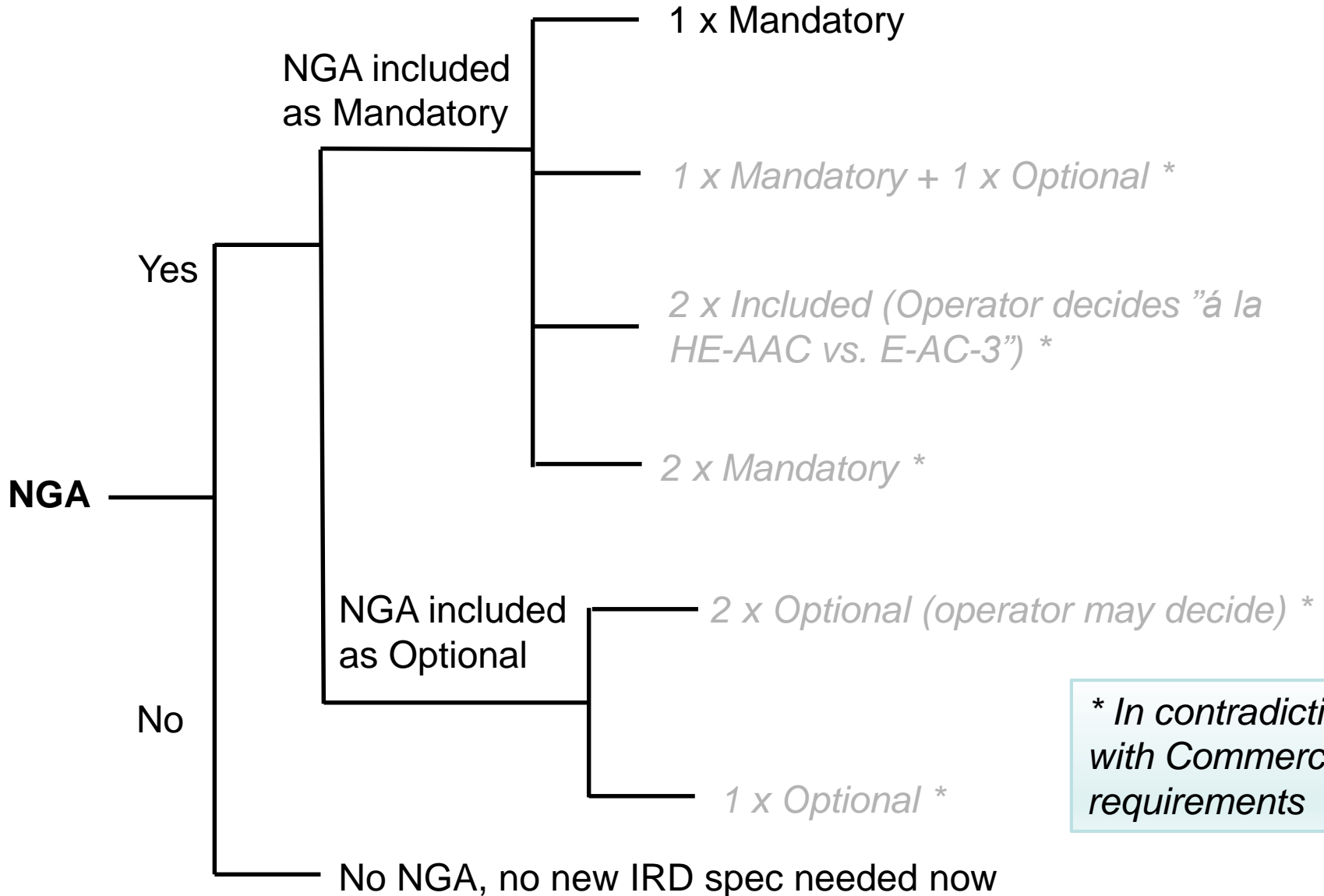
  60 – 200 kbps   +   NGA

From the NorDig Commercial Requirements for NGA (excerpt and shortened):

- General-4: Duplication of tools or codecs fulfilling the same commercial requirement shall be avoided, i.e. no toolbox if possible.
- Audio-1: Follow DVB
- Audio-2: The inclusion of a new audio codec (NGA) derived on needs from NorDig members, or improved functionality of existing audio codecs
- Audio-3: The new NGA codec shall be added to the existing ones
- Audio-4: New features that should be considered:
  - Descriptive audio
  - Spoken subtitles
  - Multi-language
  - Dialogue enhancement
  - Additional dialogue services
  - Down-mixing
  - Immersive audio
  - Transcoding of NGA format to "legacy codec" (for external output)
- Audio-5: Audio priority. Priority between multiple audio streams within a service shall be well and un-ambiguous updated to handle also new audio codecs listed in NorDig specification. The same priority for older audio streams.
- Audio-6: Loudness management.
- Audio-7: Audio output without need for external decoder
- Audio-8: The IRD must be able to down-mix any type of audio content, as well as be able to present audio for different speaker set-ups.
- Audio-9: Receiver mixing of audio streams and the possibility to change level

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From the NorDig Commercial Requirements for the alternative "No NGA codec" (excerpt and shortened):

- Audio-1: Follow DVB
- Audio-2: Shall maintain existing set of audio codecs
- Audio-3: n/a
- Audio-4: New features that should be considered:
    - Descriptive audio
    - Spoken subtitles
    - Multi-language
    - Dialogue enhancement
    - Additional dialogue services
    - Down-mixing
    - Immersive audio
    - Transcoding of NGA format to "legacy codec" (for external output)
    - Any added or improved functionality shall be realised using the audio codecs already included in the specification, and should not introduced a significant increase in implementation complexity. Solutions significantly different from what has been adopted in other horizontal markets, (e.g. DTG), should be avoided.
- Audio-5: Audio priority. Do not change.
- Audio-6: Loudness management.
- Audio-7: Audio output without need for external decoder
- Audio-8: The IRD must be able to down-mix any type of audio content, as well as be able to present audio for different speaker set-ups.
- Audio-9: Receiver mixing of audio streams and the possibility to change level between dialogue and Music & Effects.

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Reasonable Selection alternatives

NGA

- **Yes**
  - NGA included as Mandatory
    - 1 x Mandatory
    - *1 x Mandatory + 1 x Optional **
    - *2 x Included (Operator decides "á la HE-AAC vs. E-AC-3") **
    - *2 x Mandatory **
  - NGA included as Optional
    - *2 x Optional (operator may decide) **
    - *1 x Optional **
- **No**
  - No NGA, no new IRD spec needed now

* In contradiction with Commercial requirements

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For IRD specification:

- Priority list. The proposal is that if there exists an NGA stream, it is prioritised over all legacy audio codecs. Therefore, if NGA exists, it will need to be a complete service.

- Legacy audio streams are then prioritised in the same way as in the existing IRD specification.

- For the IRD that may have an HEVC decoder, but no NGA decoder, it identifies a legacy audio stream and decodes audio per the legacy audio priority order.

- Legacy video services may be present in parallell, so there will be accessibility service there as well

Conclusions from NorDig Audio Sub Group

- Select one NGA alternative: Fulfills NorDig Commercial Requirements. New Audio and video TTML. No need for simulcast of legacy audio*. Non-HEVC IRD´s can still be on the market

- Wait (NGA maybe later): If NGA is selected later, legacy audio codec still needs to be simulcasted

- Both NGA alternatives still in IRD spec, but only optional: Risk of no NGA at all within 5 to 10 years.

