Dolby Audio Encoder DP591

Product specification

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Contents

1 Introduction

The Dolby Audio Encoder DP591 is a real-time encoder and transcoder that supports processing and delivery of live audio feeds, including Dolby Atmos immersive audio.

1.1 Overview

The DP591 is the encoder to support the implementation of immersive audio within existing live production creation, contribution, and distribution infrastructures.

The Dolby Audio Encoder DP591 delivers live audio that includes Dolby Atmos audio content, and also fully supports 5.1 and stereo audio formats.

The DP591 enables the audio engineer to:

- Encode PCM audio stems and metadata to the Dolby ED2 contribution format, to Dolby Digital Plus, or to Dolby Digital Plus with Dolby Atmos content
- Transcode Dolby E to Dolby Digital Plus and Dolby ED2 to Dolby Digital Plus with Dolby Atmos content
- Decode Dolby ED2 content to its original PCM channels

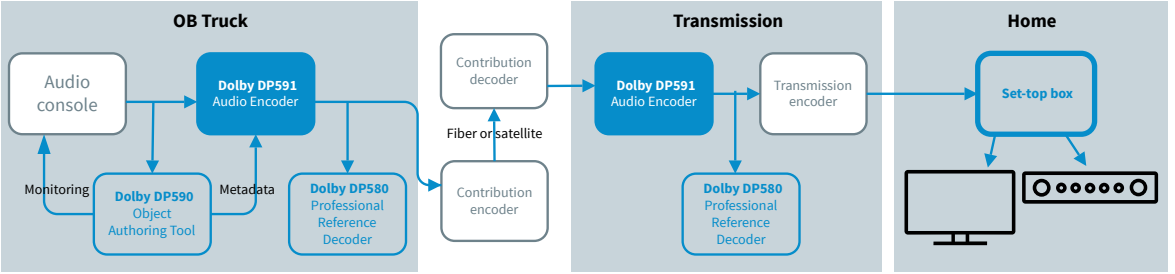
1.2 Key features

The Dolby Audio Encoder DP591 is a key element of the live Dolby Atmos toolkit. The toolkit assists broadcasters, live audio mixers, and engineers in the adoption and delivery of immersive audio for live events.

1.2.1 Workflow

The DP591 performs a role in both the contribution and distribution phases of the broadcast production chain.

The DP591 acts as a real-time audio encoder and transcoder, as shown in the following diagram.



In the outside broadcast (OB) truck, the DP591 ingests PCM audio over SDI or MADI and metadata over IP. It encodes the PCM audio channels and metadata to Dolby ED2.

In the headend, the DP591 transcodes one Dolby E program or one Dolby ED2 presentation to Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content, respectively.

The DP591 can also encode Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content directly from PCM audio, and decode Dolby ED2 to PCM audio without metadata.

1.2.2 Technical benefits

The DP591 delivers proven technology to broadcast providers.

- It supports real-time encoding of PCM audio stems and the associated metadata for delivery over existing contribution and transmission links.
- It transcodes Dolby E and Dolby ED2 streams to Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content to support transmission encoding.
- It decodes Dolby ED2 content to its original PCM channels to support reauthoring of the audio.
- It provides proven design and reliability for installation in existing OB trucks.
- It interfaces with the Dolby DP590 to support the delivery of encoded Dolby Atmos content designed by the sound mixer.

1.2.3 Business benefits

The adoption of the live Dolby Atmos toolkit makes business sense.

- It eliminates the need for broadcasters to make a major investment in new production facilities and OB trucks to deliver great immersive audio experiences to the home and on mobile devices.
- It allows broadcasters to deliver immersive audio for live events that leverages the growing number of Dolby Atmos enabled playback devices.
- It delivers enhanced Dolby Atmos audio using existing contribution and distribution links.

1.3 Live Dolby Atmos toolkit

The live Dolby Atmos toolkit for broadcast applications enables immersive audio authoring, encoding, and monitoring. It consists of the Dolby Object Authoring Tool DP590, the Dolby Audio Encoder DP591, and the Dolby Professional Reference Decoder DP580.

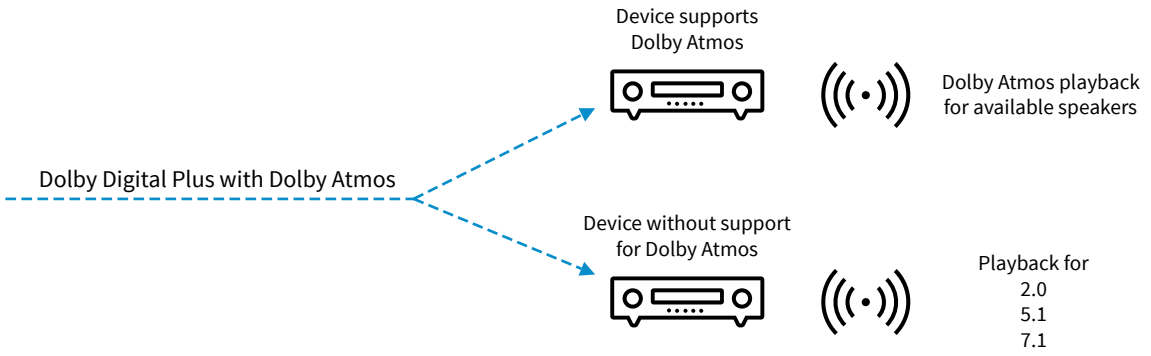
Dolby Atmos

Dolby Atmos brings a new dimension to viewer enjoyment; the immersive audio experience. Widely available in commercial cinemas, it is now being adopted by home viewers. It employs Dolby's channel-based immersive and object-based audio solutions to encode the audio channel bed along with audio objects with explicit positional metadata. This audio and metadata is supported by adaptions to Dolby legacy encoding formats.

These adaptations permit compression, transmission, and decoding in combination with existing production workflows and equipment.

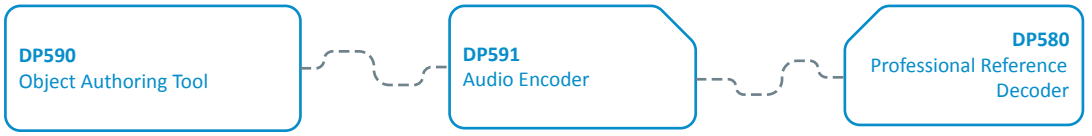
Because Dolby Atmos audio content playback is adaptable and scalable, it provides the best experience for the available playback equipment.

Home viewers with Dolby Atmos playback equipment will enjoy the best immersive experience for their speaker configuration. Even without a Dolby Atmos setup, users can still play Dolby Atmos content and enjoy the same outstanding sound they have been getting from their stereo, 5.1, or 7.1 system.



Devices to support Dolby Atmos

Each device in the toolkit performs a different role in the production chain. While each operates as a stand-alone unit, the three devices interface with each other to provide complete support for broadcasters who want to add immersive audio to their services.



The number and deployment of each device in a given production chain depends upon the production workflow. To understand how to incorporate the toolkit in the production chain, it is helpful to review the role that each device performs.

1.3.1 Dolby Object Authoring Tool DP590

The Dolby Object Authoring Tool DP590 is a real-time authoring product.

The Dolby DP590 ingests PCM audio from the audio console, and enables the user to author presentations of the audio that include immersive audio objects. Each presentation represents the channel bed, audio object position and gain, as well as channel routing and track selection. It defines these presentations with metadata. It sends the metadata to the Dolby Audio Encoder DP591 to be encoded with the PCM channels to create the Dolby ED2 contribution format, or Dolby Digital Plus with Dolby Atmos content.

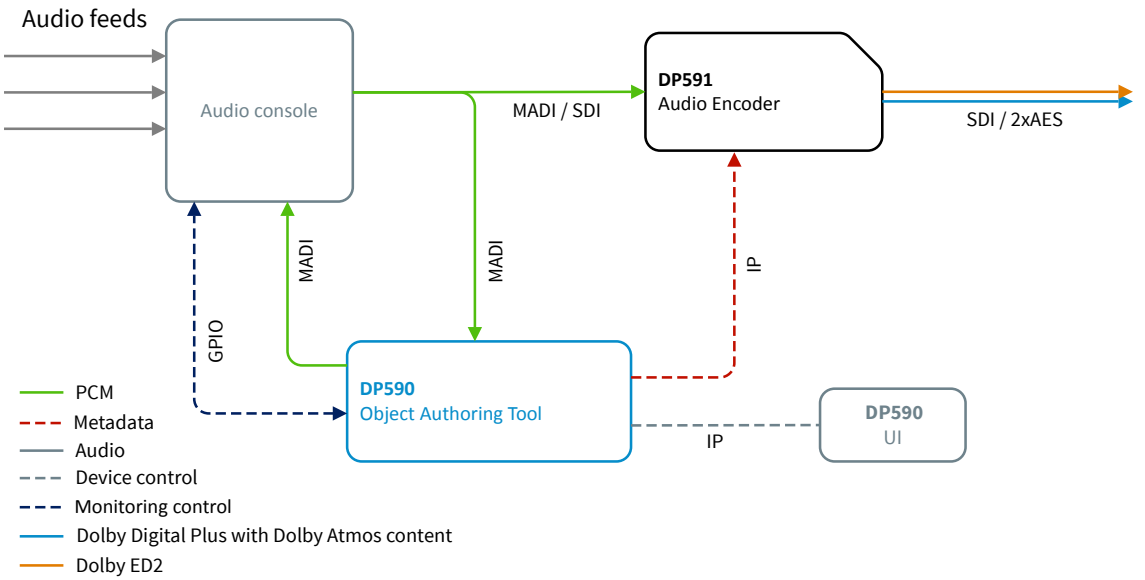
At the same time, the Dolby DP590 sends the audio presentations back to the audio console for real-time monitoring. It renders the presentations according to user selection, allowing the audio engineer to verify the Dolby Atmos mix, as well as legacy 5.1 or 2.0 versions.

The following diagram shows how the Dolby DP590 fits into the broadcast production workflow.

At the live venue

Outside the live venue in the OB truck, the Dolby DP590 supports audio presentation authoring, and monitoring of the modified mix.

Figure 1: Authoring and monitoring Dolby Atmos audio



1.3.2 Dolby Audio Encoder DP591

The Dolby Audio Encoder DP591 is a real-time encoder and transcoder.

On site at the live venue, the audio console sends the same PCM audio feed to both the Dolby DP591 and the Dolby DP590. The Dolby DP591 encodes the feed using metadata it receives from the Dolby DP590. It encodes to the Dolby ED2 contribution format or to Dolby Digital Plus with Dolby Atmos content. It can also use internal metadata to encode to Dolby Digital Plus formats.

From the OB truck, the Dolby ED2 is transmitted to the broadcast center for processing and distribution.

In the broadcast center the Dolby DP591 receives the contribution content and processes the input as follows:

- Transcodes Dolby ED2 to Dolby Digital Plus with Dolby Atmos content
- Transcodes Dolby E to Dolby Digital Plus
- Encodes PCM audio to Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content

The Dolby Digital Plus formats can be distributed to the home set-top box (STB).

