Paving the Way for Wider Adoption

One of the main places people listen to music today is in their cars. From listening to songs on a road trip with friends to singing along to a favorite track while driving around the city, cars are a special place for enjoying entertainment. Dolby Atmos is a way to create and experience entertainment that enables listeners to connect with their favorite content more deeply through greater details, clarity, and sound separation. The adoption of Dolby Atmos Music continues to grow, with 87% of Billboard's 2022 Year End Top 100 artists having released music in Dolby Atmos[1]. In the car, Dolby Atmos allows drivers and passengers to feel the sound move all around them in a whole new way.

1. Billboard, "Year-End Charts Top Artists", 2023

Dolby Atmos

ADI's A^{2}B technology has revolutionized next generation in-vehicle audio architectures and has quickly become the de facto industry standard for low-latency audio connectivity.

Dolby Atmos has been available in cars on the road since 2021. With increasing announcements and availability across a growing number of global auto OEMs and electric vehicle (EV) manufacturers, interest and demand are at an all-time high as more people seek out a Dolby Atmos for cars experience.

Dolby Atmos has been making waves at industry events like the Detroit Auto Show and Consumer Electronics Show (CES). As it continues its industry momentum in driving forward immersive car entertainment, it is clear that adapting to emerging system architectures such as Analog Devices (ADI) Automotive Audio Bus (A^{2}B®) technology is crucial to the adoption of Dolby Atmos for cars by a larger segment of auto OEMs.

Building on a longstanding partnership between the two companies, Dolby is working with ADI to address some of these challenges. ADI has long been a major player in the history of DSP chips with technological solutions that are in everything from automotive audio systems to smart building technology to consumer electronics. Coupled with the robust automotive audio processor

portfolio, ADI's A^{2}B technology has revolutionized next generation in-vehicle audio architectures and has quickly become the de facto industry standard for low-latency audio connectivity.

ADI's A²B Audio Bus at a Glance:

- Fully synchronous, bi-directional data transfer at 50Mbps
- Integrated audio, control, and bus power (up to 50W) over low-cost UTP wire that eliminates the need for local power/ground wires, reducing overall wiring complexity, cost, and associated weight
- Low and deterministic latency (50μs)
- Simple and easy to use – no software intervention required after initial bus setup and discovery
- Advanced system-level diagnostics
- Full-featured development tools enabling quick evaluation, as well as in-depth system design and debug

Dolby Atmos

"A^{2}B's simplicity and ease of use – together with its deterministic, low-latency operation – make it the perfect technology choice for wiring-intensive applications such as road noise cancellation, in-car communications, and personal audio zones."

VLAD BULAVSKY, GENERAL MANAGER OF ADI'S AUTOMOTIVE CABIN CONNECTIVITY GROUP

When Dolby Atmos is implemented in a car cabin, the Dolby Digital bitstream that carries the Dolby Atmos content needs to be decoded and then mapped to the speakers in the car cabin. In traditional automotive audio systems, decoding and rendering content in Dolby Atmos typically takes place in the head unit, with the resulting output then distributed throughout the car using heavy and costly analog harnesses.

A^{2}B offers a fully synchronous, digital alternative to legacy analog wiring. In addition to the fundamentally higher quality digital audio, A^{2}B significantly decreases the total amount of required wiring because it replaces multiple, individual head-unit-to-speaker connections with a multi-node, daisy chain bus using low-cost UTP wiring. In addition to providing a more cost-effective solution, the reduction in total wiring also decreases the total weight of the wiring harness, increasing battery life and extending range in the rapidly growing electric vehicle segment.

"With over 100Mu shipped and design-ins at over 35 OEMs, A^{2}B has quickly become the de facto industry standard for low-latency, digital audio connectivity," said Vlad Bulavsky, General Manager of ADI's Automotive Cabin Connectivity group. *"A^{2}B's simplicity and ease of use – together with its deterministic, low-latency operation – make it the perfect technology choice for wiring-intensive applications such as road noise cancellation, in-car communications, and personal audio zones."*

An existing A^{2}B-connected automotive audio system can easily be adapted to accommodate transmission of Dolby Atmos data in parallel with other synchronous audio data out of the head unit over the same two-wire twisted pair.
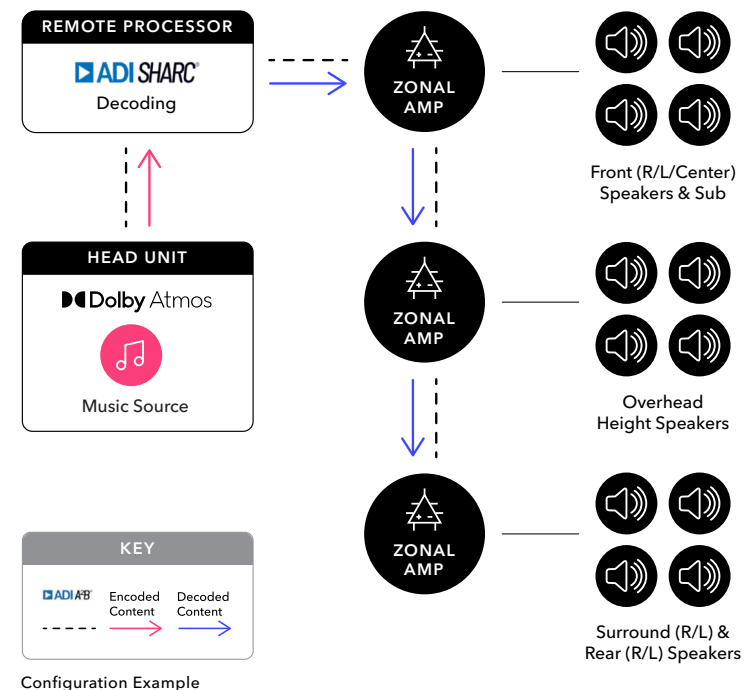
A Creative Solve for OEMs