- No NGA at all, Only legacy codecs: The future for audio will be delayed. NGA may never happen för HEVC IRD´s
- Select one NGA codec and have the other NGA codec as optional: More testing might be needed for the manufacturers

- TV industry asking for commitment to really use NGA if NGA is mandated for NorDig HEVC IRDs

*) Already existing legacy "HEVC" IRD´s on the market that does not have NGA, may need simulcast of legacy audio   9

Key criteria for codec evaluation and discussion

- Licensing fee for operators / receiver manufacturers

- Status in DVB, specification

- Country adoption

- Status in other regions (US, Asia, Europe, etc.)

- Service situation including trials

- Features (special features, etc.)

- Eco system

    – Production environment support

    – Continuity chain support (metadata handling, manufacturers, etc.)

    – Headend system support (encoder)

    – TV/STB support (product examples if possible or coming products year 2017(?), 2018, 2019, etc. (if possible))

    – TV/STB SOC support

    – AV Receiver and Soundbar support (product examples if possible or coming products year 2017(?), 2018, 2019, etc. (if possible))

- Codec efficiency

Audio Sub Group input

- Specific questions from ExCom:
  - More detailed comparison table
  - Codec efficiency
  - Connection from IRD to AVR/Soundbar
  - Production work flow
  - AC-3 patent has expired, what are the implications regarding this?
  - Dolby Atmos/AC-4/E-AC-3 explained

Facts and compare: MPEG-H Audio vs Dolby AC-4 – discussion point:

Topic	MPEG-H	AC-4
Cost for Device Manufacturers	ISO/IEC IPR policy applies, IPR statements under FRAND conditions publicly available from Fraunhofer, Dolby, Technicolor, Qualcomm, etc Indicative prices: http://www.mpeghaa.com/licensing.html* Low volume $0.99, Typical volume $0.76, High volume $0.45 * Fraunhofer and Qualcomm included	Zero extra cost for TVs/STBs that already includes Dolby Audio (virtually all TVs and the majority of STBs) Licensed under FRAND conditions, pricing for devices without existing Dolby Audio Low volume $1.20, Typical volume $0.85, High volume $0.50,
Cost for Broadcasters	Free to use by broadcasters • New encoding platform needed as part of next generation video encoding solutions	Free to use by broadcasters • New encoding platform needed as part of next generation video encoding solutions
Codec efficiency *(add as a separate slide in presentation, Request from Ingve)*	• Both do the job • Both have similar audio reproduction quality • Approximately double as effective as previous codecs ** Audio quality may have improved for both codecs since the listening test which was made 2015*	
Country adoption / Service situation	UHD ATSC 3.0 regular DTT service in South Korea: • Mandated as the only audio codec for the terrestrial TTA specification in South Korea: "Transmission and Reception for Terrestrial UHDTV Broadcasting Service" • MPEG-H Audio system is the first and only NGA deployment on a regular service anywhere in the world • 24/7 service by 3 broadcasters (KBS, SBS and MBC) with 4 programs	The only NGA codec mandated in a DVB based country specification Mandated as the only NGA codec for Italian, UHD Book 1.0 unified specification for Satellite and Terrestrial TV. Recommended as the only NGA audio codec for ATSC 3.0 in USA, Mexico and Canada DVB channels including immersive trials on-air in DTT in France (since 2015), Spain (since 2015), Poland (since 2017); Pan-European FTA satellite (since 2017), USA (since 2015)

Facts and compare: MPEG-H Audio vs Dolby AC-4 – discussion point:

Topic	MPEG-H	AC-4
UHD Encoders	Live UHD Video Encoders supporting the complete MPEG-H Audio NGA feature set (LC Profile Level 3): • DS Broadcast • KaiMedia • PixTree • MediaExcel Fraunhofer has indicated that other brands are coming to market in close future.	Live UHD Encoders: • Harmonic (inc. ex-Thomson) • Ericsson (inc. Envivio and ex-Tandberg) • Ateme (AC-4 pass-through confirmed) • KaiMedia • DS Broadcast Dolby has indicated that other brands are coming to market in close future.
Standardisation	ISO/IEC 23008-3 Open International Standard • MPEG reference source code in FDIS (final draft) • MPEG conformance test streams available • MPEG test criteria for test streams and decoders. • MPEG-H LC Profile Level 3 development kit offered by Fraunhofer • Fraunhofer further supports manufacturers with additional test packages and a Trademark Program for Receivers.	AC-4 Open International Standard: ETSI TS 103 190-2 • Full AC-4 development kit available to all licensees • Dolby AC-4 is a complete solution that covers more than just a patent licensing fee. • It includes an optimised software development kit, test streams, documentation, three-tier support, and product certification services. • Stringent conformance testing for device interoperability
IRD manufacturer´s support	TV sets in Korea for ATSC 3.0: • LG • Samsung Chipset vendors: • Mstar, Realtek, Analog Devices* and Cadence *For AVR/Soundbar	TV Sets available for DVB countries worldwide: • LG • Samsung • Sony • Sagemcom (STB) AC-4 planned and announced: • TP Vision • Vizio • Skyworth • TCL Chipset vendors: MStar, MediaTek, Broadcom, Cadence, Hisilicon, Sigma

Facts and compare: MPEG-H Audio vs Dolby AC-4 – discussion point:

Topic	MPEG-H	AC-4
AV Receiver/Soundbar Support	MPEG-H provides a unique solution for separating UI and decoding: • User Interactivity (personalization and accessibility) in the IRD • MPEG-H decoding in the (immersive) AVR/Soundbar Immersive Soundbars with integrated MPEG-H decoder announced from Sennheiser, Samsung and Qualcomm • *"Qualcomm designed the audio components to support a soundbar in the sub-$300 price range"* Existing AVRs/Soundbars: MPEG-H decoding in the IRD and re-encoding to legacy formats (up to 5.1) as specified in Nordig Unified IRD	AC-4 is unique in enabling the delivery of Dolby Atmos with NGA • Dolby Atmos is a standard feature in most home theatre products with AVRs and soundbars in-market for 4 years, down to €300 • Connectivity to all deployed Dolby Atmos AVRs and soundbars is achieved by decoding AC-4 in the IRD and re-encoding using existing Dolby formats • This ensures that decoded AC-4 can be consumed on any existing equipment, and those with Dolby Atmos devices will receive immersive audio from immersive AC-4 broadcast • AC-4 bitstreams can also be transferred over HDMI • Dolby Atmos Products from: Yamaha, Onkyo, Sony, Samsung, LG, and more

Production/Continuity chain/Headend support	Live Production (SDI, MADI and IP interfaces):
	• Real time Authoring and monitoring
	    • Jünger and Linear Acoustics (full NGA feature set)
	Post Production:
	• DAW plug-ins
	    • NAT Spatial Audio Designer and DSpatial
	• Native support in Pyramix DAW:
	• Full Suite of products and tools from Fraunhofer IIS
	• Integration with Lawo, Calrec consoles
	• Teleview, Aircode
		• Full Suite of products and tools from Dolby for AC-4 and Atmos
		• Native support for Dolby Atmos in Avid ProTools
		• Plug-ins for Steinberg and Merging Technologies
		• Integration with Lawo, Calrec, DigiCo and Avid consoles
		• Integra Systems, DekTec, Axon, BBright

