Dolby DP590 Object Authoring Tool
Product specification

12 February 2018
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1 Introduction
The Dolby DP590 Object Authoring Tool is a real-time audio object authoring environment. It supports the creation and monitoring of Dolby Atmos immersive, 5.1, and 2.0 mixes. It also emulates the playback experience of delivering those mixes as Dolby Digital Plus.

- Overview
- Key features
- Live Dolby Atmos toolkit

1.1 Overview
The DP590 is a state-of-the-art audio authoring tool that enables the creation of immersive audio within existing live production contribution and distribution infrastructures. It produces the metadata that defines audio presentations made up of elements such as the channel bed and Dolby Atmos audio objects.

The DP590 provides an authoring environment in which the sound engineer specifies object positioning and channel mixes for the live feeds coming from the audio console.

It receives from the audio console:
- Up to 64 channels of PCM audio, containing the audio channels for the authoring session

It outputs to the Dolby Audio Encoder DP591 over IP:
- Metadata that describes the authoring selections for encoding to either Dolby ED2 or Dolby Digital Plus with Dolby Atmos content

It outputs to the audio console over MADI:
- PCM audio to support real-time monitoring of the immersive content, as well as rendered mixes of the content
- Production mixes (5.1 and stereo) of the immersive content, for distribution downstream when those formats are required

1.2 Key features
The Dolby Object Authoring Tool DP590 is a key element of Dolby’s industry leading live Dolby Atmos toolkit that assists broadcasters, live audio mixers, and engineers in the adoption and deployment of immersive audio for live events.

1.2.1 Workflow
The DP590 performs primarily in the content creation phase of the broadcast production chain, in the OB truck. It can also play a role in the broadcast center by applying presentation metadata to reauthored content, such as remixing or voiceover audio.

The DP590 enables the audio engineer to:
• Define various combinations of audio elements, and save each unique combination as an audio presentation. Downstream decoders can be set to decode and render each presentation (for example “5.1 English”) as required.

• Provide meaningful names for the presentations that may refer to languages, targeted delivery paths, or enhanced experiences.

• Monitor the presentations being created in real time, including the 5.1 and 2.0 mixes, as well as rendered versions that emulate a playback device such as set-top box (STB) or TV.

• Create a 5.1 and 2.0 production mix while simultaneously creating the Dolby Atmos versions, and deliver them alongside the monitoring channels.

• Deliver the presentation metadata to the Dolby DP591 encoder in tandem with the live PCM audio feed, to produce the Dolby ED2 contribution format or Dolby Digital Plus with Dolby Atmos content as distribution format.

The DP590 wraps around the audio console, as shown in the diagram.

It receives the live feed, renders the audio presentations based on the metadata authoring definitions, and sends the presentations back to the console for monitoring. It sends the authored presentation metadata to the Dolby Audio Encoder DP591 to be encoded to the Dolby ED2 contribution format or to Dolby Digital Plus with Dolby Atmos content as distribution format.

1.2.2 Technical benefits

The DP590 delivers proven technology to broadcast providers.

• It supports the creation of the different presentations and the associated metadata required for immersive audio delivery.

• It provides local confidence monitoring of the presentations created for different playback environments without the need for additional equipment.

• It supports loudness measurement of the monitored presentation to ensure regulatory compliance.

• It provides proven design and reliability for installation in existing OB trucks.

• It interfaces with industry leading mixing consoles and provides external control of DP590 functionalities from existing mixing consoles through GPI/O, using Jnior devices.

• It provides an easy-to-use user interface that simplifies the process of creating immersive audio for live events.

1.2.3 Business benefits

The adoption of the Dolby object authoring toolkit makes business sense.
• It eliminates the need for broadcasters to make a major investment in new production capabilities to deliver compelling immersive audio entertainment experiences to the home and on mobile.

• It works with existing microphone configurations, with limited modification needed to bring fans closer to the action. It allows broadcasters to deliver immersive audio for live events that leverages the growing number of Dolby Atmos enabled playback devices.

• It supports the transition to 4K/UHD/HDR with enhanced audio experiences, while allowing these experiences to get better over time as platforms and skills develop.

• It simplifies the workflow for live production of immersive audio.