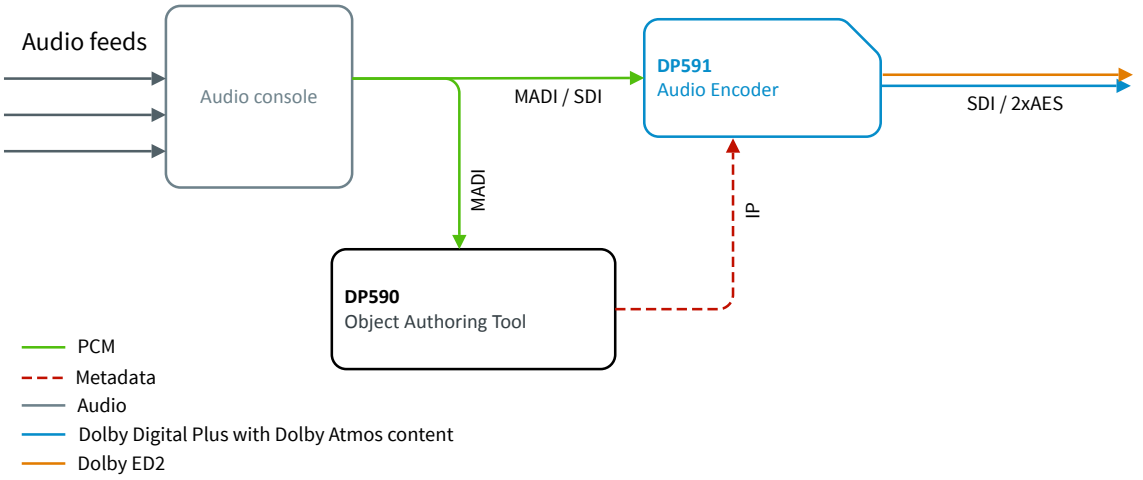
To support audio reauthoring, such as voiceover or remixing, the Dolby DP591 decodes Dolby ED2 to its original PCM channels (without metadata) which can then be routed to a studio environment.

The following diagrams show how the Dolby DP591 fits into the broadcast production workflow.

At the live venue

Outside the live venue in the OB truck, it encodes audio from the live feed.

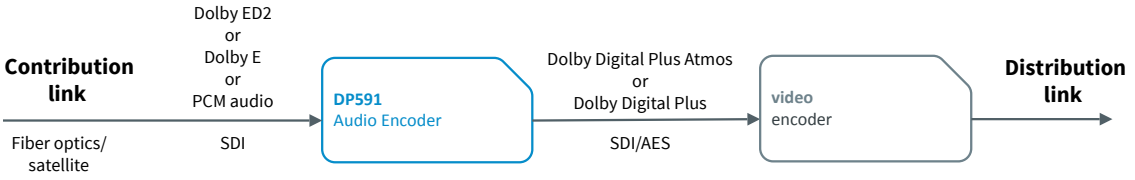
Figure 2: Encoding



In the broadcast center

In the broadcast center, it transcodes the live feed for distribution.

Figure 3: Transcoding



1.3.3 Dolby Professional Reference Decoder DP580

The Dolby Professional Reference Decoder DP580 delivers audio quality control metrics and confidence monitoring at any point in the broadcast chain.

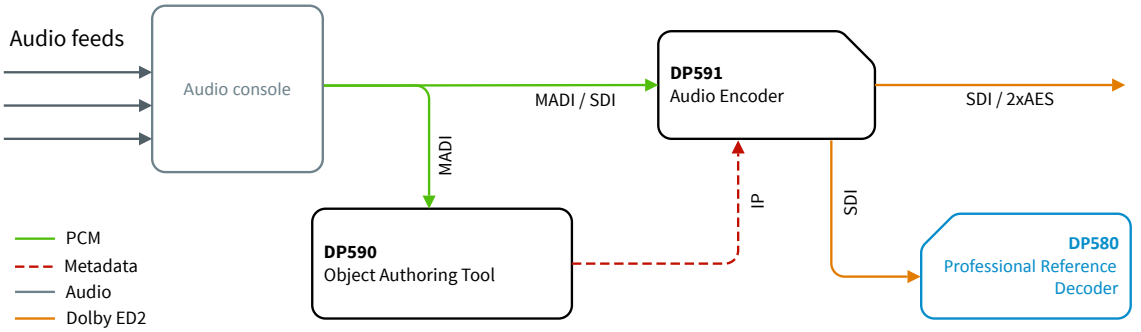
The device monitors Dolby technologies such as Dolby AC-4 and Dolby Digital Plus with Dolby Atmos content, as well as legacy audio formats. It performs loudness measurement, and emulates STB, audio/video receiver (AVR), and TV behavior. It supports multiple input and output types, making it easy to integrate into existing infrastructures.

The following diagrams show how the Dolby DP580 fits into the broadcast production workflow.

At the live venue

Outside the live venue in the OB truck, it monitors the Dolby ED2 created by the Dolby DP591 Audio Encoder.

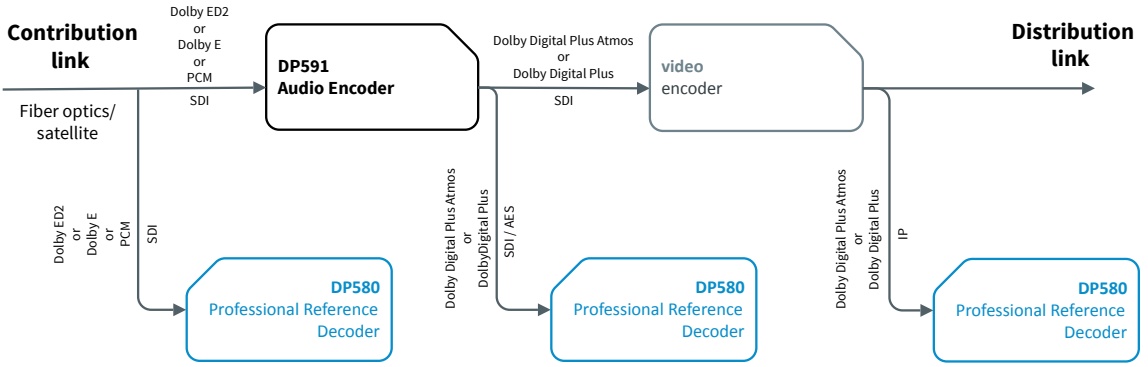
Figure 4: Monitoring content authoring



In the broadcast center

In the broadcast center, it monitors the live feed before transcoding, after transcoding, and after reembedding in the video for distribution.

Figure 5: Monitoring broadcast content



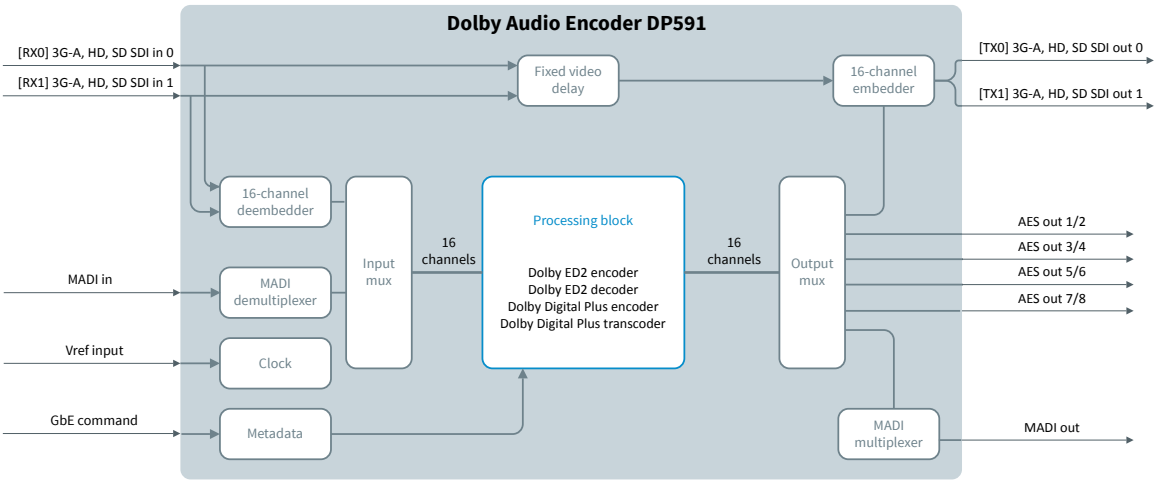
2 Device description

The Dolby Audio Encoder DP591 is a rack-mountable, real-time encoder that performs audio encoding and transcoding within a live broadcast workflow.

2.1 DP591 block diagram

The block diagram illustrates the audio processing flow through the DP591 device.

Figure 6: DP591 block diagram



2.2 Operating environment

The DP591 operates in stand-alone mode, under the control of a web GUI provided by an internal HTTP server over an IP connection to the command port.

The UI provides full control of the device system settings, processing services, clock source configuration, software updates, SNMP management, and event logs. It includes a user's guide, available from the UI main menu.

The device provides status and processing feedback through LEDs and indicators on the front panel, graphical LEDs and event logs in the UI, and SNMP event traps. The front panel provides controls for setting the device IP address.

To perform contribution encoding, the DP591 is located in the OB truck. It takes input from the audio mixing console over MADI or SDI ports, and receives metadata files from the Dolby Object Authoring Tool DP590 over IP. It provisions output over mirrored SDI ports, and AES ports.

As a transcoder for playout distribution, the DP591 is located in the broadcast center. It takes input from the contribution link over SDI ports. It provisions output over mirrored SDI ports and AES ports.

Also in the broadcast center, the DP591 can decode the SDI input Dolby ED2 for output to PCM audio over SDI or MADI outputs. This output is typically routed to a studio for audio reauthoring.

The device can be connected to two independent power sources through dual autoswitching power supplies. It supports SNMP event trapping to provide management and redundancy support over the IP link. This enables the configuration of 1:1 hot redundancy for the device by provisioning a second DP591 with the same settings as the primary DP591 unit.

2.3 General features

The DP591 performs three primary functions in the live production workflow: encoding to contribution and transmission formats, transcoding for playback transmission, and decoding to PCM audio for reauthoring purposes. The device components support each of these roles.

The following tables give a summary of the DP591 feaures.

Hardware

Feature	Description
Chassis	• Single rack unit (1 U rackmount). • Mounts in Electronic Industries Association (EIA) standard rack. • Dual, hot-swappable, autoswitching AC power supplies support power source redundancy. • Temperature-controlled fans provide front-to-rear air flow.
Local Control Panel	• Four-line, 20-character easy-to-read FSTN LCD display. • Six-button LED backlit keypad. • Four multicolor (red, yellow, green) status LEDs.

Software

Feature	Description
Operating System	• Ubuntu (Linux)
Control	• From a web client GUI • Front-panel control for setting command IP address
Upgrades	• From the GUI (see the user's guide for instructions)

Input

Feature	Description
MADI/AES	One female 75Ω BNC unbalanced connector. This input supports: • MADI: Signal levels per AES-10-2008 • AES: Not used
SDI	Two autodetecting, female 75Ω BNC unbalanced connectors. These inputs support: • 1.5 Gbps HD-SDI (SMPTE 292M-1998) • 3 Gbps 3G-SDI (SMPTE 424M-2012) Level A
Gigabit Ethernet	• One 1000Base-T Ethernet RJ-45 connector command port. • One 1000Base-T Ethernet RJ-45 connector media port.
Video Input Vref	One female 75Ω BNC unbalanced connector. This input supports Vref signal sync types: • Black burst: ITU-R BT.1700 (PAL), SMPTE ST 170 (NTSC) • HD tri-level: SMPTE 274M, SMPTE 296M
USB	• Four USB 2.0 (480 Mbps) ports on back panel • Two USB 2.0 (480 Mbps) ports on front panel
VGA video port	Not used.