Codec efficiency (1/2)

- Both do the job

- Both have similar audio reproduction quality

- AC-4 and MPEG-H were compared in a listening test by ATSC in 2015[1], [2]
  https://www.dvb.org/search/results/only/documents/page/1/items/12/groupid/11/keywords/TM-AVC0803

- Approximately double as effective as previous codecs

- Codec efficiency increaes with more audio services, for example multiple languages

*1) Audio quality may have improved for both codecs since the listening test which was made in 2015

*2) Some of the tests conducted did not use the MPEG-H LC profile. MPEG conducted thorough listening tests for all different tools of the LC profile

Codec efficiency (2/2)

- ATSC listening test:
  - comparison of AC-4 and MPEG-H in a single listening test
  - Available for DVB members as document TM-AVC0803
  - TM-AVC0803, "ATSC Response to DVB TM-AVC Liaison on ATSC 3.0 Audio"
  - https://www.dvb.org/search/results/only/documents/page/1/items/12/groupid/11/keywords/TM-AVC0803
  - Some of the tests conducted did not use the MPEG-H LC profile
    - MPEG conducted thorough listening tests for all different tools of the LC profile

MPEG-H Audio
TV connected with Soundbar over HDMI ARC
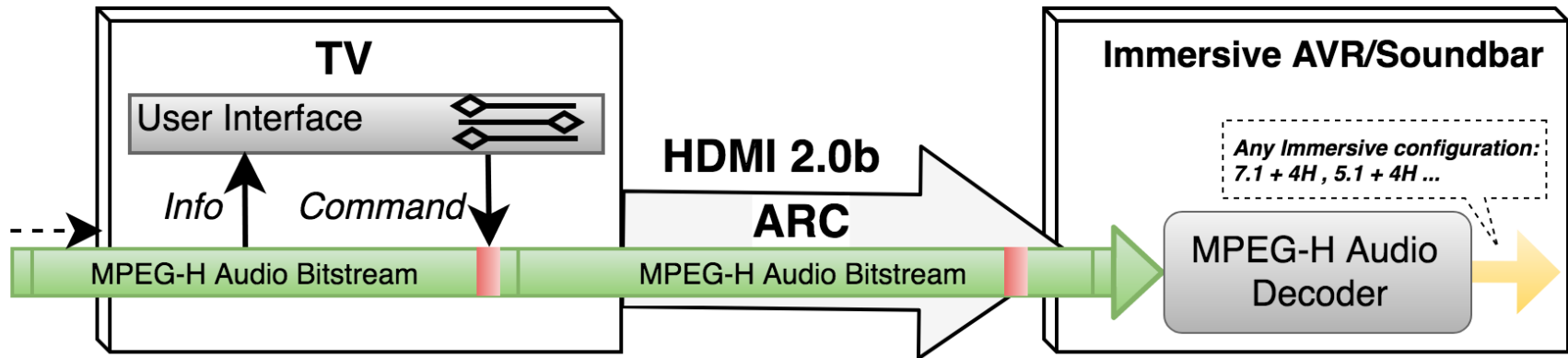
* Info — standardized MPEG-H packet for Audio Scene Info
* Command — standardized MPEG-H packet for Interactivity Info

Immersive Soundbar connectivity

- No MPEG-H decoding in the TV, interactivity/accessibility features enabled in TV set
- TV embeds User Interaction information into MPEG-H bitstream
- TV passes the MPEG-H bitstream to Soundbar over HDMI 2.0b (ARC)
- MPEG-H Audio decoding in Soundbar

Stereo TV output: MPEG-H decoding in the TV

Existing AVRs/Soundbars: MPEG-H decoding in the TV and re-encoding to legacy formats (up to 5.1) as specified in Nordig Unified IRD
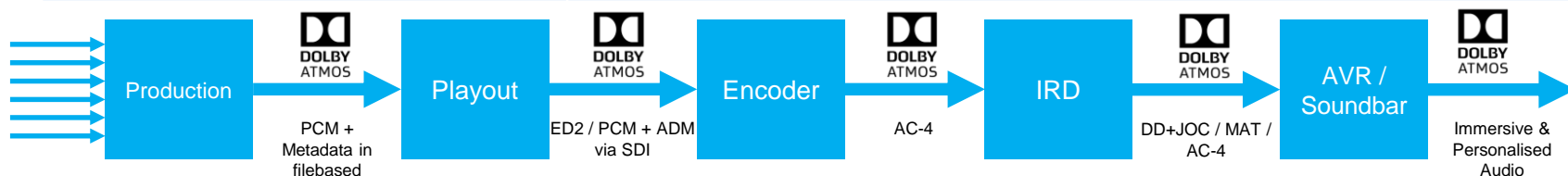
Source: Fraunhofer

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Dolby AC-4
IRD's audio "decoder" and connection to Soundbar
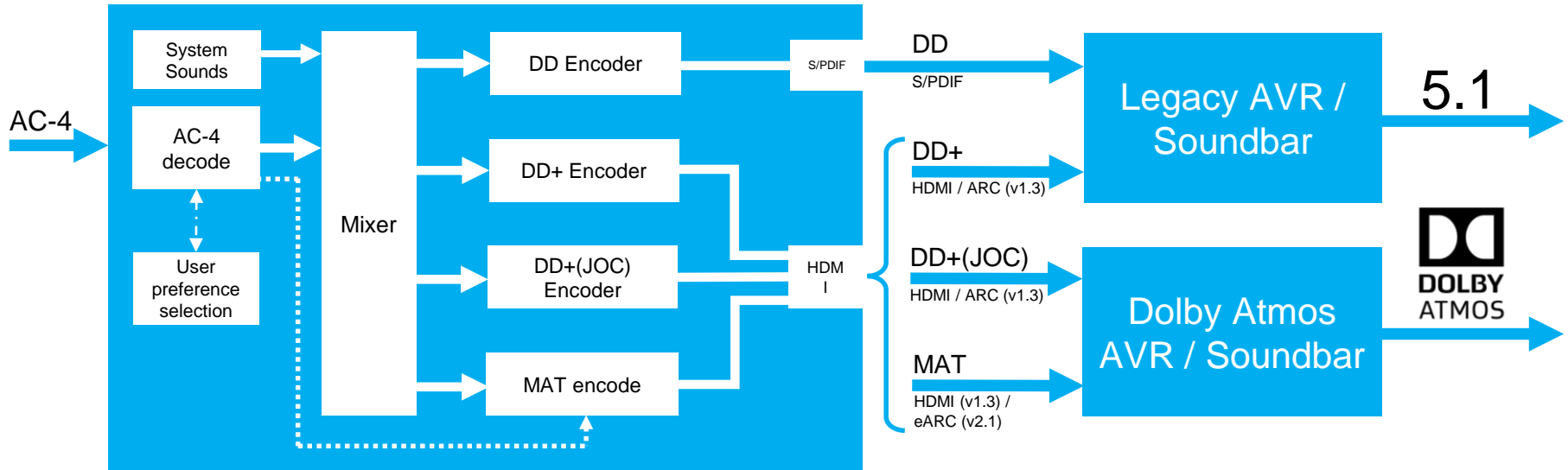
- Personalization made in the IRD and the selected audio sent to the AVR/soundbar
- Uses DD+JOC (or MAT) re-encoding, an integral part of the Dolby deliverable
- This enables the mixing of IRD generated audio (for example audio generated by HbbTV apps, text-to-speech engines, TTML audio description, STB/TV sounds).
- Immersive experience available to all existing immersive (Atmos) devices
- Downmix to 5.1 or stereo for all other legacy equipment
- Minimizes the problems caused by codec and format changes on HDMI
- AC-4 pass-thru is optional