• It gives producers and audio mixers the creative freedom to mix audio as desired to create the immersive audio experience that will pull fans into the action.

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 adaptations 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.

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.
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 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.
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.
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 Object Authoring Tool DP590 is a rack-mountable, real-time authoring environment that interfaces with the audio console and with the Dolby Audio Encoder DP591 to create metadata for immersive audio content.

- Dolby DP590 block diagram
- Operating environment
- General features
- DP590 front panel
- DP590 rear panel
- GPI/O support

2.1 Dolby DP590 block diagram

The block diagram illustrates the audio processing flow through the DP590 device.

*Figure 6: DP590 block diagram*

2.2 Operating environment

The DP590 operates as a stand-alone device. A Windows-based GUI application, connected through the IP link, controls the device.

The DP590 receives up to 64 channels of MADI input from the audio console, and transmits MADI output back to the console. It connects to the Dolby Audio Encoder DP591 via IP link.
The DP590 UI provides a graphical, easy-to-use environment for configuring the audio bed components and the Dolby Atmos audio objects that make up each presentation of the audio feed.

**Figure 7: The DP590**

To support content creation, the DP590 creates metadata describing the presentations designed by the author. It sends the metadata to the Dolby Audio Encoder DP591 to produce the encoded immersive audio stream.

To support monitoring of the content creation process, as well as monitoring of the live feed, the device transmits the results of the authoring session back to the audio console over 20 channels on the MADI output. By selecting a presentation in the UI the user can monitor the Dolby Atmos version, or a 5.1 or 2.0 rendered version of the presentation, in real time.

In addition to controlling the monitoring selections from the UI, a link, using a Jnior automation controller, provides a connection to the audio console. This enables the engineer to make monitoring selections directly from the console surface.

The device provides loudness monitoring of the output from the front panel display, and from the UI. The user selects the loudness measurement method in the UI. The user can monitor the input and output audio levels from meters in the UI.

The device can be connected to two independent power sources through dual autoswitching power supplies.

### 2.3 General features

The DP590 provides an immersive audio authoring environment, renders audio for quality monitoring, and transmits metadata on command to the Dolby DP591 encoder. The device components support each of these roles.

The following tables provide a summary of the DP590 features.
## Hardware

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>• Ubuntu (Linux)</td>
</tr>
</tbody>
</table>
| Control          | • From a Windows-based GUI application, connected through the IP link  
                        • Front-panel control for setting command IP address |
| Upgrades         | • USB flash drive reinstallation                                           |

## Input

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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  
                    • These inputs serve as clock reference source only. |
| Gigabit Ethernet | • One 1000Base-T Ethernet RJ-45 connector command port.  
                        • One 1000Base-T Ethernet RJ-45 connector media port. Not used. |
| 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. |
### Output

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MADI/AES</td>
<td>One female 75Ω BNC unbalanced connector. This output supports:</td>
</tr>
<tr>
<td></td>
<td>• MADI: Signal levels per AES-10-2008</td>
</tr>
<tr>
<td></td>
<td>• AES: Not used</td>
</tr>
<tr>
<td>Headphones</td>
<td>• One 6.35 mm (1/4-inch) standard stereo headphone jack for confidence monitoring</td>
</tr>
</tbody>
</table>

### Audio support

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>• PCM audio at 48 kHz.</td>
</tr>
<tr>
<td></td>
<td>• Up to 64 channels over MADI input.</td>
</tr>
<tr>
<td>Output</td>
<td>• PCM audio at 48 kHz.</td>
</tr>
<tr>
<td></td>
<td>• 20 channels over MADI output.</td>
</tr>
<tr>
<td>Metadata</td>
<td>• Creates metadata to support the channel bed and Dolby Atmos objects as designed by the audio engineer.</td>
</tr>
<tr>
<td></td>
<td>• Sends a metadata file to up to two Dolby Audio Encoder DP591 devices to support encoding to the Dolby ED2 contribution format and to Dolby Digital Plus with Dolby Atmos content.</td>
</tr>
<tr>
<td></td>
<td>• Metadata supports up to 16 audio elements organized into up to 16 audio presentations.</td>
</tr>
<tr>
<td>Signal monitoring</td>
<td>• Signal meters in UI show levels for each input and each output channel.</td>
</tr>
<tr>
<td>Loudness monitoring</td>
<td>• Loudness measurement per the following standards: ITU-R BS.1770-3 with DI:</td>
</tr>
<tr>
<td></td>
<td>• ITU-R BS.1770-3 with DI</td>
</tr>
<tr>
<td></td>
<td>• ITU-R BS.1770-3</td>
</tr>
<tr>
<td></td>
<td>• EBU R128</td>
</tr>
<tr>
<td></td>
<td>• Loudness measurement values display on device front panel and in the UI.</td>
</tr>
</tbody>
</table>