Output

Feature	Description
SDI	Two autodetecting, female 75Ω BNC unbalanced connectors. These outputs support: • 1.5 Gbps HD-SDI (SMPTE 292M-1998) • 3.0 Gbps HD-SDI (SMPTE 424M-2008)
AES	Four female 75Ω BNC unbalanced connectors. These outputs support: • Signal levels per AES3-4-2009
MADI/AES	One female 75Ω BNC unbalanced connector. This output supports: • MADI: Signal levels per AES-10-2008 • AES: Not used

Audio Support

Feature	Description
Input	• PCM audio at 48 kHz • 20-bit Dolby E • 20-bit Dolby ED2
Output	• 20-bit Dolby ED2 • Dolby Digital Plus with Dolby Atmos content at 384, 448, 640 kbps • Dolby Digital Plus at 384, 448, 640 kbps • PCM audio at 48 kHz
Pass-through	• Up to four SDI input groups to the same channels on SDI output, when encoding Dolby ED2
Metadata	• Receives metadata from Dolby Object Authoring Tool DP590 for encoding Dolby ED2 and Dolby Digital Plus with Dolby Atmos content from PCM audio • Generates internal metadata for encoding Dolby Digital Plus and Dolby Digital Plus with Dolby Atmos content from PCM audio • Supports encoding of up to three presentations of audio content from MADI input to Dolby Digital Plus with Dolby Atmos content • Supports transcoding of up to one presentation of audio content from Dolby ED2 to Dolby Digital Plus with Dolby Atmos content
Audio reauthoring	• Decodes Dolby ED2 to PCM audio for reauthoring audio in the studio environment (Dolby Atmos metadata dropped when decoding)

Monitoring

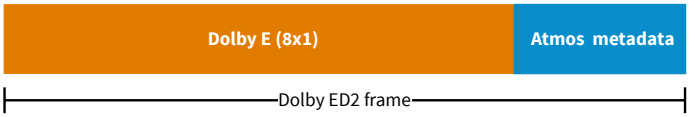
Feature	Description
SNMP	• Supports SNMP v 1.2 monitoring and trap event generation.
Logs	• Event logs record user configuration actions, changes in input or processing status, and error states. • System logs record device status and processing details for review by Dolby technical support. • Available in the UI and for download.

2.4 Audio features

The DP591 supports legacy uncompressed and compressed audio formats, as well as new technologies designed by Dolby to support the immersive audio experience.

The DP591 supports the following audio formats:

Audio Formats

Feature	Description
PCM audio	• Up to 64 channels on MADI input or output. • Up to 16 channels (eight embedded pairs) on SDI input or output. • Two audio channels per AES output. • 48 kHz.
Dolby Digital Plus	• 2.0, 5.1, 7.1 channels digital audio at 384, 448, 640 kbps.
Dolby E	• Six to eight channels of audio compressed as an AES-EBU digital audio stream (20-bit). • Video frame aligned.
Dolby ED2	A contribution format that builds on Dolby E: • Eight channels per AES pair (20-bit). • Video frame aligned. • Audio can be decoded by legacy Dolby E decoders. • Carries object audio metadata. • Typically grouped in two pairs to carry 16 channels of audio plus metadata. This format is designed for mezzanine encoding and professional use. 
Dolby Digital Plus with Dolby Atmos content	An extension to the existing Dolby Digital Plus format: • Supports up to 16 audio objects. For example, a 5.1 channel bed and up to ten Dolby Atmos objects. • Dolby Atmos metadata enables object decoding. • Existing Dolby Digital Plus decoders can decode the core audio elements to replay on 5.1 or stereo systems. Many can pass through the Dolby Digital Plus with Dolby Atmos content content stream to external decoders. • Dolby Atmos AVR or sound bar will decode the core audio and metadata and render to the available speakers. • Mobile apps that support Dolby Atmos playback solutions will decode the Dolby Digital Plus with Dolby Atmos content and render directly to headphones. • 384, 448, 640 kbps. This format is designed for transmission and delivery to consumer devices.

2.5 Video features

The DP591 is equipped to handle serial digital HD-SDI and 3G-SDI Level A video input. It performs no video processing, only pass-through. It maintains audio/video synchronization for all output types.

The DP591 supports the following video formats.

Resolution	Frame rate (fps)
1080i	29.97
1080p	50, 59.94

2.6 DP591 front panel

The front panel provides device control and status information.

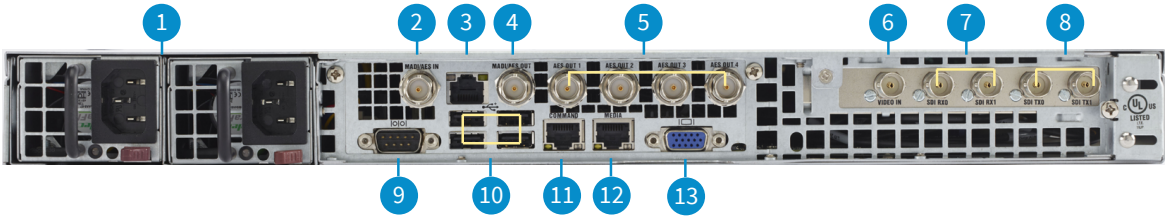
Item	Interface	Description
1	Input LED	• Green: Active signal on the selected input. • Red: No active input signal. • Off: No input selected.
2	Audio LED	• Green: Audio data is detected on the input. • Red: Red for five seconds indicates that there are cyclic redundancy check (CRC) or Pa errors detected. • Off: No audio data is detected on the input.
3	Sync LED	• Green: The device is synchronized to the primary clock source. • Yellow: The device is synchronized to a secondary clock source. • Off: No clock source is detected.
4	Error LED	• Not used.
5	Control screen	• Displays the input type and the encoding mode. • From the menu you can set/view device IP addresses.
6	Navigation keys	• Used to navigate through the device menu and to set the device IP addresses.
7	Volume control knob	• Not used.
8	Headphone jack	• Not used.
9	Dim button	• Not used.
10	Two USB 2.0 ports	• Used to load firmware upgrades.

11	Power button	• Powers up the unit. Use at the end of the initial installation, and for shutting down or power cycling the device.
		  • Short press: The OS shuts down gracefully, closing processes and saving open files.
		  • Long press: Forces power down of the system. Nothing is saved, and data may be lost.

Item	Interface	Description
12	Reset button	• Physical reset of the device. No data is saved.
13	Over-temperature indicator	• Solid red: Indicates that the unit temperature is higher than the recommended range for safe operation. Ensure that the unit front and rear air vents are not blocked, and that the ambient room temperature meets device environmental specifications. • Flashing red: Indicates fan failure.
14	Power supply failure indicator	• Red: Indicates that one of the power supplies has failed, or is disconnected from the power mains.

2.7 DP591 rear panel

The DP591 rear panel provides access to the device input and output connections, as well as to the power supply.



Item	Interface	Description/use
1	AC power supply	Two AC power supplies, 100 and 240 VAC, 50–60 Hz, and 350 W, with temperature controlled fans: • Redundant power supplies. When one fails, the unit generates an alarm and switches to the other power supply. • Fans provide front-to-rear air flow. When the temperature exceeds maximum operating temperature, a front-panel indicator lights up.
2	MADI/AES input	One female 75Ω BNC unbalanced connector. This input supports: • MADI: Signal levels per AES-10-2008 • AES: Not used This MADI input port receives up to 64 channels of PCM audio from an audio console, for encoding. The MADI input cannot be used as a clock source only, but when it carries the input it can drive the clock.
3	Gigabit Ethernet port	One RJ-45 connector for 1000Base-T Ethernet. This port is not in use.
4	MADI/AES output port	One female 75Ω BNC unbalanced connector. This output supports: • MADI: Signal levels per AES-10-2008 • AES: Not used This MADI output port transmits up to 64 channels of decoded PCM audio to a downstream device for reauthoring purposes.

Item	Interface	Description/use
5	AES output port	Four female 75Ω BNC unbalanced connectors. These outputs support: • Signal levels per AES3-4-2009 This port outputs: • Encoded Dolby ED2 for contribution services • Transcoded Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content for distribution services • Decoded Dolby ED2 (the first eight channels) to PCM audio for reauthoring purposes
6	Video Input (Vref) port	One female 75Ω BNC unbalanced connector. This input supports Vref signal sync types: • Black burst: ITU-R BT.1700 (PAL), SMPTE ST 170 (NTSC) • HD tri-level: SMPTE 274M, SMPTE 296M This port receives a Vref signal to act as a video clock reference.
7	SDI input port	Two autodetecting, female 75Ω BNC unbalanced connectors. These inputs support: • 1.5 Gbps HD-SDI (SMPTE 292M-1998) • 3 Gbps 3G-SDI (SMPTE 424M-2012) Level A This port receives HD-SDI and 3G-SDI Level A video with up to eight embedded SDI audio pairs, for transcoding as follows: • Dolby ED2 to Dolby Digital Plus with Dolby Atmos content • Dolby E to Dolby Digital Plus • PCM audio to Dolby Digital Plus This port can act as a clock source.
8	SDI output port	Two autodetecting, female 75Ω BNC unbalanced connectors. These outputs support: • 1.5 Gbps HD-SDI (SMPTE 292M-1998) • 3.0 Gbps HD-SDI (SMPTE 424M-2008) This port outputs HD-SDI Level A video with up to eight embedded SDI audio pairs of: • Encoded Dolby ED2 for contribution services • Transcoded Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content for distribution services • Decoded PCM audio for reauthoring purposes
9	Serial port	This port is not in use.
10	USB 2.0 ports	Four USB 2.0 (480 Mbps) ports. These ports are used for USB firmware upgrades.
11	GbE command port	One RJ-45 connector for 1000Base-T Ethernet. This port provides access for device control through a web-based user interface. It receives metadata over IP from a Dolby DP590.
12	GbE media port	One RJ45 connector for 1000Base-T Ethernet. This port is not in use.
13	VGA video port	This port is not in use.

3 Use cases

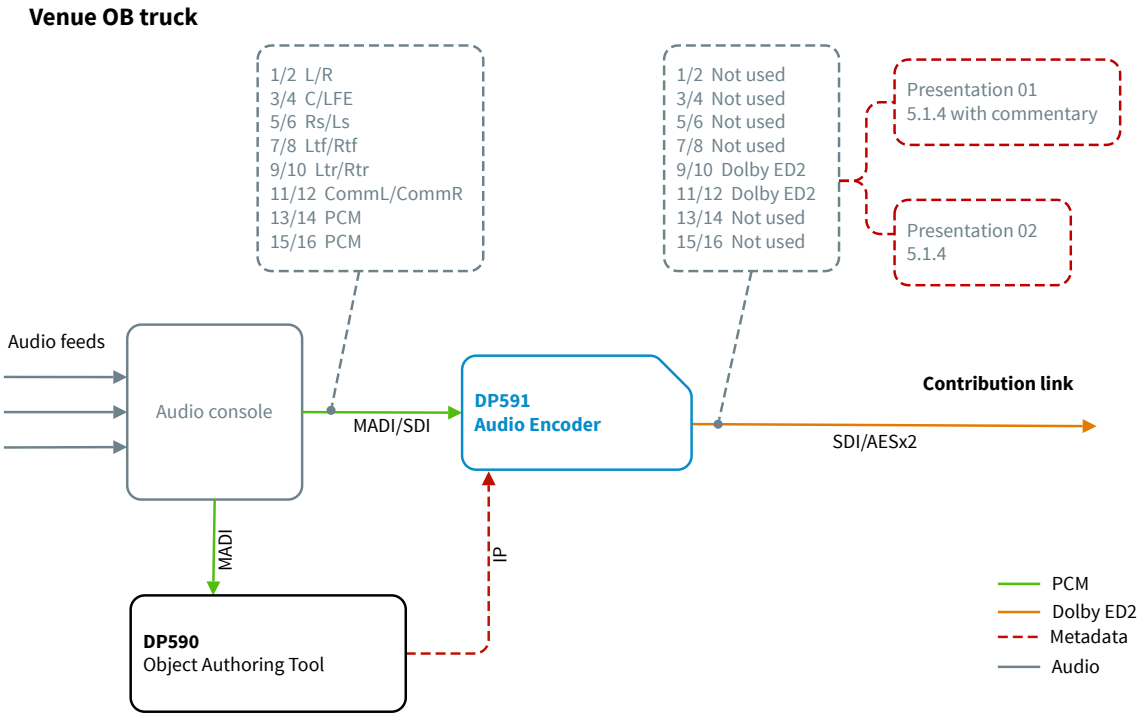
The DP591 processes audio for the contribution link and for the distribution link. These example use cases show the different processing functions of the DP591.