Source: Dolby

Dolby AC-4 - Glossary

Term	Definition
AC-4	ETSI standardised codec (TS 103 190-2) capable of carrying channel and object based immersive and/or personalised audio
Dolby Atmos®	Immersive audio experience; delivered to consumers using Dolby's technologies. And very widely deployed throughout the entertainment ecosystem since 2012
Dolby Digital Plus™	Dolby's implementation of the ETSI standardised technology, E-AC-3
Dolby Digital Plus with Dolby Atmos (also known as DD+JOC)	Dolby Digital Plus, including backwards-compatible object audio carriage using Enhanced AC-3 (specified in ETSI TS 103 420) delivering a Dolby Atmos immersive experience
Dolby Audio™	Dolby's system implementation for TV OEMs consisting of emissions codec decoder, system / supplementary audio mixer and re-encoder for legacy AVR decoding.
Dolby Atmos Enabled TV	A TV including the latest implementation of the Dolby Audio deliverable, currently including: AC-4 decoding, system sound mixing, DD+JOC re-encoding

Production —[DOLBY ATMOS]→ Playout —[DOLBY ATMOS]→ Encoder —[DOLBY ATMOS]→ IRD —[DOLBY ATMOS]→ AVR / Soundbar —[DOLBY ATMOS]→

PCM + Metadata in filebased | ED2 / PCM + ADM via SDI | AC-4 | DD+JOC / MAT / AC-4 | Immersive & Personalised Audio
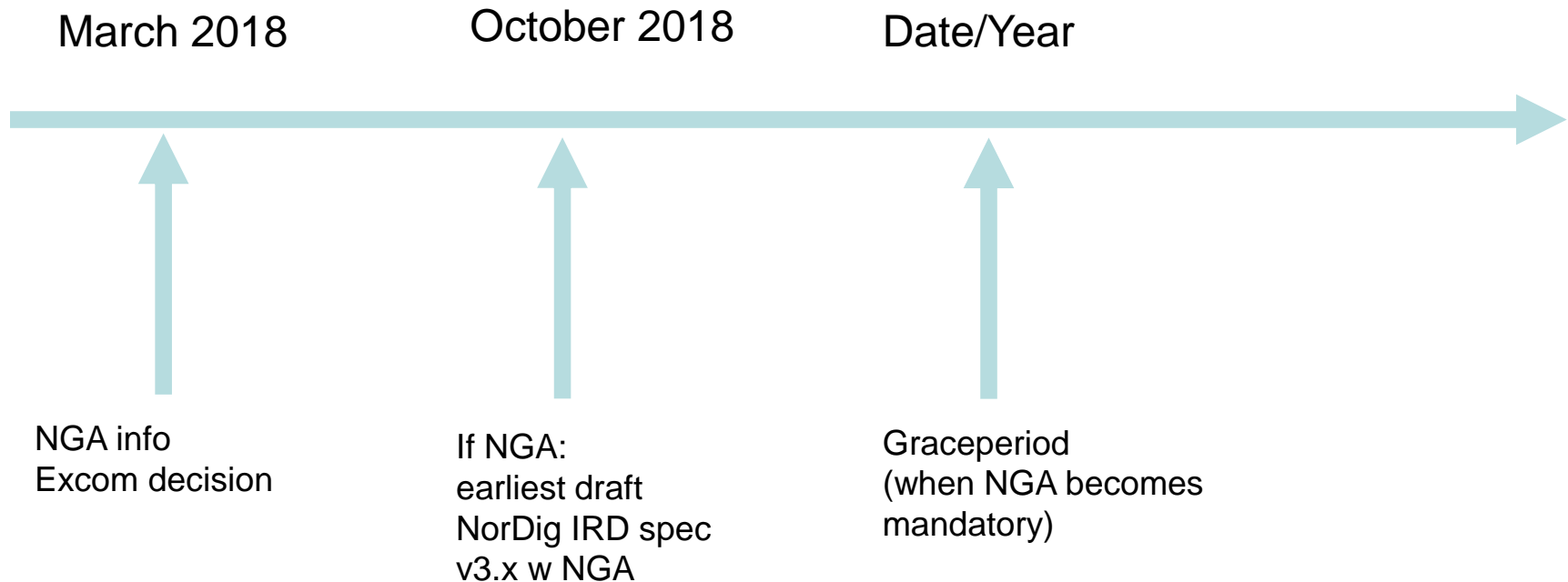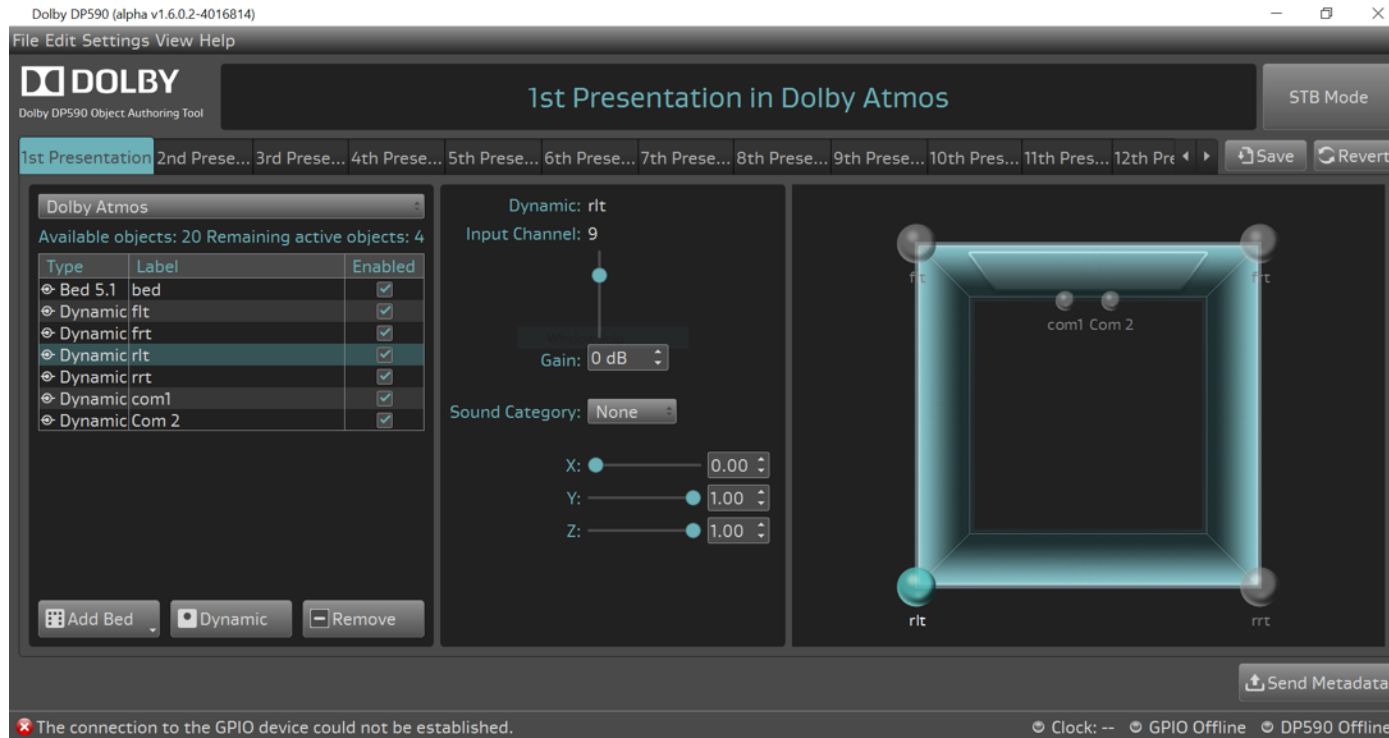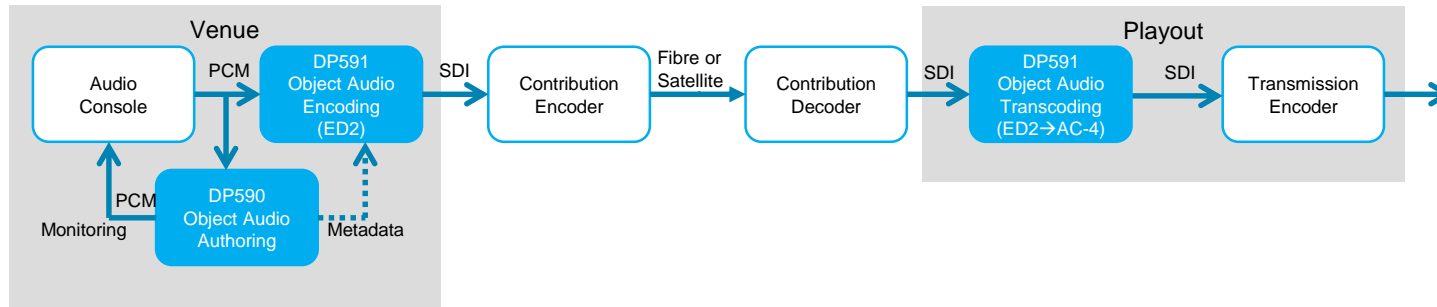
Source: Dolby