### Device monitoring

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logs</td>
<td>• Client logs record user configuration actions, processing status, warning and error states.</td>
</tr>
<tr>
<td></td>
<td>• Server logs record device status and processing details for review by Dolby technicians.</td>
</tr>
<tr>
<td></td>
<td>• Available in the UI and for download.</td>
</tr>
</tbody>
</table>
GPI/O

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
</table>
| Junior Ethernet I/O controller | • Provides a link between the console surface and the device UI.  
• Up to eight functions can be mapped to device UI features.  
• Connects to the DP590 through the IP link.                                  |

2.4 DP590 front panel

The front panel provides device control and status information.

<table>
<thead>
<tr>
<th>Item</th>
<th>Interface</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1    | Input LED  | • Green: Active input signal.  
• Red: No active input signal.                                                  |
| 2    | Audio LED  | • Green: Audio data is detected on the input.  
• Off: No audio data is detected on the input.                                          |
| 3    | Sync LED   | • Green: The device is synchronized to the highest priority clock source available.  
• Yellow: The device is synchronized to a lower priority clock source.  
• Off: No clock source is detected.                                                     |
| 4    | Error LED  | • Not used.                                                                                                                  |
| 5    | Control screen | • Displays the unit name.  
• From the menu you can set/view device IP addresses, and view the loudness level. |
| 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 | • One 6.35 mm (1/4-inch) standard stereo headphone jack for confidence monitoring.                                      |
| 9    | Dim button  | • Not used.                                                                                                                  |
| 10   | Two USB 2.0 ports | • Used to load firmware upgrades.                                                                                           |
## 2.5 DP590 rear panel

The DP590 rear panel provides access to the device input and output connections, as well as to the power supply.

![DP590 rear panel diagram](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Interface</th>
<th>Description/use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AC power supply</td>
<td>Two AC power supplies, 100 and 240 VAC, 50–60 Hz, and 350 W, with temperature controlled fans:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Redundant power supplies. When one fails, the unit generates an alarm and switches to the other power supply.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fans provide front-to-rear air flow. When the temperature exceeds maximum operating temperature, a front-panel indicator lights up.</td>
</tr>
<tr>
<td>2</td>
<td>MADI/AES input</td>
<td>One female 75Ω BNC unbalanced connector. This input supports:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• MADI: Signal levels per AES-10-2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• AES: Not used</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This MADI input port receives up to 64 channels of PCM audio from an audio console. The DP590 will drive the clock from MADI input when neither SDI or Vref are present.</td>
</tr>
<tr>
<td>3</td>
<td>Gigabit Ethernet port</td>
<td>One RJ-45 connector for 1000Base-T Ethernet. This port is not in use.</td>
</tr>
<tr>
<td>Item</td>
<td>Interface</td>
<td>Description/use</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>-----------------</td>
</tr>
</tbody>
</table>
| 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 an audio router for monitoring purposes. It transmits production mixes for distribution downstream. |
| 5    | AES output port | Four female 75Ω BNC unbalanced connectors. These outputs support:  
- Signal levels per AES3-4-2009  
This output is not used in the current use cases supported by the DP590. |
| 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 to 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 output is not used in the current use cases supported by the DP590. |
| 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 Windows-based user interface application. It sends metadata over IP to a Dolby DP591. |
| 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. |

### 2.6 GPI/O support

The DP590 supports a general purpose input/output (GPI/O) connection to the console controls using a Jnior automation controller. This convenience feature enables the live audio mixer to select the monitoring content from the console surface or from the DP590 UI.

The DP590 GPI/O connection supports up to eight functions, one for each pin on the Jnior device. You map the functions to an audio presentation or monitoring mode from the DP590 UI.