- Encoding Dolby ED2
- Encoding PCM to Dolby Digital Plus formats
- Transcoding to Dolby Digital Plus formats
- Decoding Dolby ED2 to PCM
- Pass-through audio

3.1 Encoding Dolby ED2

This use case illustrates encoding PCM audio to the Dolby ED2 contribution format using metadata from the Dolby DP590. It fits production workflows that require a compressed audio contribution format.

Figure 7: Encoding to Dolby ED2



The DP591 expects 16 channels of input PCM audio. It encodes all 16 channels to Dolby ED2. It configures the channels based on the metadata received from the Dolby DP590.

The device routes the output to the user-defined SDI output group. The default is group 1 (pairs 1/2, 3/4). If the SDI output group is 1 or 2, AES output will carry matching pairs.

In this example, the SDI output group is 3, and there is no AES output. The Dolby ED2 carries two presentations of audio content, one with 5.1.4 (5.1 bed with 4 Dolby Atmos objects) and commentary, the other with 5.1.4 and no commentary.

3.2 Encoding PCM to Dolby Digital Plus formats

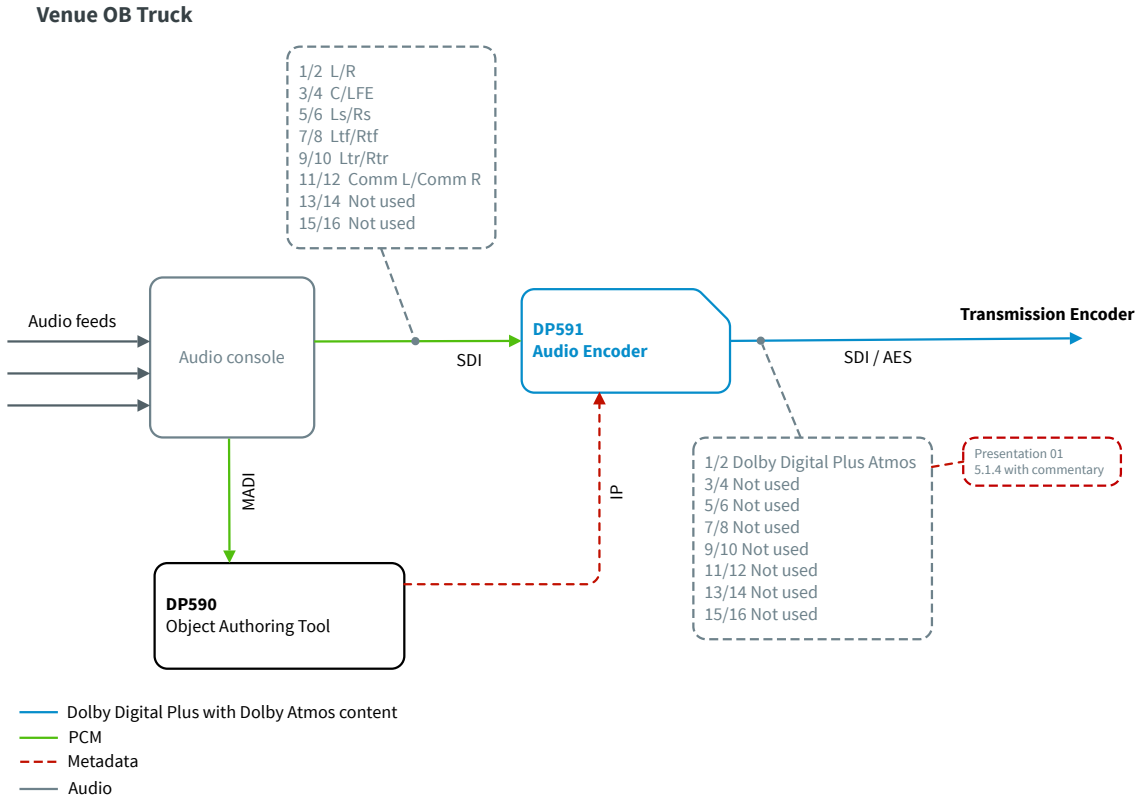
Encoding PCM audio to Dolby Digital Plus and Dolby Digital Plus with Dolby Atmos content is for live production workflows that create transmission content directly in the OB truck or backhaul PCM to the headend.

The DP591 can encode PCM audio to all Dolby Digital Plus formats. It can use metadata from the DP590 to create presentations of Dolby Digital Plus with Dolby Atmos content designed by the sound engineer. It can generate metadata internally to assign channel signals for stereo, surround, and height speakers.

3.2.1 SDI input PCM to Dolby Digital Plus formats

This use case illustrates encoding PCM audio to Dolby Digital Plus with Dolby Atmos content from SDI input.

Figure 8: PCM to Dolby Digital Plus with Dolby Atmos content using DP590 metadata

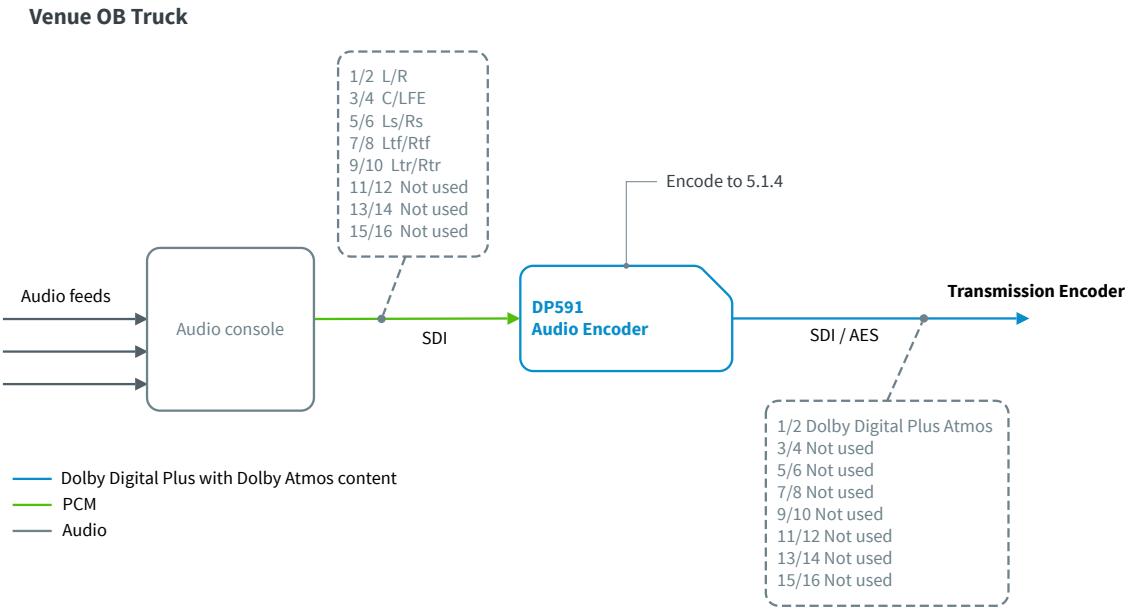


The DP591 expects 16 channels of input PCM audio. It encodes to Dolby Digital Plus with Dolby Atmos content, configuring the channels based on the metadata received from the DP50.

The encoder routes the output to the first SDI output pair. AES output carries matching pairs.

In this example, the device encodes Dolby Digital Plus with Dolby Atmos content. It carries the Dolby Atmos metadata, and contains one presentation of the audio content, as designed by the sound engineer. It is a presentation of 5.1.4 (5.1 bed with 4 Dolby Atmos objects) and commentary.

Figure 9: PCM audio to Dolby Digital Plus with Dolby Atmos content without DP590 metadata



The DP591 expects 16 channels of input PCM audio. The device encodes the input PCM channels consecutively, based on the Dolby Digital Plus format selected by the user.

The encoder routes the output to the first SDI output pair. The AES output carries matching pairs.

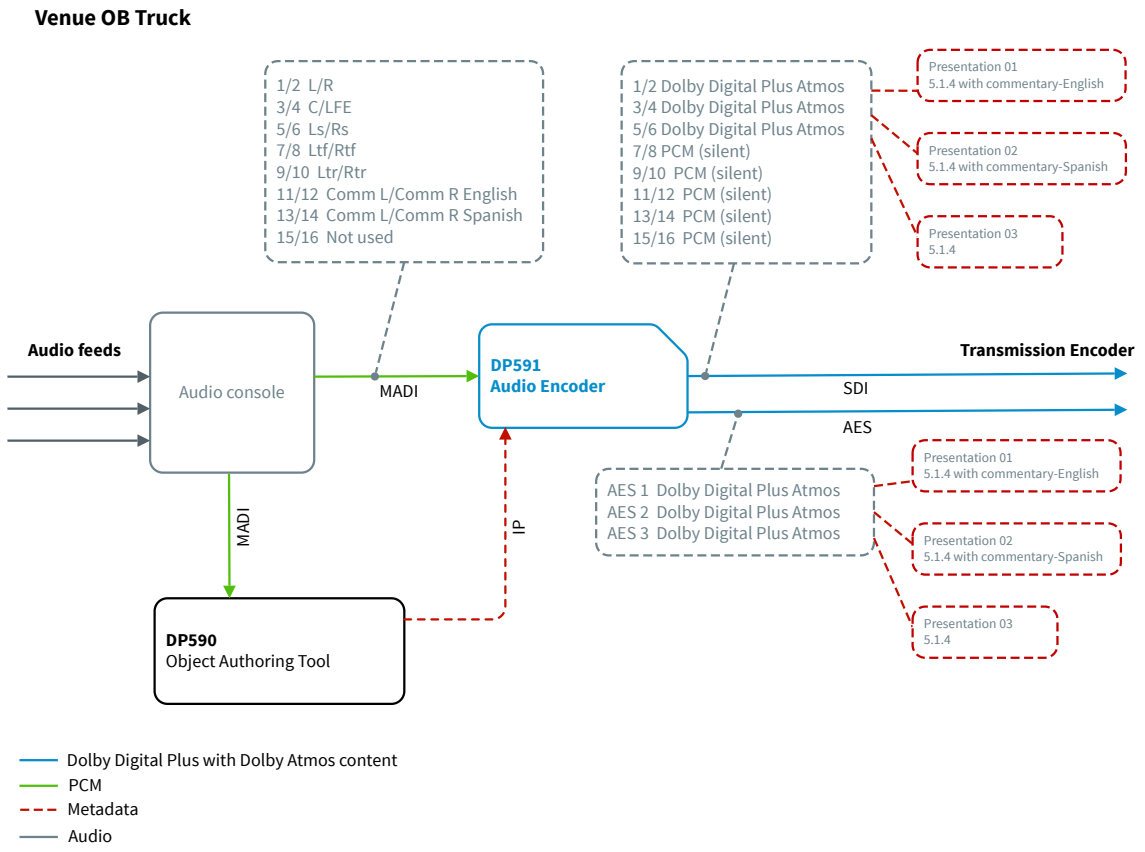
In this example, the device encodes PCM audio to Dolby Digital Plus without using metadata from the Dolby Object Authoring Tool DP590. The encoder defines the positioning information using internally generated metadata, based the encoding selection. The user chose to encode to Dolby Digital Plus 5.1.4. The encoder default layout for this format is:

5.1.4	L	R	C	LFE	Ls	Rs	Ltf	Rtf	Ltr	Rtr

3.2.2 MADI input PCM to Dolby Digital Plus formats

This use case illustrates encoding PCM audio to Dolby Digital Plus with Dolby Atmos content using MADI input.

Figure 10: PCM audio to Dolby Digital Plus Atmos using DP590 metadata



The DP591 expects 16 channels of input PCM audio. It encodes to Dolby Digital Plus with Dolby Atmos content, configuring the channels based on the metadata received from the DP590.