Test cases and Rules of Operations

- In addition to the IRD requirements, it is also important for NGA; manufacturers request factors below to ensure a proper implementation:
    - to have NorDig test cases
    - to have established NorDig Rules of Operations for NGA
    - to have test streams (complete transport streams with complete signaling
    - to get support from codec proponents. We have a clear indication from both codec proponents that they will help with this.

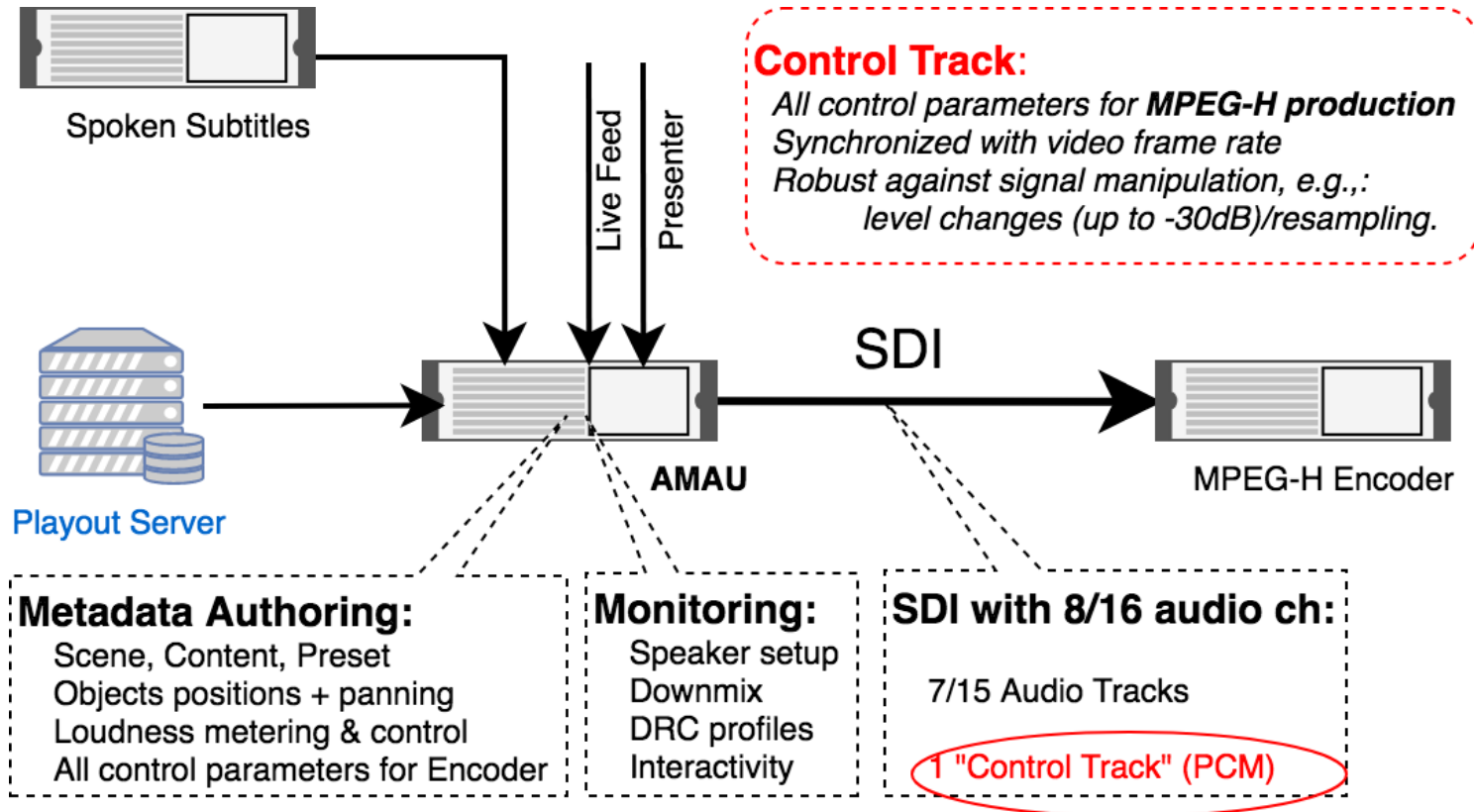# NGA Timeline – To be Specified more during Excom meeting

March 2018

October 2018

Date/Year

NGA info
Excom decision

If NGA:
earliest draft
NorDig IRD spec
v3.x w NGA

Graceperiod
(when NGA becomes
mandatory)

Dolby Atmos and AC-4 Live Workflow

Source: Dolby

MPEG-H Audio – Live Production Example
Unique Solution for Metadata delivery over SDI

Control Track:
All control parameters for **MPEG-H production**
Synchronized with video frame rate
Robust against signal manipulation, e.g.,:
level changes (up to -30dB)/resampling.