The device supports the following options:
- Presentation:
One or more presentations that have been defined by the author, such as
Music_and_Effects_No_Commentary

- Monitoring mode:
  Dolby Atmos mix, 5.1 mix, 2.0 mix

When the engineer wants to monitor a given presentation, or a mix of that presentation, he selects it via the appropriate console controls.

As part of the setup process, the engineer wires the Jnior to the console controls. These controls are unique to each console model.

The Jnior connects to the DP590 through the IP link. The DP590 UI provides settings for mapping the console controls (Jnior pinouts) to the presentations, and to the monitoring mixes for those presentations.

The engineer typically sets up the GPI/O pinouts after designing the audio presentations in the DP590 UI.

While the GPI/O connection supports up to eight selections for presentations or monitoring modes, the engineer can select any of the configured presentations from the device UI. Set-top box mode is only available from the UI.
3 Use case for DP590

This use case illustrates the workflow for using the DP590 to author and monitor audio presentations of the live feed.

Authoring

The audio console receives the audio stems from the live event. It sends the audio to both the DP590 and Dolby Audio Encoder DP591. The DP590 applies the presentation settings that have been defined by the sound engineer to the incoming audio feed.

The audio mixer monitors the presentations to verify the settings. Once satisfied with the results, the mixer is ready to send the metadata to the DP591 for encoding.

The mixer chooses which presentations, and which mixes to send to the encoder. The device generates the metadata to describe those presentations. The mixer then initiates transmission of the metadata file from a control in the UI.

*Figure 8: Authoring Dolby Atmos metadata for encoding*

In this example, the audio mixer chooses to include metadata from two presentations. From the UI, he selects the Dolby Atmos mix from "Immersive" and from "Immersive clean". When he sends the metadata file, the encoder applies the settings to encoding the PCM input in real time.

While the audio mixer can choose to include any of the presentation mixes in the metadata, the DP591 encoder will use only the metadata that corresponds to the encoding/transcoding processing that it supports.

Monitoring

Meanwhile, the device sends the active audio presentation back to the console for monitoring. The engineer can change the currently monitored presentation mix by changing the active presentation in the UI or over the GPIO link.
Additionally, from a button control on the UI screen, the engineer can test how rendering the content on a device that is not capable of presenting Dolby Atmos content will sound by using the STB mode settings.

*Figure 9: Monitoring immersive content*

In this example, the audio mixer uses the console controls over the GPI/O link to select 3 and 6, which are mapped to presentation "Immersive" and to the "Dolby Atmos" monitoring mix, respectively. This sets the active presentation to the Immersive Dolby Atmos mix, and the monitoring output reflects those settings.

The audio mixer has set the speaker configuration to 5.1.4 to indicate that the OB truck is outfitted with four height speakers. The device delivers the Dolby Atmos mix for that speaker configuration.

The setting for STB mode is off, as it does not apply to monitoring the Dolby Atmos mix.
4 Audio authoring

The UI provides a graphical, easy-to-use environment for configuring immersive audio content.

- The authoring environment
- Presentations

4.1 The authoring environment

The UI organizes the authoring process into authoring sessions, where each session includes the settings defined by the audio engineer for input, audio presentations, and output.

In each session the audio engineer can use up to 16 audio elements to create up to 16 audio presentations. The sessions can be saved and reloaded from a file.

The UI can run in offline mode, allowing the audio mixer to work on configurations without disturbing a live feed. When connected, changes can be applied to the active presentation in real time.

4.2 Presentations

Audio authoring in the DP590 is centered around the audio presentation. A presentation describes a unique combination of audio elements that are to be presented together.

The concept of a presentation introduces a powerful advance in the delivery of personalized audio. From the same audio stems, the sound mixer creates multiple, unique combinations of the audio content. The DP590 supports 64 channels of MADI input. These audio elements comprise the components of a presentation.

For example, outside the stadium at a live event, the OB truck is receiving input from various microphone feeds.
The audio mixer creates a channel bed and audio objects from different locations in the stadium that can serve as height objects in the immersive mix. In this example, the channel bed is 5.1 and there are audio objects representing audio stems from four locations in the venue. Two separate commentary feeds are included: one in English, and one in Spanish. The audio mixer sends these audio channels over MADI to the DP590.