The encoder routes the output to the first SDI output pair, and then to the consecutive following pairs. AES output carries matching pairs.

In this example, the device receives metadata from the DP590. It encodes Dolby Digital Plus with Dolby Atmos content, which contains three presentations of the audio content, as designed by the sound engineer.

Without DP590 metadata

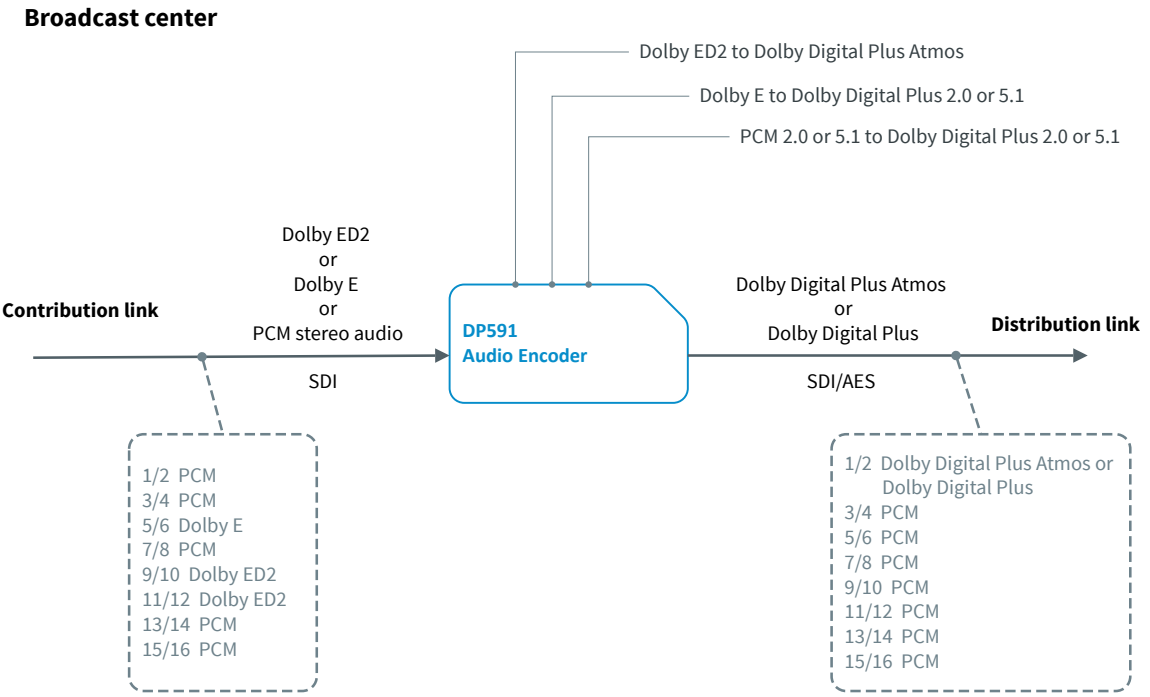
The behavior for encoding PCM to Dolby Digital Plus formats without using metadata from the DP590 is the same for MADI input as for SDI input.

3.3 Transcoding to Dolby Digital Plus formats

This use case illustrates transcoding the Dolby ED2 contribution format to Dolby Digital Plus with Dolby Atmos content. It includes transcoding of Dolby E to Dolby Digital Plus, and encoding of PCM 2.0 or 5.1 audio to Dolby Digital Plus 2.0 or 5.1, when these appear on the input.

The DP591 performs transcoding in the broadcast center for transmission services.

Figure 11: Transcoding to Dolby Digital Plus formats



The live event program carries the Dolby ED2 contribution format. The DP591 transcodes one presentation of the audio content to Dolby Digital Plus with Dolby Atmos content.

The DP591 expects Dolby ED2 for the live Dolby Atmos feed. Other programs that are switched into the live feed should carry Dolby E audio, or PCM audio. These are transcoded/encoded to Dolby Digital Plus.

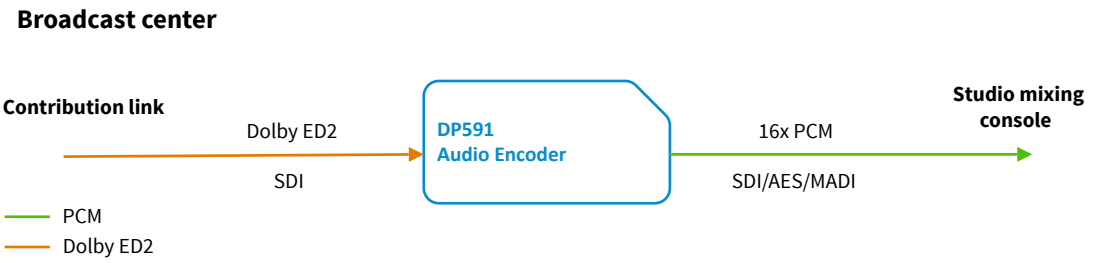
The user-selected preferred pair tells the device where to find the Dolby ED2, Dolby E, and the fall-back PCM stereo audio. In this example, the settings are pair 5 for Dolby ED2, pair 3 for Dolby E, and pair 1 for the fall-back, PCM audio.

The encoder routes the output to the first SDI output pair. The AES output carries matching pairs.

3.4 Decoding Dolby ED2 to PCM

This use case illustrates decoding Dolby ED2 to PCM audio. The output can be routed to a studio console for reauthoring purposes.

Figure 12: Decoding Dolby ED2 to PCM audio



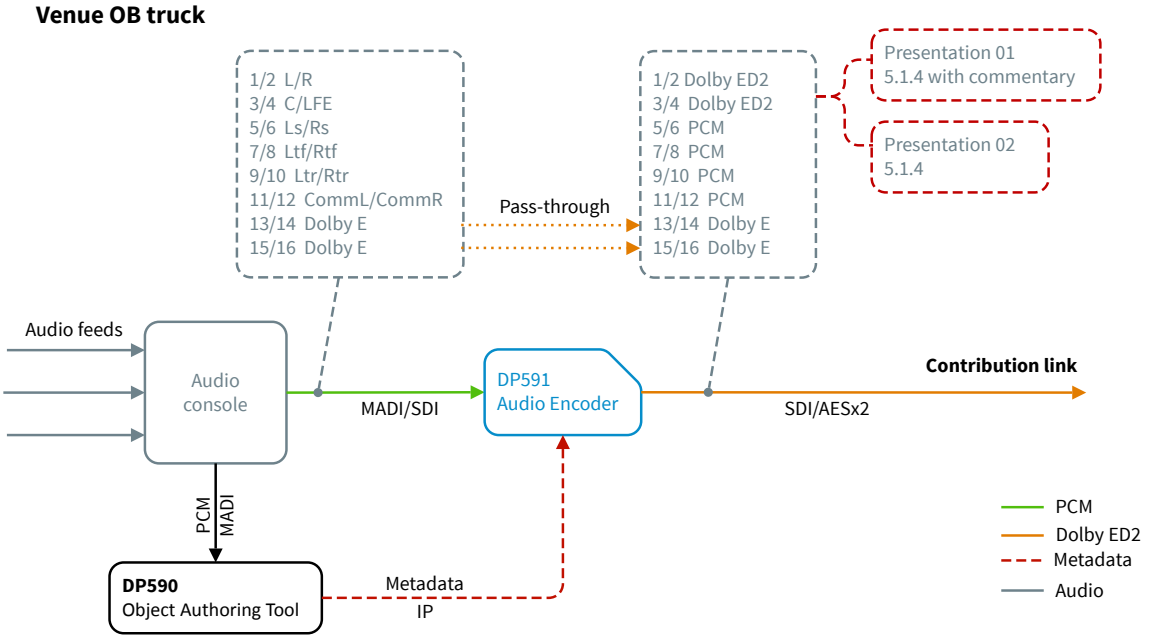
The device can decode to up to 16 channels of PCM audio. Decoding Dolby ED2 discards the Dolby Atmos metadata.

The encoder routes the output to the SDI, AES, and MADI outputs. The encoder defines the channel order.

3.5 Pass-through audio

This use case illustrates the DP591 pass-through functionality. The device passes audio streams from input to output, without processing, so that they are included in the live feed.

Figure 13: Dolby ED2 passes through to the output



The sound engineer includes Dolby E streams in the mix going to the DP591, along with the PCM channels to be encoded to Dolby ED2. The DP591 passes through the Dolby E streams without processing them.

The engineer selects which SDI output group (pairs) will carry the pass-through streams. In this example, the SDI pass-through group is 4. The device looks for the streams to pass-through on the corresponding SDI input group, input group 4.

There is no AES output of the pass-through streams.

4 Audio processing

The DP591 processes the input audio according to the active encoding mode and the type of input it receives.

4.1 Encoding and decoding modes

The DP591 operates in three modes: encoding to Dolby ED2, encoding to Dolby Digital Plus formats, and decoding Dolby ED2 to PCM audio.

The DP591 fulfills two roles in the broadcast production chain. It encodes to a contribution format for professional use (Dolby ED2), and it encodes or transcodes to Dolby Digital Plus formats for transmission and delivery to consumer devices.

Dolby ED2 encoding

In a content creation or contribution role, the DP591 ingests live PCM audio from the audio mixing console in the OB truck at the event location. It interfaces with the Dolby Object Authoring Tool DP590 over an IP connection, receiving metadata to support the delivery of the encoded Dolby Atmos content designed by the sound mixer. It encodes to the compressed Dolby ED2 contribution format.

Dolby Digital Plus encoding

In a distribution role, the DP591 ingests encoded Dolby ED2 for transcoding to Dolby Digital Plus with Dolby Atmos content. The user selects one audio presentation from the Dolby ED2 stream to create the Dolby Digital Plus with Dolby Atmos content stream. This channel-based output is distributed to the end user and decoded by the STB.

For workflows that do not require compressed audio for the contribution link, the DP591 can encode PCM audio directly to Dolby Digital Plus or Dolby Digital Plus with Dolby Atmos content for distribution. The encoder can use metadata from the Dolby Object Authoring Tool DP590 that includes Dolby Atmos content, or it can use internally generated metadata to create the Dolby Digital Plus channel layout.

The device can encode the following Dolby Digital Plus formats:

- 2.0
- 5.1
- 5.1.2

- 5.1.4
- 7.1.4

In this mode, the encoder relies on a default channel layout when it creates the output. The device encodes audio channels as listed in the following table.

Encoding mode	Channels 1/2	Channels 3/4	Channels 5/6	Channels 7/8	Channels 9/10	Channels 11/12
2.0	L/R					
5.1	L/R	C/LFE	Ls/Rs			
5.1.2	L/R	C/LFE	Ls/Rs	Ltm/Rtm		
5.1.4	L/R	C/LFE	Ls/Rs	Ltf/Rtf	Ltr/Rtr	
7.1.4	L/R	C/LFE	Ls/Rs	Lrs/Rrs	Ltf/Rtf	Ltr/Rtr

For MADI input, the encoder processes the MADI channels consecutively from 1 to 16.

For SDI input, the user defines the starting pair either by using the manual option and choosing the pair, or by using the auto option and setting a fall-back pair. In either case, the encoder finds the indicated starting pair and then looks to the surrounding pairs for PCM signals. It encodes all available adjacent PCM pairs according to the default channel layout.

For example, if the user-defined starting pair is pair 2, and there is also PCM audio on pair 1 and pair 3, the device uses all three pairs (1, 2, and 3) for encoding.

To ensure the expected results, the best practice for the user is to configure the input PCM channels to match the default channel layout. The input should support the encoding mode selection. Any output channels that do not have corresponding input audio signals will carry silence.

By default, the DP591 encodes incoming Dolby E as 2.0 or 5.1, based on the first Dolby E program.