Spoken Subtitles

Live Feed

Presenter

SDI

Playout Server

AMAU

MPEG-H Encoder

Metadata Authoring:
Scene, Content, Preset
Objects positions + panning
Loudness metering & control
All control parameters for Encoder

Monitoring:
Speaker setup
Downmix
DRC profiles
Interactivity

SDI with 8/16 audio ch:
7/15 Audio Tracks

1 "Control Track" (PCM)

• MPEG-H metadata delivered transparently over SDI trough the entire production facility

AMAU = MPEG-H Audio Monitoring and Authoring Unit

Source: Fraunhofer 23

END presentation
NorDig-NGA report
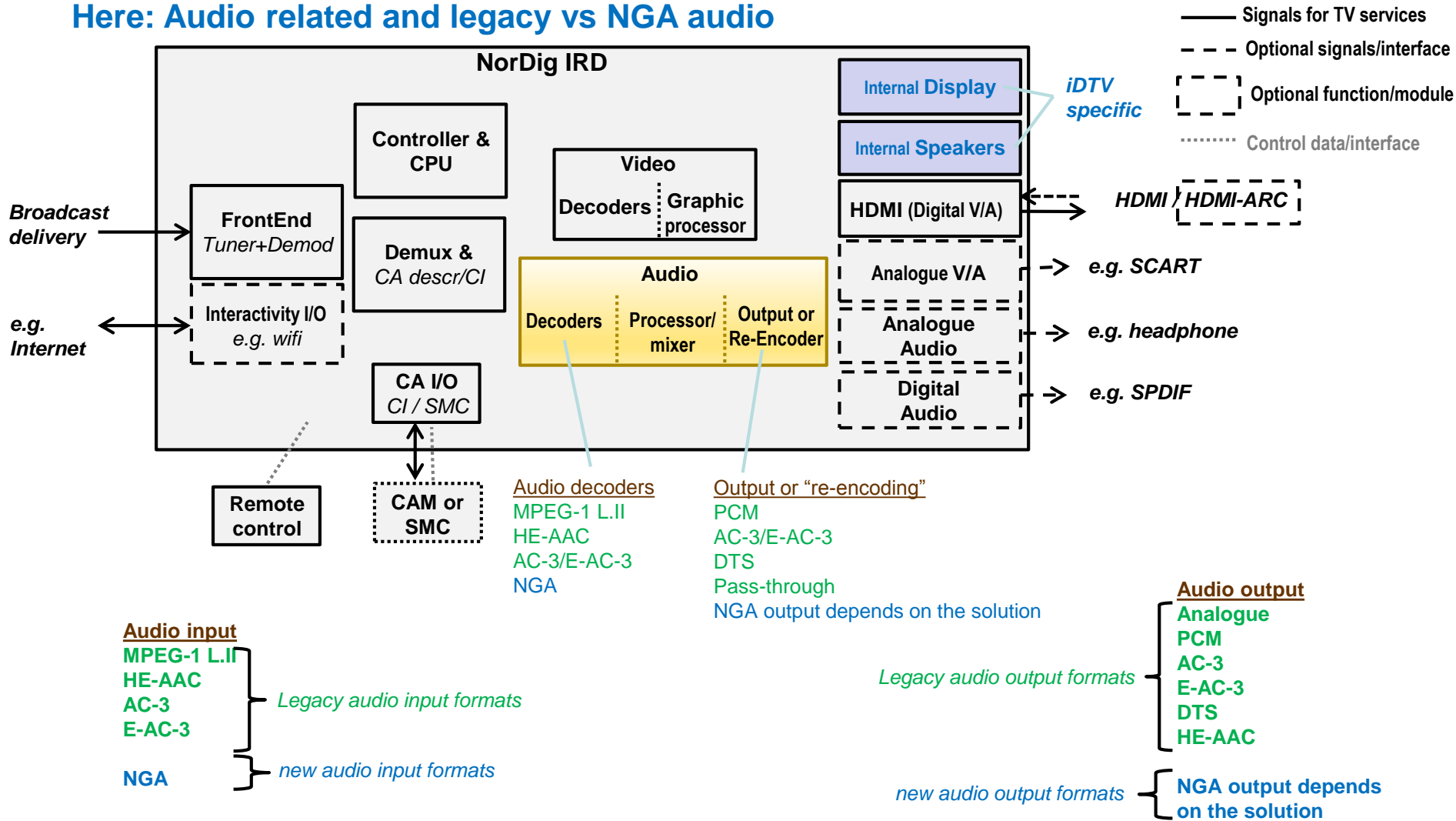
After here some additional informative slides

ANNEX

Annex A: Dolby AC-4 audio

Annex B: MPEG-H audio

Annex: NorDig IRD - Functionality of Hardware and Firmware
Here: Audio related and legacy vs NGA audio

NorDig IRD

Legend:
- Signals for TV services
- Optional signals/interface
- Optional function/module
- Control data/interface

Internal **Display** — iDTV specific
Internal **Speakers**

Controller & CPU
Video Decoders | Graphic processor
HDMI (Digital V/A) → HDMI / HDMI-ARC

FrontEnd *Tuner+Demod* ← Broadcast delivery
Demux & *CA descr/CI*
Audio: Decoders | Processor/mixer | Output or Re-Encoder
Analogue V/A → e.g. SCART

Interactivity I/O *e.g. wifi* ← e.g. Internet
Analogue Audio → e.g. headphone

CA I/O *CI / SMC*
Digital Audio → e.g. SPDIF

Remote control
CAM or SMC

Audio decoders
MPEG-1 L.II
HE-AAC
AC-3/E-AC-3
NGA

Output or "re-encoding"
PCM
AC-3/E-AC-3
DTS
Pass-through
NGA output depends on the solution

Audio input
MPEG-1 L.II
HE-AAC
AC-3
E-AC-3
— *Legacy audio input formats*

NGA — *new audio input formats*

Audio output
Analogue
PCM
AC-3
E-AC-3
DTS
HE-AAC
— *Legacy audio output formats*

new audio output formats — **NGA output depends on the solution**

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Annex A:
Information about AC-4
for NorDig ExCom

Dolby Implementation Cost

- For IRD manufacturers, Dolby AC-4 is competitively priced, with rates that are actually lower than the rates for other Dolby Audio codecs. Dolby only charges for one technology per device, which means that Dolby AC-4 effectively costs nothing in devices that include our existing Dolby Audio technologies.