In the DP590 UI, the designer builds the presentation layout by adding channel bed elements and object elements to the presentation table. Each element maps to channels on the MADI input.

Presentation 01 might look like the example in the following table.

<table>
<thead>
<tr>
<th>MADI input channels</th>
<th>Presentation 01</th>
<th>Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–6</td>
<td>Bed 5.1</td>
<td>M&amp;E</td>
</tr>
<tr>
<td>7</td>
<td>Dynamic</td>
<td>Lfh</td>
</tr>
<tr>
<td>8</td>
<td>Dynamic</td>
<td>Rfh</td>
</tr>
<tr>
<td>9</td>
<td>Dynamic</td>
<td>Lrh</td>
</tr>
<tr>
<td>10</td>
<td>Dynamic</td>
<td>Rrh</td>
</tr>
<tr>
<td>11</td>
<td>Dynamic</td>
<td>Commentator English</td>
</tr>
</tbody>
</table>
The device propagates the layout to all presentations, as all presentations in a session must contain the same base elements. The designer can customize each presentation as desired, and choose which elements to include in the output.

In this example, the Spanish commentary is not enabled in presentation 01. The designer has enabled it in presentation 02, which will be routed to a Spanish-speaking audience.

**Target mixes**

To support distinct target devices, the DP590 makes three flavors, or mixes, of each presentation:

- Dolby Atmos
- 5.1
- Stereo

The device uses all enabled elements in the presentation to create the mix. Changes to any of the mixes are saved with the presentation.

The audio mixer chooses which mixes to include in the metadata that goes to the DP591, and monitors them one mix at a time.

**Presentation design**

To design a presentation, the DP590 authoring environment provides:

- A table in which to include the channel and objects elements that make up a presentation
- Controls for the application of gain to each of the individual channel elements
- A graphical panner for positioning the audio objects
- A target mix selector for switching between the mixes

The DP590 defines each of the presentations with metadata, and each is saved under a user-defined name.

The flexible nature of presentation design means that you can adapt the processing to match any workflow.
For example, when designing an immersive workflow, the designer may want to keep adjusting just one presentation, enabling and disabling different elements, changing the gain or object positions as he monitors.

With an established workflow, he may prefer to make several presentations, each with different elements enabled for output. After testing the output down through the broadcast chain, he can switch between them and rely on the results.

**Customize presentations**

Each presentation contains the same elements from the MADI input. To customize a presentation, the designer changes each mix individually. He can:

- Apply or reduce gain for each channel element, to adjust loudness.
- Apply position coordinates for a particular audio object, creating an immersive audio effect.
- Include or exclude individual elements. For example, include a particular commentary track so that distribution can be localized to multiple countries.

Each mix of the presentation (Dolby Atmos, 5.1, stereo) can contain different gain and position coordinate settings and enable/disable different elements.

*Figure 11: Customizing mix presentations*

In this example, the designer has enabled the commentary 02 object for the Dolby Atmos mix. The device will render this mix and include the commentary object at the coordinates specified for that mix. It will render the mix in accordance with the speaker configuration setting that the user has selected.

For the 5.1 mix, he has enabled commentary 01 object. The device will render this mix with Dolby Atmos objects and commentary for 5.1 channels.

For the stereo mix, the designer has disabled all Dolby Atmos objects. He has enabled the commentary 01 object. The device will downmix the 5.1 bed and commentary to stereo.

**Presentations for encoding**

To send metadata for presentations to the DP591 encoder, the user selects which presentations to include in the output bitstream. For each presentation, he can also choose which target mixes to include.

The device sends a file with the metadata for only the selected presentations. He can send any or all of the presentations to the DP591.

The Dolby ED2 contribution format can carry all of the presentation metadata. However, the DP591 only transcodes one presentation to Dolby Digital Plus with Dolby Atmos content, and it uses only the metadata from the Dolby Atmos mix.
5 Audio processing

The DP590 processes audio according to the authoring selections defined by the sound mixer. It creates metadata to describe the audio elements and configurations that the sound mixer chooses.