While processing the live feed, the device can switch between transcoding and encoding, depending on the input and the encoding mode settings.

Decoding Dolby ED2 to PCM audio

To support audio reauthoring, such as remixing or voice over, the DP591 decodes Dolby ED2 to PCM audio (up to 16 channels) for output to a studio environment. Decoding Dolby ED2 to PCM audio drops all Dolby Atmos metadata information.

4.2 Input selection

The user selects the input port to receive the audio, and which input channels or pair groups to process.

For SDI input, the DP591 supports two modes for input pair selection:

- Manual: The user chooses input pairs, and the device looks for the input on those pairs.
- Auto: The user chooses preferred pairs for Dolby ED2 (first priority), Dolby E (second priority) and a fall-back pair. The device switches between the pairs as needed to find the input audio.

For Dolby ED2 encoding, the device expects to find 16 channels of PCM audio on the input.

For Dolby Digital Plus encoding, the input can be configured as desired.

The user must ensure that the input supports the encoding mode format he selects. For example, if the input carries only three adjacent pairs of PCM audio channels and the user selects encoding to Dolby Digital Plus 5.1.4, the device will encode the three PCM pairs as 5.1 and place silence on the missing channels.

4.3 Metadata processing

The DP591 can receive metadata from the Dolby DP590 to create immersive audio content. It also generates metadata internally, to encode PCM audio to Dolby Digital Plus formats, and to apply user-defined settings for Dolby Digital Plus encoding parameters such as dialogue normalization value (dialnorm).

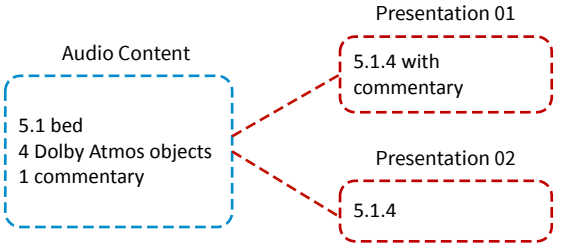
Metadata from the Dolby DP590

When the device is encoding to the Dolby ED2 contribution format, it processes the input audio along with metadata it receives from the DP590. Metadata from the DP590 defines the positional location of objects, channel information, and one or more presentations of the audio content.

For example, consider a live event with audio being captured all throughout a stadium. An announcer is providing event commentary. Using the Dolby Object Authoring Tool DP590, the sound mixer designs the distribution and placement of the audio stems for the presentation of the audio. He may create one presentation that includes the ambience and effects tracks and the commentary tracks, as well as another presentation that includes only the ambience and effects tracks.

The metadata for each presentation will reflect the positioning information and channel layout, as well as define which tracks are included.

Figure 14: Audio presentations



The Dolby Audio Encoder DP591 receives the metadata from the DP590 as an XML file over the IP link. As it encodes the live audio feed, it reads the file and uses the metadata to create the Dolby ED2 contribution format stream.

From the Dolby ED2 format, the DP591 can transcode one user-selected presentation to Dolby Digital Plus with Dolby Atmos content.

For MADI input only, the DP591 can encode PCM audio for up to three presentations to Dolby Digital Plus with Dolby Atmos content.

Internally generated metadata

To encode PCM audio to Dolby Digital Plus formats without using metadata from the DP590, the DP591 generates metadata to support the user-selected Dolby Digital Plus encoding mode.

Encoding metadata settings

The device supports user configuration of key Dolby Digital Plus parameters, available in the UI. These parameters are:

- Dialogue normalization
- Dynamic range control Line mode
- Dynamic range control RF mode
- Dolby Surround mode
- Surround phase shift
- Preferred stereo downmix
- Height trims
- Surround trims

4.4 Seamless switching

Seamless switching refers to how the encoder handles the transition from encoding one program to another without introducing audible glitches, pops, or silence. The DP591 processes program switches with a maximum mute duration of 40 milliseconds.

Transitions from one program to another are a natural and necessary part of the broadcast workflow. The broadcast content switches from live input content to recorded content and back again.

The DP591 transitions between different audio formats smoothly and without introducing any noticeable gaps.

Autoswitching behavior

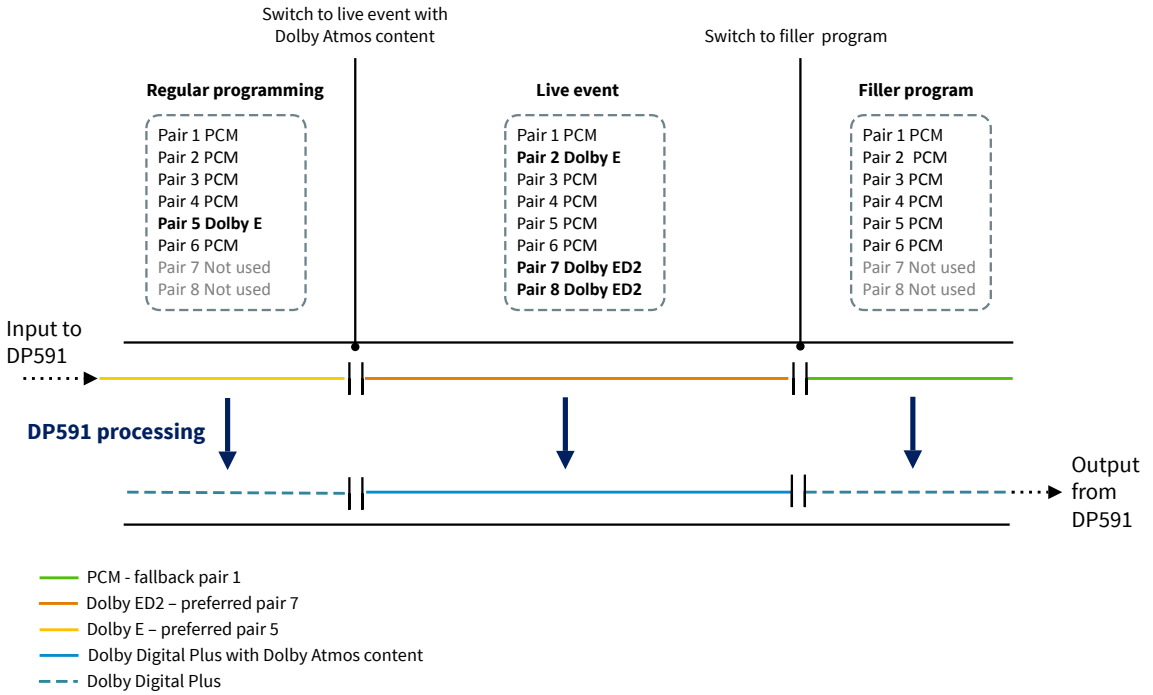
To ensure that the correct audio is encoded at an input program switch, the DP591 supports user assignment of up to three preferred audio pairs on which to look for the input audio content. Each pair represents two audio channels.

To use this feature, the best practice input configuration would always carry either a Dolby E pair and/or a PCM stereo audio pair in addition to the Dolby ED2 that carries the live Dolby Atmos content. Any other programs injected in the feed must carry either Dolby E, or PCM audio, or both.

To configure the DP591 to pick up the correct input pairs for switching, the user selects a preferred input pair for Dolby ED2, Dolby E, and a fall-back pair if neither is present. The fall-back pair is PCM stereo audio, in case the Dolby E is not available for some reason. The device always looks for Dolby ED2 first, then for Dolby E, then the fall-back.

This example shows a switching scenario where the input feed to the DP591 switches from one program to another. The DP591 will switch from Dolby E to Dolby ED2 to PCM audio. The encoder switches to the preferred input pair and processes the input correctly.

Figure 15: DP591 switching behavior when using preferred input pairs



By default, the DP591 processes the input as follows:

Input	Output
Dolby ED2	Dolby Digital Plus with Dolby Atmos content
Dolby E	Dolby Digital Plus 2.0 or 5.1 (according to the first program on the input)
PCM audio	Dolby Digital Plus 5.1.2

The encoder supports processing PCM audio to any of the Dolby Digital Plus formats. The typical configuration for transcoding and switching is PCM to Dolby Digital Plus 2.0 or 5.1.

It is up to the engineer to select a fall-back pair with enough channels of PCM input audio to support the encoded Dolby Digital Plus channels.

By default, the device looks to the following pairs:

- Dolby ED2: Pair 7
- Dolby E: Pair 5
- Fall back: Pair 1

4.5 A/V sync

The DP591 maintains audio/video synchronization within a range of -5 to +15 ms. Dolby provides metrics for all processing modes.

The following tables list the measurements for DP591 a/v sync. Dolby Digital Plus formats refers to both Dolby Digital Plus and Dolby Digital Plus with Dolby Atmos content.

Encode

Video format	Input/Output	PCM to Dolby ED2	PCM to Dolby Digital Plus formats
1080p50	SDI/SDI	0.1 ms	4.9 ms
1080p59.94	SDI/SDI	-0.2 ms	4.8 ms
1080i29.97	SDI/SDI	-0.2 ms	4.9 ms

Transcode

Video format	Input/Output	Dolby ED2 to Dolby Digital Plus formats	Dolby E to Dolby Digital Plus
1080p50	SDI/SDI	5.5 ms	5.3 ms
1080p59.94	SDI/SDI	5.4 ms	5.5 ms
1080i29.97	SDI/SDI	5.5 ms	5.3 ms

Decode

Video format	Input/Output	Dolby ED2 to PCM audio
1080p50	SDI/SDI	0.6 ms
1080p59.94	SDI/SDI	0.5 ms
1080i29.97	SDI/SDI	0.7 ms

4.6 Latency

Latency refers to the delay between when an audio signal enters a system and when it emerges from the system. To maintain synchronization, the same delay must apply to the video feed. Dolby provides latency metrics for each DP591 processing mode.

Any encoding/transcoding/decoding process introduces delay. DP591 processing ensures equal audio and video latency. If the audio is delayed by n frames, the video is delayed by a corresponding number of frames.

The following tables list the latency measurements for DP591 audio processing. These values represent the delay that needs to be applied to the video feed when reembedding the audio.