- For professional equipment manufacturers, the highest per-unit royalty rate is $50 per group of eight transcoders—i.e., $6.25 per encoder
    - https://blog.dolby.com/2015/09/setting-the-record-straight-on-dolby-ac-4-and-mpeg-h/

Dolby Encoding in Devices

AC-4 live encoder support

- Ericsson (inc. Envivio and ex-Tandberg):
  - https://archive.ericsson.net/service/internet/picov/get?DocNo=6/28701-FGB1010708&Lang=EN&HighestFree=Y
  - http://ir.envivio.com/releasedetail.cfm?ReleaseID=930403
  - https://www.thebroadcastbridge.com/content/entry/3817/dolby-demos-live-ultra-hd-with-hdr?cat_id=70
- Ateme:
  - https://www.ateme.com/world-premiere-4ever-2-proud-deliver-ultra-hd-tv-phase-2-live-production-uhd-tv-hfr-100-frames-per-second-dolby-ac-4-audio/
  - https://www.ateme.com/wp-content/uploads/2017/08/ATEME_TITAN_File_Datasheet_August-2017.pdf
  - https://ce-pro.eu/news/home-cinema/first-live-dolby-visiondolby-atmos-broadcast-success/

- Harmonic (inc. ex-Thomson):
  - https://www.harmonicinc.com/news-events/press-releases/read/harmonic-makes-audio-history-first-live-air-atsc-trial-dolby-ac-4/
  - https://www.harmonicinc.com/media/2016/05/Harmonic_DS_ViBE_4K.pdf
- DS Broadcast
  - http://www.dsbroadcast.com/ds/news/news01.html?id=press&exec=view&no=5
- KaiMedia
  - http://www.kai-media.com/Products_4K_UHD_Live_Encoder_eng.html

Dolby AC-4 Country Adoption / Services

- The only NGA codec mandated in a DVB based country specification

- Italian UHD Book 1.0
  - https://www.hdforumitalia.it/documents/uhd-book-1-0/?lang=en
- ATSC 3.0 for North America
  - https://www.thebroadcastbridge.com/content/entry/7989/dolby-ac-4-recommended-for-north-american-broadcasters-migrating-to-atsc
- On-air trials
  - France: France Television (with Dolby Atmos in AC-4 with multiple languages, and Dolby Vision)
    - https://media.broadcasters.rolandgarros.com/Portals/0/site%20commun%20presse-media/NotesInfo/EN/CP%20Roland-Garros%20UHD%20%20Eutelsat-Fransat_EN_REV.DOCX
  - Spain: RTVE (with Dolby Atmos in AC-4 and Dolby Vision)
    - https://www.tvbeurope.com/production-post/spains-rtve-completes-first-live-broadcast-dolby-atmos
  - Poland: TVS
    - http://satkurier.pl/news/162422/testy-dzwieku-ac4-w-multipleksie-lokalnym-tvs.html
  - US: NBC WRAL-TV (including Winter Olympics in AC-4 and Dolby Atmos)
    - https://www.svconline.com/wire/harmonic-makes-audio-history-first-live-air-atsc-trial-dolbyr-ac-4-402129
    - http://www.nab.org/documents/newsroom/pressRelease.asp?id=4422

AC-4 Standardisation

- ETSI Specification
  - http://www.etsi.org/deliver/etsi_ts/103100_103199/10319002/01.02.01_60/ts_10319002v010201p.pdf
- ETSI AC-4 Renderer
  - http://www.etsi.org/deliver/etsi_ts/103400_103499/103448/01.01.01_60/ts_103448v010101p.pdf
- ETSI IPR Policies
  - http://www.etsi.org/about/how-we-work/intellectual-property-rights-iprs

  – Dolby AC-4 is a complete solution that covers more than just a patent licensing fee. It includes an optimised software development kit, test streams, documentation, three-tier support, and product certification services.

  – https://blog.dolby.com/2015/09/setting-the-record-straight-on-dolby-ac-4-and-mpeg-h/

Dolby AC-4 TV and STB Support

TV Sets and STBs available for DVB countries worldwide

- Supported:
  - LG
    - https://www.businesswire.com/news/home/20170104005607/en/
    - http://www.lgnewsroom.com/2017/10/2017-lg-oled-tvs-first-to-offer-dolby-truehd-lossless-sound/
  - Samsung
    - https://www.businesswire.com/news/home/20160414005430/en/
  - Sony
    - https://www.sony.co.uk/electronics/televisions/wf660-wf663-wf665-series/specifications
    - https://www.digitaltvnews.net/?p=26183
  - Sagemcom (STB)
    - Marie-Caroline SARO, T: +33 6 88 84 81 74, E: presse@sagemcom.com

- Announced colaboration:
  - TP Vision
    - https://www.businesswire.com/news/home/20150804005754/en/
  - TCL
    - http://investor.dolby.com/releasedetail.cfm?ReleaseID=1053801
  - Skyworth
    - http://investor.dolby.com/releasedetail.cfm?ReleaseID=1053801
  - Vizio
    - https://www.digitaltvnews.net/?p=26183

Dolby AC-4 Chipset Support

- Mstar
  - https://www.mstarsemi.com/news.php#140
- MediaTek
  - https://www.mediatek.com/products/digitalTv/mt5582
- Broadcom
  - https://av.watch.impress.co.jp/docs/news/1030380.html
- Cadence
  - https://ip.cadence.com/news/571/330/Cadence-Tensilica-HiFi-DSP-Offers-First-processor-IP-Approved-for-Dolby-AC-4-Decoder
- Hisilicon
  - https://advanced-television.com/2016/09/11/hisilicon-to-bring-dolby-ac-4-to-ultra-hd-video-chipset/
- Sigma
  - https://av.watch.impress.co.jp/docs/news/1030380.html

Dolby Support for Soundbars and AVRs

- <u>AC-4 connectivity to soundbars and AVRs is explained on slide 18</u>

- This connectivity ensures that decoded and personalized AC-4 audio can be consumed on any existing audio playback equipment, and consumers with widely deployed Dolby Atmos devices will receive immersive and personalized audio from AC-4 via their IRD

- Full details of almost 100 home audio products with Dolby Atmos from most leading manufacturers, and the ecosystem that supports them, can be found here
- https://www.dolby.com/us/en/technologies/dolby-atmos/home-theater-products.html

- Dolby Atmos Soundbar/AVR products widely deployed worldwide from most leading manufacturers since 2014
- Yamaha, Onkyo, Sony, Samsung, LG, and many more.

- Audio playback devices enabled with Dolby Atmos are already receiving live and recorded Dolby Atmos immersive services and content, from different sources, including via broadcast and OTT services. Services using AC-4 are listed on slide 29; other immersive services using DD+ JOC (E-AC-3) today include Sky, Canal+, Orange, Comcast, Netflix and others

Dolby AC-4 Production Tools

- Full Suite of products and tools from Dolby for AC-4 and Atmos
- Avid Pro Tools
  - https://www.pro-tools-expert.com/home-page/2017/6/24/avid-relase-pro-tools-128hd-with-complete-dolby-atmos-integration
- Steinberg Nuendo
  - https://www.steinberg.net/en/landing_pages/nuendo_7/vst_multipanner_for_dolby_atmos.html
- Merging Technologies Pyramix
  - http://www.merging.com/news/news-stories/pyramix-11-1-to-include-full-object-based-audio-workflow
- Atmos immersive production work flow at Sky, currently using DD+JOC as emission codec
  - https://www.svgeurope.org/blog/headlines/next-generation-audio-summit-inside-skys-implementation-of-dolby-atmos-for-the-latest-premier-league-season-coverage/
- Dolby Professional Audio Tools
  - https://www.dolby.com/us/en/professional/broadcast/products/dp580.html

Dolby AC-4 Continuity / Headend Support Tools

- Interra Systems
  - http://www.interrasystems.com/pr_apr07a_15.php
- DekTec
  - https://www.dektec.com/products/applications/StreamXpert/
- Axon
  - https://hub.dolby.com/partners-sound-video-innovation/
- BBright
  - https://advanced-television.com/2016/09/06/bbright-and-dolby-laboratories-collaborate-to-upgrade-uhd-play/