- Metadata
- Latency
- Clocking behavior

5.1 Metadata

The DP590 produces metadata to support immersive content creation and monitoring.

Metadata creation

The DP590 creates and manages metadata for one authoring session at a time.

The content creation metadata describes the audio presentations created by the sound mixer in the DP590 UI. The device sends this metadata, or a subset of it, to the Dolby Audio Encoder DP591 for encoding. It can also be exported to a file.

The device supports monitoring of the audio presentations during content creation or while broadcasting, and provides the metadata necessary to achieve the monitoring effects selected by the user.

Metadata for encoding

The DP590 transmits metadata to the DP591 to be encoded along with the PCM audio into either Dolby ED2 or Dolby Digital Plus with Dolby Atmos content. The DP591 is the only encoder that can create these formats.

From the DP590 UI, the user controls when to send the metadata file to the DP591. He decides which presentations to include in the metadata according to which presentations he wants to be available for encoding the bitstream. The encoder then implements the metadata immediately upon receiving the file.

Figure 12: Metadata path from creation to encoding
If the user chooses to include multiple presentations in the metadata from the DP590 to the Dolby Audio Encoder DP591, the encoder includes the metadata for all presentations in the Dolby ED2 contribution format bitstream.

When the DP591 is encoding or transcoding to Dolby Digital Plus formats, the encoder requires the user to choose one presentation for each Dolby Digital Plus output stream. The encoder uses only the metadata for that presentation when encoding the bitstream. Transcoding from Dolby ED2 to Dolby Digital Plus with Dolby Atmos content only uses the metadata from the Dolby Atmos presentation mix.

**Metadata for monitoring**

The user can select a variety of monitoring options and emulation modes. The device uses metadata settings to achieve the monitoring effects, such as downmixing, STB mode, speaker configuration, and so on. The device applies this metadata in real time, according to the selections made by the user.

The device applies a unique metadata set for each of the monitoring mixes: Dolby Atmos, 5.1, and stereo.

The metadata the device generates for the monitoring and emulation modes has no effect on the metadata file it generates for transmission to the DP591 encoder.

**5.2 Latency**

The DP590 introduces a delay of 10 ms when processing audio for monitoring or for production presentations.

The delay for production presentation audio (legacy 5.1 and 2.0) must be compensated for downstream by applying the same delay to the video. This is typically performed by the video embedder.

**5.3 Clocking behavior**

The DP590 uses hard-coded logic for clock selection.

The device acquires the clock according to the following priority scheme:

- First: SDI input
- Second: Vref input
- Third: MADI input

The device will always attempt to use the highest priority clock source, when present. Before using the SDI or Vref as the clock reference, it validates the input source and verifies that it is synchronous with the MADI audio input.

The device reports the clock source status on the LEDs on the device front panel, the LEDs in the UI, and in the event logs. The device reports the clock source status on the device front-panel LEDs, in the UI, and in the event logs.
6 Audio monitoring

The DP590 supports real-time monitoring of Dolby Atmos or legacy versions of the audio presentations designed by the audio engineer. It provides loudness measurement and input and output audio level monitoring meters.

- Monitoring content
- Loudness measurement
- Monitoring audio levels

6.1 Monitoring content

The DP590 delivers the active audio presentation over the MADI output to the audio console, where it can be routed to monitoring equipment. The audio mixer selects the presentation mix he wants to monitor from the UI or from the audio console controls via the GPI/O connection.

Monitoring settings have no effect on the metadata output to the DP591 encoder.

Monitoring mixes

Content creators need to listen to a presentation as the end user will experience it in the home. The DP590 supports this by offering rendered mixes of each presentation in Dolby Atmos, 5.1, or stereo content. When monitoring the presentations, the sound mixer can listen to the appropriate mix for each target device.

Monitoring options

The DP590 includes monitoring options that enable the user to listen to a variety of mixes and rendered versions of the audio. Some monitoring options apply globally for monitoring all presentations:

- Speaker configuration: Select the speaker configuration that matches the monitoring environment. The device uses this setting when rendering the Dolby Atmos mix from any presentation for monitoring.
- Headphone mix: Select the mix to monitor on the headphone channels.
- Production presentation: Select the presentation from which to take the 5.1 and stereo mixes for inclusion in the output.