Encode PCM audio to Dolby ED2

Video format	Input/Output	Delay per clock source (ms)		
		SDI0	MADI	Vref
1080p50	SDI/SDI	80.0	80.0	80.0
	SDI/AES	80.1	80.1	80.1
	MADI/SDI	80.0	80.0	80.0
	MADI/AES	80.1	80.1	80.1
1080p59.94	SDI/SDI	66.6	66.5	66.5
	SDI/AES	66.6	66.6	66.5
	MADI/SDI	66.5	66.5	66.5

Video format	Input/Output	Delay per clock source (ms)		
		SDI0	MADI	Vref
	MADI/AES	66.5	66.5	66.6
1080i29.97	SDI/SDI	66.6	66.5	66.6
	SDI/AES	66.6	66.6	66.6
	MADI/SDI	66.5	66.5	66.5
	MADI/AES	66.5	66.5	66.5

Encode PCM audio to Dolby Digital Plus with Dolby Atmos content

Video format	Input/Output	Delay per Vref clock source (ms)
1080p50	SDI/SDI	244.9
	SDI/AES	245.0
	MADI/SDI	164.8
	MADI/AES	164.9
1080p59.94	SDI/SDI	204.9
	SDI/AES	205.1
	MADI/SDI	138.2
	MADI/AES	138.3
1080i29.97	SDI/SDI	205.0
	SDI/AES	205.0
	MADI/SDI	271.6
	MADI/AES	271.7

Transcode Dolby ED2 to Dolby Digital Plus with Dolby Atmos content

Video format	Input/Output	Delay per Vref clock source (ms)
1080p50	SDI/SDI	245.6
	SDI/AES	245.6
1080p59.94	SDI/SDI	205.6
	SDI/AES	205.7
1080i29.97	SDI/SDI	205.6
	SDI/AES	205.7

Transcode Dolby E to Dolby Digital Plus

Video format	Input/Output	Delay per Vref clock source (ms)
1080p50	SDI/SDI	245.4
	SDI/AES	245.4
1080p59.94	SDI/SDI	205.6
	SDI/AES	205.8

Video format	Input/Output	Delay per Vref clock source (ms)
1080i29.97	SDI/SDI	205.6
	SDI/AES	205.8

Decode Dolby ED2 to PCM audio

Video format	Input/Output	Delay per Vref clock source (ms)
1080p50	SDI/SDI	80.6
	SDI/AES	80.7
	SDI/MADI	80.7
1080p59.94	SDI/SDI	67.3
	SDI/AES	67.4
	SDI/MADI	67.5
1080i29.97	SDI/SDI	67.2
	SDI/AES	67.4
	SDI/MADI	67.5

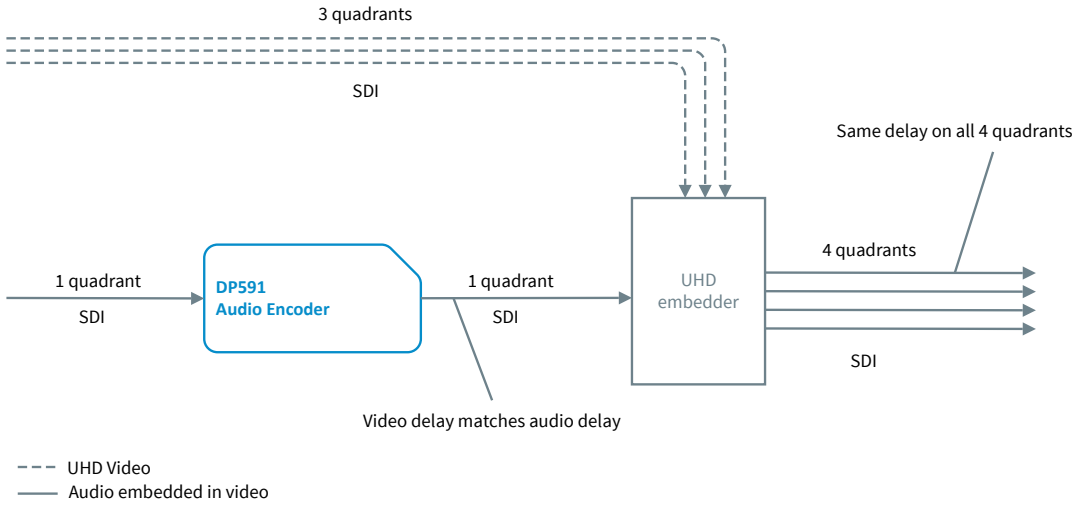
Delay for 4K UHD video over 3G-SDI

When processing 4K UHD video over 3G-SDI, the encoder ingests only the first video quadrant that is carrying the audio. The DP591 processes the audio, applying the correct delay to the video (one quadrant).

The production workflow must apply the same delay to the other three video quadrants. This function is typically performed by the UHD embedder. Although many operators prefer to keep the video feed on a separate path and reembed the encoded audio, synchronizing these three quadrants to the DP591 output video is a reliable way to generate the signal.

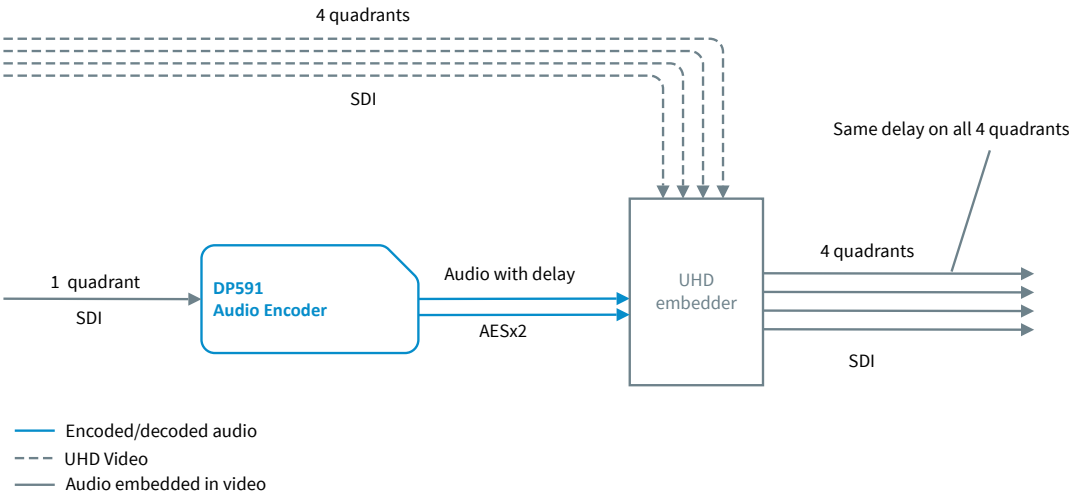
In this figure, the DP591 applies delay to one UHD video quadrant, and the embedder aligns the quadrants.

Figure 16: DP591 applies delay to one UHD video quadrant, embedder aligns quadrants



When reembedding AES output encoded audio, the embedder must delay the video to match the audio delay.

Figure 17: DP591 encoding delays audio, embedder delays video to align with audio



4.7 Dolby E frame alignment

The DP591 implements Dolby E/Dolby ED2 to video frame alignment as per the Dolby recommendation for Dolby E reference line positions.

The Dolby ED2 contribution format is based on Dolby E, and uses the same audio frame structure. All discussions of Dolby E line positions apply equally to Dolby ED2.

Dolby E streams include audio and metadata encoded into blocks of SMPTE 337M data. Dolby E outputs these data blocks at a rate associated with a chosen video frame rate, to be frame aligned with the video.

To allow error-free, cut-style editing and video switching, a small section of null data (or silent samples) exists around the video switch point (also referred to as the guard band). This guard-band location allows a Dolby E bitstream to be delayed, up to a point, as a safeguard against frame errors that may occur in a bitstream upon switching or editing.

The measurement of where the guard band ends and the SMPTE 337M Dolby E data burst starts is called the line position. This relates to a specific video line to which the start of the Dolby E data burst is aligned.

Dolby ED2 line position metrics

The following tables list the Dolby ED2 line position after encoding. These metrics can be used as a reference when aligning with other Dolby E/Dolby ED2 streams in the same workflow, which is highly desirable.

The tables list the Dolby E/Dolby ED2 line position on the SDI and AES outputs. The table columns contain the following information:

- Video in/out: The resolution and frame rate of the video on the SDI in port (if present), and SDI out port. In case of no input video the device defaults to 1080p50 and outputs "black" video.
- Audio in: The port receiving the audio input.
- Clock: The clock source used by the DP591 for encoding.
- VREF/SDI/AES µs/line/ideal: SDI and AES indicate the audio output being measured by the analytic tool. The tool provides metrics relative to Vref regardless of the clock source, so those values are also included.

- µs: The time elapsed, in microseconds, from the SMPTE RP168 reference point (the point in time indicating the start of the video frame)
- line: The video line to which the start of the Dolby E data burst is aligned
- ideal: The offset of the line position from the ideal position (the recommended alignment locations for Dolby E frames with respect to SD video lines, HD video lines, and the RP168 reference point).

Encode PCM audio to Dolby ED2

Video in/out	Audio in	Clock source	µs/line/ideal		
			Vref	SDI	AES
1080p50/ 1080p50	SDI	Vref	761.5µs / 42 (+0)	743.5µs / 41 (-1)	687.8µs / 38 (-4)
1080p50/ 1080p50	SDI	SDI0	758.8µs / 42 (+0)	743.5µs / 41 (-1)	673.6µs / 37 (-5)
1080p50/ 1080p50	MADI	Vref	761.6µs / 42 (+0)	743.5µs / 41 (-1)	689.4µs / 38 (-4)
1080p50/ 1080p50	MADI	SDI0	759.6µs / 42 (+0)	743.5µs / 41 (-1)	704.5µs / 39 (-3)
1080p59.94/ 1080p59.94	SDI	Vref	683.2µs / 46 (-1)	681.9µs / 45 (+2)	610.9µs / 41 (-5)
1080p59.94/ 1080p59.94	SDI	SDI0	698.8µs / 47 (+0)	667.1µs / 45 (+2)	628.5µs / 42 (-5)
1080p59.94/ 1080p59.94	MADI	Vref	682.1µs / 48 (+1)	681.9µs / 44 (+3)	637.8µs / 43 (-5)
1080p59.94/ 1080p59.94	MADI	SDI0	696.1µs / 46 (-1)	681.9µs / 45 (+2)	632.6µs / 42 (-5)
1080i29.97/ 1080i29.97	SDI	Vref	744.9µs / 25 (+1)	711.4µs / 23 (-1)	641.9µs / 21 (-3)
1080i29.97/ 1080i29.97	SDI	SDI0	740.6µs / 24 (+0)	711.4µs / 23 (-1)	646.0µs / 21 (-3)
1080i29.97/ 1080i29.97	MADI	Vref	740.6µs / 24 (+0)	711.4µs / 23 (-1)	646.0µs / 21 (-3)
1080i29.97/ 1080i29.97	MADI	SDI0	745.2µs / 25 (+1)	711.8µs / 24 (+0)	662.9µs / 22 (-2)

For more information about Dolby E line positions, see https://www.dolby.com/us/en/technologies/dolby-e-preferred-alignment.html

4.8 Clocking behavior

The DP591 supports clock signal acquisition from the Vref, SDI0, SDI1, and MADI inputs. The primary clock source drives the clock on all downstream components.

The DP591 supports user-defined clock source settings for a primary and secondary clock source. The options are:

- Primary: Vref, MADI, SDI0, SDI1
- Secondary: Vref, MADI, SDI0, SDI1, NONE

If the active clock reference source becomes asynchronous with the input source, the DP591 restarts audio processing to synchronize again. If synchronization with the primary source fails, the DP591 attempts with the secondary source. The user can also force a reacquisition of the clock source from the UI.

By default, the encoder sets the primary clock source to match the input source. The device reports the clock source status on the device front panel LEDs, the LEDs in the UI, and in the event logs.

5 Output behavior

The DP591 has default behavior for provisioning output. For some types of processing, the user can assign output SDI groups.

5.1 Default output

The DP591 provisions encoded and transcoded audio streams over both the SDI and AES output ports. It sends decoded PCM audio out over SDI, AES, and MADI output ports.

The DP591 always generates output on the SDI out ports. When encoding or transcoding, it provisions mirrored output to SDI output ports TX0 and TX1.

It sends matching output to the AES out ports, except when the user assigns the Dolby ED2 encoding output to groups 3 or 4 of the SDI output, in which case there is no output over AES.

When decoding, it provisions the same output to all output interfaces.

The following tables list the default output behavior of the DP591.

Encoding PCM audio to Dolby ED2

Input interface	SDI output audio	AES output audio	SDI output video
MADI/SDI	Two streams of Dolby ED2 on: SDI TX0 1/2, 3/4* SDI TX1 1/2, 3/4	Two streams of Dolby ED2 on: AES 1/2, 3/4*	If SDI in, video with format and frame rate as on input. Dolby ED2 frame rate: • 25 fps when primary clock source is PAL based • 29.97 fps when primary clock source is NTSC based If no SDI in, MADI as primary clock source, 3G-A 1080p50 "black" video. Dolby ED2 frame rate: • 25 fps

*User can select SDI output group/pairs. AES pairs match output for SDI groups 1 and 2 only.