Annex B:
Information about MPEG-H
for NorDig Excom

MPEG-H Standardisation and Trademark Program

ISO/IEC 23008-3 Open International Standard https://www.iso.org/standard/63878.html
- ISO/IEC 23008-6: 3D audio reference software https://www.iso.org/standard/71973.html in FDIS (final draft)
- ISO/IEC 23008-9: 3D Audio conformance testing https://www.iso.org/standard/71974.html (under development)
  - MPEG conformance test streams draft available
  - MPEG test criteria for test streams and decoders

The performance of MPEG-H Audio was carefully evaluated by MPEG:
  - https://mpeg.chiariglione.org/standards/mpeg-h/3d-audio/mpeg-h-3d-audio-verification-test-report
  - More than 15000 subjective ratings, from 288 expert listeners, in 7 independent test labs.
- MPEG-H LC Profile Level 3 development kit offered by Fraunhofer
  - http://www.mpeghaa.com/support.html
  - https://www.iis.fraunhofer.de/en/ff/amm/prod/digirundfunk/digirundf/tvaudio.html
- MPEG-H Trademark Program
  - AT CES 2018, Fraunhofer launched the MPEG-H trademark program website for manufactures and consumers: www.mpegh.com

MPEG-H broadcast encoder support

- Live UHD Encoders supporting the complete MPEG-H Audio NGA feature set (LC Profile Level 3):

- KaiMedia 4K UHD Live Encoder
    – http://www.kai-media.com/Products_4K_UHD_Live_Encoder_eng.html
- DS Broadcast Encoder
    – https://www.iis.fraunhofer.de/en/pr/2016/20160413_broadcast_encoder.html
    – http://www.dsbroadcast.com/ds/product/?A=1&uid=3
- PixTree Encoder
    – https://www.iis.fraunhofer.de/en/pr/2017/20170103_Pixtree.html
- MediaExcel UHD Encoder
    – https://www.iis.fraunhofer.de/en/pr/2016/20160906_Mediaexcel.html

- Those encoders are commercially available and are used in Korea on-air for the regular UHD service.

MPEG-H Authoring and metadata creation

- Live Production Units supporting the complete MPEG-H Audio NGA feature set (LC Profile Level 3), commercially available :
  - Jünger MMA - Multichannel Monitoring and Authoring
    - https://junger-audio.com/uploads/brochure/598c7b9a6a612d242d1d0000/ju_nger_Brosch_MMA_lowres_170804.pdf
  - Linear Acoustics AMS - Authoring & Monitoring System
    - https://www.telosalliance.com/Linear/Linear-Acoustic-AMS-Authoring-Monitoring
- Professional Decoders and Stream Monitors:
  - Teleview
    - http://www.teleview.com/tlv500
  - Aircode
    - http://www.aircode.com/eng/products/Products01.asp

MPEG-H Authoring and metadata creation post-production

- Post Production DAW plugins supporting the complete MPEG-H Audio NGA feature set (LC Profile Level 3):
  - New Audio Technologies:
    - https://www.newaudiotechnology.com/en/the-spatial-audio-designer-version-2/
  - DSpatial:
    - http://www.mpeghaa.com/nab2017.html
  - Pyramix DAW: Native MPEG-H Audio export in DAW
    - http://www.merging.com/news/news-stories/pyramix-11-1-to-include-full-object-based-audio-workflow
  - MPEG-H Authoring Tool:
    - https://www.iis.fraunhofer.de/en/muv/2017/nabshow-2017.html
- Integration with consoles
  - Calrec
    - https://soundandpicture.com/2015/04/fraunhofer-partners-with-calrec-for-worlds-first-live-broadcast-demo-of-mpeg-h-tv-audio-system/
  - Lawo
    - http://www.tvtechnology.com/equipment/0005/lawo-teams-up-with-new-audio-technology-on-lime/281880
    - https://www.lawo.com/de/aktuell/news/nbsp/cooperation_with_new_audio_technology_lawo_introduces_lime_immersive_mixing_engine_for_mc2_consoles.html
- THX end-to-end solution
  - https://www.prnewswire.com/news-releases/thx-announces-end-to-end-positional-audio-solution-300603754.html

MPEG-H TV Support

- TVs supporting the complete MPEG-H Audio NGA feature set (LC Profile Level 3) are already available on the market in Korea since May 2017:
- LG (Korea ATSC 3.0)
  - https://www.iis.fraunhofer.de/en/pr/2017/20170105_MPEGH_LG.html
- Samsung (Korea ATSC 3.0)
  - http://www.businesswire.com/news/home/20170601006518/en/South-Korea-Launches-UHD-TV-MPEG-H-Audio

MPEG-H Chipset Support

- Chip sets supporting the complete MPEG-H Audio NGA feature set (LC Profile Level 3):
- Mstar
  - http://www.mstarsemi.com/news.php?#141
- Realtek
  - https://www.iis.fraunhofer.de/en/pr/2017/20170915_AME_Realtek.html
- Analog Devices
  - http://www.businesswire.com/news/home/20170905006224/en/Fraunhofer-IIS-Analog-Devices-showcase-MPEG-H-Audio
- Cadence
  - https://www.cadence.com/content/cadence-www/global/en_US/home/company/newsroom/press-releases/pr/2016/cadence-offers-industrys-first-licensable-mpeg-h-audio-decoder-f.html

MPEG-H Soundbar support

- <u>MPEG-H connectivity to planned soundbars and AVRs is explained on slide 17</u>

- MPEG-H personalization and accessibility can be applied in the IRD without MPEG-H decoding by embedding user interactivity commands into the original MPEG-H bitstream.

- The immersive MPEG-H bitstream transferred over HDMI to an MPEG-H enabled Immersive Soundbar offers the unaltered immersive audio quality as it is provided by the broadcaster in the emission bitstream to the IRD.

- The first planned soundbar supporting MPEG-H has been shown by Sennheiser at the CES 2018:
  - https://www.engadget.com/2018/01/11/sennheiser-ambeo-3d-soundbar/
  - https://www.digitaltrends.com/home-theater/sennheiser-first-soundbar-ambeo-3d-surround-dolby-atmos/

- Samsung Soundbar with MPEG-H, planned support announced at CES 2018:
  - http://www.avsforum.com/samsung-soundbars-ces-2018/

- MPEG-H soundbar developed by Qualcomm:
  - "*Qualcomm designed the audio components to support a soundbar in the sub-$300 price rang*e"
  - https://www.tomsguide.com/us/qualcomm-mpeg-h-soundbar,news-26605.html

MPEG-H service situation

- On May 31, 2017 South Korea launched its 4K UHD TV service
  - The MPEG-H Audio system became the first and only NGA deployment on a regular service anywhere in the world.
  - http://www.audioblog.iis.fraunhofer.com/south-korea-uhd-tv-mpeg-h/
- Regular 24/7 service by 3 broadcasters (KBS, SBS and MBC) with 4 programs
  - https://www.atsc.org/newsletter/going-global-atsc-3-0-4k-broadcasting-launched-korea/
  - *"Leading terrestrial broadcasters (KBS, MBC and SBS) started their main service – 4K Ultra HD channels – in the Seoul metropolitan area on May 31"*