STB mode

In addition to the presentation mixes and monitoring options, the DP590 provides options that emulate different target device capabilities, or different STB modes. Choosing between the different presentation mixes and using the STB mode options, the listener hears what the presentation would sound like on a given device, or with a given speaker configuration.

The user can activate STB mode for any presentation mix, but some settings are relevant only for particular mixes. The following table lists the options.
5.1 Rendering of the presentation mix

<table>
<thead>
<tr>
<th>Presentation mix</th>
<th>Description</th>
<th>STB mode options</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>A 5.1 rendering of the presentation mix</td>
<td>• Compression mode (dynamic range control profile):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• RF</td>
</tr>
</tbody>
</table>

Stereo Rendering of the presentation mix

<table>
<thead>
<tr>
<th>Presentation mix</th>
<th>Description</th>
<th>STB mode options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereo</td>
<td>A stereo rendering of the presentation mix</td>
<td>• Compression mode (dynamic range control profile):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• RF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Downmix mode:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Direct (no downmix, use stereo mix metadata)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lt/Rt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lo/Ro</td>
</tr>
</tbody>
</table>

To create the downmix, the device uses the 5.1 mix metadata.

The audio mixer activates STB mode by a toggle button in the UI. The device renders the selected mix, applying the options to emulate playback for the legacy device. The audio mixer can switch between presentations, mixes, and STB mode as often as needed.

6.2 Loudness measurement

To ensure compliance with loudness level regulations, it is necessary for broadcasters to measure loudness levels at many points within the production workflow. The DP590 provides loudness measurement of the monitored presentation, to support loudness monitoring during content creation as well as during the live broadcast.

The DP590 performs loudness measurement on the active output. In other words, it measures whichever presentation mix is actively enabled in the UI. It displays the measurement in a window in the UI, and on the front-panel display.

The device supports loudness measurement algorithms from the following standards:

- ITU-R BS.1770-3 with DI
- ITU-R BS.1770-3
- EBU R128

The user selects an algorithm in the UI, and the device applies it in real time to the output. The loudness measurement is a useful indicator for the audio mixer to ensure that the audio program is within the loudness target level.

6.3 Monitoring audio levels

The DP590 monitors audio levels for all input and output channels.

The audio meters in the UI show the audio levels in dBFS for every MADI input and output channel. The meters include an alarm threshold level that is adjustable by the user. The alarms are logged in the error log.
7 Output behavior
The DP590 sends PCM audio over the MADI output routed to the audio console, and a metadata (.xml) file over the IP link to a Dolby DP591.

- Default output
- Production presentations

7.1 Default output
The DP590 uses default channel mapping when provisioning output back to the console. Users can select the presentation they want to monitor.

Output for monitoring
The device outputs the currently selected audio presentation over the MADI output channels connected to the audio console. The audio mixer monitors the output for quality, and switches between audio presentations and mixes using the GPI/O link or the controls on the UI.

The device defines the MADI output channel routing to support monitoring of the audio content, and to carry production 5.1 and 2.0 mixes of the presentation, which are included on separate channels along with the monitoring output.

The DP590 reserves the MADI output channel mapping as follows:

<table>
<thead>
<tr>
<th>Output channels</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–10</td>
<td>The actively selected presentation mix for monitoring. All bed and audio objects that are enabled in the presentation are mixed into the monitoring feed.</td>
</tr>
<tr>
<td>11–16</td>
<td>The 5.1 rendered mix selected by the user as the production presentation.</td>
</tr>
<tr>
<td>17–18</td>
<td>The 2.0 rendered mix selected by the user as the production presentation.</td>
</tr>
<tr>
<td>19–20</td>
<td>Headphone rendering of the active presentation.</td>
</tr>
</tbody>
</table>

The device routes the channels from the presentation to the MADI output channels in consecutive order.

Output metadata for encoding
The device sends a metadata file with the currently selected presentation information to the DP591 encoder. It first verifies the connection to the encoder, and if found, sends the metadata file over the IP link.

The audio engineer chooses which presentations and rendered mixes to include in the metadata file. He controls when the device sends the file so that any changes can be delivered and applied immediately.