Encoding PCM audio to Dolby Digital Plus with Dolby Atmos content or Dolby Digital Plus

Input interface	SDI output audio	AES output audio	SDI output video
MADI	Up to three streams of Dolby Digital Plus with Dolby Atmos content on: SDI TX0 1/2, 3/4, 5/6 SDI TX1 1/2, 3/4, 5/6 Streams carry different presentations, if available	Up to three streams of Dolby Digital Plus with Dolby Atmos content on: AES out 1/2, 3/4, 5/6 Streams carry different presentations, if available	If SDI in, video with format and frame rate as on input. If no SDI in, MADI as PCS, 3G-A 1080i60 "black" video.
SDI	One stream of Dolby Digital Plus with Atmos content/Dolby Digital Plus on: SDI TX0 1/2 SDI TX1 1/2	One stream of Dolby Digital Plus with Atmos content/Dolby Digital Plus on: AES out 1/2	Same format and frame rate. Fixed video delay.

Transcoding Dolby ED2 and Dolby E

Input interface	Input format	SDI output audio	AES output audio	SDI output video
SDI	Dolby ED2	One stream of Dolby Digital Plus with Atmos content on: SDI TX0 1/2 SDI TX1 1/2	One stream of Dolby Digital Plus with Atmos content on: AES out 1/2	Same format and frame rate. Fixed video delay.
SDI	Dolby E	One Dolby Digital Plus stream on: SDI TX0 1/2 SDI TX1 1/2	One Dolby Digital Plus stream on: AES out 1/2	

Decoding Dolby ED2 to PCM audio

Input interface	SDI output audio	MADI output audio
SDI	5.1 bed routed to: SDI TX0 1/2, 3/4, 5/6 SDI TX1 1/2, 3/4, 5/6 Audio objects* routed in order created from left to right on: SDI TX0 7/8, 9/10, 11/12, 13/14, 15/16 SDI TX1 7/8, 9/10, 11/12, 13/14, 15/16	5.1 bed routed to: • MADI out 1/2, 3/4, 5/6 Audio objects* routed in order created from left to right on: • MADI out 7/8, 9/10, 11/12, 13/14, 15/16

*For best results when designing audio presentations with objects, map the objects 1 to n to match the channel order.

5.2 Output selection

For Dolby ED2 encoding, the device supports user-defined assignment of the SDI output pair groups that carry the two Dolby ED2 streams.

Selecting an SDI output group results in the following output:

- Group 1
  - Two streams containing Dolby ED2 will be placed on embedded audio pairs 1 and 2.
  - Dolby ED2 will be output over AES out 1/2 and 3/4.
- Group 2
  - Two streams containing Dolby ED2 will be placed on embedded audio pairs 3 and 4.
  - Dolby ED2 will be output over AES out 5/6 and 7/8.
- Group 3
  - Two streams containing Dolby ED2 will be placed on embedded audio pairs 5 and 6.
  - No Dolby ED2 on AES outs.
- Group 4
  - Two streams containing Dolby ED2 will be placed on embedded audio pairs 7 and 8.
  - No Dolby ED2 on AES outs.

The SDI 1 output mirrors the SDI 0 output.

5.3 Pass-through

The DP591 supports audio pass-through for SDI input when encoding to the Dolby ED2 contribution format.

When encoding Dolby ED2, the user can choose to pass through any SDI embedded audio from input to output, without processing. The user can select up to four input SDI pairs to pass through to the corresponding output SDI pairs.

The SDI output group setting takes precedence over the pass-through setting.

Pass-through audio is not output over the AES output ports.

For workflows that rely on both SDI and AES output on the first four output pairs (groups 1 and 2), the best practice for including pass-through output is to place it on SDI groups 3 or 4.

6 Device monitoring

The DP591 provides a full complement of both real-time and file-based status and error monitoring tools.

- LED
- Event and system log descriptions
- SNMP

The device provides real-time feedback about device status and processing operations using the LEDs on the front panel and on the UI, and by sending SNMP trap messages.

The device maintains a downloadable event log that tracks user-configuration changes, audio processing status, errors, and device status.

It also keeps system logs to track system processes. Dolby technicians may request these logs for troubleshooting purposes.

6.1 LED

The DP591 front-panel LED indicators show whether the device is receiving input, whether the input contains audio, and whether the clock source is active. In addition to the front-panel LEDs, the UI shows graphical LEDs that indicate the same information.

When monitoring the device visually, you can use the LED indicators to quickly identify a problem on the input or audio sync, and follow-up by checking the event logs.

The front panel also has indicator lights showing the power and temperature status of the device itself. These lights indicate problems in the device environment. You may choose to handle these types of issues by setting up backup and redundancy paths that are triggered by SNMP traps.

6.2 Event and system log descriptions

The DP591 logs provide a record of unit operations and behavior.

Event logs

The device generates an event log entry for every change in input or processing status, and every error state. This provides a picture of the device operation, and is very useful for monitoring and troubleshooting. You can download the .csv log files from the UI.

Each logged event includes:

- Date
- Level (type of log information):
  - General information
  - Warnings (marked in yellow)
  - Errors (marked in red)
- Category

- Input type
- Message

The device stores the event log locally. To prevent overrunning the disk space, the logs remain available until one of the following conditions occurs:

- The number of log entries exceeds one million.
- A log entry is older than two months.

A periodic backup of the event log will ensure that you retain this information.

System logs

System logs include detailed technical information about the DP591 unit processes. In the event of a system failure, users must send the logs to Dolby Laboratories for analysis and support.

6.3 SNMP

The DP591 supports SNMP version 1.2. These traps enable users to react to device failure and to changes in the input audio format.

The DP591 UI has settings for configuring the SNMP trap manager IP address. The following tables describe the SNMP traps supported by the DP591.

Information

Trap	Description
dp591AssetTag	The user-specified label for this DP591.

Events

Trap	Description
dp591InputNoneEvent	No DP591 input source is selected.
dp591InputErrorEvent	The DP591 input is unavailable, or an input error has occurred.
dp591InputWarningEvent	DP591 input warning.
dp591InputOkEvent	The DP591 input source is active.
dp591AudioNoneEvent	The DP591 input audio is missing.
dp591AudioErrorEvent	The DP591 input audio is invalid.
dp591AudioWarningEvent	The DP591 audio output is undefined.
dp591AudioOkEvent	The DP591 audio output is active and valid.
dp591StartEvent	DP591 device start up or SNMP agent configuration change.
dp591ShutdownEvent	The DP591 Audio Encoder is about to shut down.
dp591InputTypeChangedEvent	The DP591 has detected a change in input audio signal type.
dp591OutputTypeChangedEvent	The DP591 output audio signal type has changed.
dp591InputContentChangedEvent	The DP591 has detected a change in the current input audio signal type. Notification includes information about the signal type on each audio pair and whether a given pair is used for processing.
dp591ProcessingDownEvent	A critical audio processing error has occurred. The DP591 main process is terminated.

Trap	Description
dp591CrcErrorEvent	The DP591 has detected a CRC error in the decoded input stream.
dp591PowerSupplyEvent	The DP591 has detected a change in the power supply status.
dp591FanEvent	The DP591 has detected a change in the status of FANx.
dp591ClockSelectionEvent	The DP591 has detected a change in the clock source or the clock source configuration.

Status

Trap	Description	Values
dp591InputType	Currently active input signal type.	Valid values are NONE, DOLBY_E, ED2, PCM and UNSUPPORTED.
dp591OutputType	Currently active output signal type.	Valid values are NONE, DD+, DD+ JOC.
dp591InputContentType	Current SDI pair input type.	Valid values are PCM, DD, DD+, DOLBY E, ED2, AAC, AACPLUS, AC4, EMDF, MAT_IEC, PAUSE, DDPLUS_IEC, UNKNOWN.
dp591InputPairUsed	Indicates whether the input SDI pair is monitored.	Valid values are YES, NO.
dp591AudioPair	Audio pair where the CRC error was detected.	Valid values are 1 to 8.
dp591CrcErrorCount	The number of CRC errors that occurred since the last notification.	
dp591PowerSupplyId	Power supply identifier.	
dp591PowerSupplyStatus	Status of the power supply.	Available values are OK, ERROR, MISSING, UNKNOWN.
dp591FanName	System fan name.	Fan names are FAN1, FAN2, FAN3, FAN4, FAN5, FAN6, FAN7, FAN8, FAN_OUT_OF_SCOPE. The usual number of fans in a system is 5. If more than 8 fans are present, every fan after FAN8 is called FAN_OUT_OF_SCOPE.
dp591FanStatus	System fan status.	Available values are OK, ERROR, MISSING.
dp591FanRpm	System fan RPM.	
dp591ClockPriority	Active clock priority.	Available values are PRIMARY, SECONDARY, NONE.
dp591ClockSource	Name of the clock source.	Available values are MADI, SDI, VREF, NONE.

7 Hardware specification

The Dolby Audio Encoder DP591 device meets these hardware specifications and compliance standards.

7.1 Physical specifications

The DP591 occupies one rack unit and is mountable in a EIA-310 standard rack.

Dimensions	1 U rackmount: 44 × 483 × 394 mm (1.75 × 19 × 15.5 inches)
Net weight	6.5 kg (14.5 lb)

7.2 Environmental specifications

These are the environmental specifications for the DP591.

Power

Power supply	Dual, hot-swappable from rear
Input voltage range	100–240 VAC
Input frequency range	50–60 Hz, autosensing
Power consumption	350 W

Temperature and humidity

Cooling	Front-to-rear airflow temperature-controlled fans
Operating temperature	0°C–40°C (32°F–104°F)
Storage temperature	0°C–40°C (32°F–104°F)
Operating humidity	20%–80% relative humidity (noncondensing)

7.3 Compliance

The DP591 complies with the regulatory standards governing electronic equipment in North America and Europe.

Regulatory agencies

North America	UL and FCC compliant
Europe	CE compliant

Complies with the European Union Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), as amended by Commission Decisions 2005/618/EC, 2005/717/ EC, 2005/747/EC (RoHS Directive), and WEEE.

Glossary

3G-SDI
3 Gbps high-definition serial digital interface.

AD
Audio description. A supplementary service where additional content, such as a descriptive commentary for visually impaired people, is associated with a main audio program.

AES
Audio Engineering Society. An international organization that promotes advances in audio and disseminates new knowledge and research.

ASI
Asynchronous serial interface. A streaming format that often carries an MPEG transport stream. It can contain a single program or be a multiplex of multiple programs, each consisting of video and audio.

AVR
Audio/video receiver. An audio amplifier and audio/video (A/V) switching combination device for a home theater. It contains inputs for all of the audio and video sources and outputs to one or more sets of speakers and one or more monitors or TVs.

CRC
Cyclic redundancy check.

dBFS
Decibels full scale. The amplitude of a signal relative to a digital full-scale signal.

DHCP
Dynamic Host Configuration Protocol.

dialnorm
Dialogue normalization value.

dynamic range control
An audio compression metadata parameter applied to audio to limit the dynamic range.

EBU
European Broadcasting Union. An alliance of public service media entities, based mainly in Europe.

GUI
Graphical user interface.

HD-SDI
High-definition serial digital interface.

IP
Internet Protocol.

ITU
International Telecommunication Union.

MADI
Multichannel Audio Digital Interface. A communications protocol for an interface that carries multiple channels of digital audio, defined by the Audio Engineering Society. Also known as AES10.

NTP
Network Time Protocol. A network protocol for clock synchronization on computers.

Pa
The name of a start-of-frame marker defined in SMPTE 337-2008.

PCM
Pulse code modulation. A method that is used to convert analog signals into digital, binary, coded pulses by sampling the analog signal, quantizing each sample independently, and converting the resulting quantized values into a digital signal.

SDI
Serial digital interface.

SMPTE
Society of Motion Picture and Television Engineers.

SNMP
Simple Network Management Protocol. A protocol for managing IP network devices

STB
Set-top box.

UI
User interface.

USB
Universal Serial Bus. A standard that defines the cables, connectors, and communications protocols used in connections between computers and electronic devices.

Vref
Video reference.