7.2 Production presentations
In addition to sending the active audio presentation mix to the console for monitoring, the DP590 delivers production presentations consisting of 5.1 and 2.0 rendered mixes of a given presentation.
This feature simplifies the production workflow that includes Dolby Atmos audio, as all formats can be created within the same device path. The broadcaster can deliver the production presentations downstream for services that require these legacy formats.

The production presentations are independent of the monitoring mix, and reside on separate channels in the MADI output.

By default, the device uses the 5.1 and stereo mixes from the first presentation that was created in the session. For example, assume the first presentation is named Immersive. The default output would contain the following content.

<table>
<thead>
<tr>
<th>Output Channels</th>
<th>Contents</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–10</td>
<td>Presentation: Immersive</td>
<td>Monitoring</td>
</tr>
<tr>
<td>11–16</td>
<td>5.1 rendering of presentation: Immersive</td>
<td>Production</td>
</tr>
<tr>
<td>17–18</td>
<td>2.0 rendering of presentation: Immersive</td>
<td>Production</td>
</tr>
<tr>
<td>19–20</td>
<td>Headphone rendering of presentation: Immersive</td>
<td>Headphones</td>
</tr>
</tbody>
</table>

The audio mixer can assign any presentation to provide the 5.1 and stereo rendered mixes for the production presentation.

For example, assume a workflow that includes delivery of the 5.1 and stereo mixes on a separate path from the Dolby Atmos mix. The designer makes a presentation specifically intended for delivery of those production presentations. In this example, that presentation is called Legacy. He optimizes the 5.1 and stereo mixes for the delivery that he requires, and monitors them to ensure that he has the desired settings.
The following table shows the output when the audio mixer sets the production presentation to "Legacy" and the active presentation is "Immersive clean."

<table>
<thead>
<tr>
<th>Output Channels</th>
<th>Contents</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–10</td>
<td>Presentation: Immersive clean</td>
<td>Monitoring</td>
</tr>
<tr>
<td>11–16</td>
<td>5.1 rendering of presentation: Legacy</td>
<td>Production</td>
</tr>
<tr>
<td>17–18</td>
<td>2.0 rendering of presentation: Legacy</td>
<td>Production</td>
</tr>
<tr>
<td>19–20</td>
<td>Headphone rendering of presentation: Immersive clean</td>
<td>Headphones</td>
</tr>
</tbody>
</table>

The audio mixer can route these production mixes downstream, as required.

The delay for production presentations is the same as for the Dolby Atmos monitoring channels, and must be compensated downstream when the audio is reembedded in the video.

**Related information**

*Latency* on page 27
8 Device monitoring

The DP590 provides real-time and file-based status and error monitoring tools.

- LED
- Logs

The device gives real-time feedback about device status and processing operations using the LEDs on the front panel and on the UI.

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

It also keeps server logs to track system processes. Dolby technicians might request these logs for troubleshooting whenever necessary.

8.1 LED

The DP590 front-panel LED indicators show whether the device is receiving input, as well as 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 clock, GPIO, and device status.

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 client 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.

8.2 Logs

The DP590 logs record system activity and operations.

The DP590 keeps two types of logs:

- Client log

  This log records configuration changes, processing status, and warnings. It is a temporary log, and is available only when the client application is open or when the number of entries does not exceed 100,000. The log is available from the UI and for download to a delimited text file.

- Server log

  This log contains information about the DP590 unit processes. In the event of a system failure, users must send the logs to Dolby Laboratories for analysis and support. This log persists on the device, even when the client application is closed. The log is available from the UI and for download to a .zip file. The file can be quite large.
9 Hardware specification
The Dolby DP590 Object Authoring Tool device meets these hardware specifications and compliance standards.

- Physical specifications
- Environmental specifications
- Compliance

9.1 Physical specifications
The DP590 occupies one rack unit and is mountable in a EIA-310 standard rack.

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

9.2 Environmental specifications
These are the environmental specifications for the DP590.

**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)

9.3 Compliance
The DP590 complies with the regulatory standards governing electronic equipment in North America and Europe.

**Regulatory agencies**

<table>
<thead>
<tr>
<th>Regulatory agencies</th>
<th>UL and FCC compliant</th>
<th>CE compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Glossary

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

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

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.

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

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.

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.
**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.