But what about OEM architectures that want to support Dolby Atmos decoding and rendering outside of the head unit? Many audio system architectures require audio processing to be offloaded from the head unit to a remote amplifier or processing node located elsewhere in the vehicle, perhaps in the trunk.

◗◖Dolby Atmos

The A^{2}B bus is designed for automotive audio, optimized to efficiently move PCM audio data throughout the system between the head unit, amplifier, speakers, and microphone/sensor nodes.

In this system configuration, the head unit receives the streaming encoded Dolby Atmos content and sends it over A^{2}B – in parallel with other audio – to a remote node to be processed and then distributed to the system's speakers.

However, the A^{2}B bus is designed for automotive audio, optimized to efficiently move PCM audio data throughout the system between the head unit, amplifier, speakers, and microphone/sensor nodes. As a result, the Dolby Digital Plus data streaming into the head unit has to be formatted for efficient transmission over the A^{2}B network. ADI has developed an automotive framework to demonstrate this, where the head unit packetizes the encoded bitstream and sends it over A^{2}B to a remote processing node featuring the powerful SHARC ADSP-21569 audio processor. The SHARC audio processor receives the data off the A^{2}B bus, reassembles it, and feeds it into the Dolby Atmos decoder running on the SHARC+ DSP core. The SHARC audio processor then sends the rendered output PCM data to the speakers, again over the A^{2}B bus along with whatever other audio content is being distributed throughout the cabin.

REMOTE PROCESSOR

▶ADI SHARC®
Decoding

HEAD UNIT

◗◖Dolby Atmos

Music Source

KEY

▶ADI A²B® Encoded Content Decoded Content

Configuration Example

Front (R/L/Center) Speakers & Sub

Overhead Height Speakers

Surround (R/L) & Rear (R/L) Speakers

ZONAL AMP

ZONAL AMP

ZONAL AMP

Dolby Atmos

Thanks to this solution, Dolby Atmos for cars can be more rapidly adopted by OEMs who use an A^{2}B-based architecture, giving more people the opportunity to enjoy their favorite content in an immersive listening experience with Dolby Atmos for cars.

Many car amplifiers already use SHARC processors for cabin tuning, so when ADI approached Dolby about implementing Dolby Atmos source code into their processors, it just made sense.

"Over the years, ADI has developed a deep understanding of Dolby's technologies, including our holistic approach of testing the implementation and validating the experience in a system context," says Andreas Ehret, Senior Director of Dolby Automotive. *"Some of the core components had been available for re-use from earlier joint projects, so getting the remaining pieces implemented and working through testing and validation in the context of a car environment has been a smooth process."*

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ADI's DSP Solution at a Glance:

- Scalable 32-bit floating-point audio performance with large on-chip SRAM
- Advanced audio filter accelerators and ASRCs (+30% MIPS)
- Integrated Arm for advanced connectivity
- Rapid proof-of-concept with advanced hardware and software tools

"ADI is delighted to have Dolby Atmos running on our SHARC processor, providing an immersive audio living room setting within a vehicle cabin," said Andrew Lanfear, General Manager of ADI's Automotive Cabin Audio Processing group. *"In addition to furnishing automotive consumers with this enhanced entertainment, the audio subsystem in the car must simultaneously execute time-critical processing algorithms to support exciting emerging audio applications like active and road noise cancelation and personal audio zones. Our SHARC processors offer exceptional performance with ultra-low latency and determinism to meet the needs of these applications and more."*

◖◗ Dolby Atmos

"... car OEMs now can choose from an extended palette of options to create an optimal and highly efficient solution that perfectly suits their needs."

ANDREAS EHRET, SENIOR DIRECTOR OF DOLBY AUTOMOTIVE

Looking Farther Down the Road

Car entertainment is ever evolving. Remaining agile and tracking future trends is key to enabling consumers to get the most out of the content they love. Dolby's partnership with ADI is powering future opportunities through scalability, low latency, and power capability. ADI's A^{2}B audio bus and DSP solutions are a step in the right direction for Dolby's goal of making Dolby Atmos for cars a more universally available entertainment experience for consumers in their cars — not only for how we experience car entertainment today, but also for what is to come in the future.

Immersive and interactive experiences in the car have become an integral part of our everyday lives, with an increasing number of functions from entertainment to productivity becoming standard. Low and deterministic latency is a key competitive differentiator and critical design consideration for latency-sensitive applications to allow consumers to get the most of their experiences in their vehicles.

"Each car OEM has their own specific ideas and design constraints that result in a unique and tailored system architecture," says Andreas Ehret, Senior Director of Dolby Automotive. *"With ADI's solution to deliver Dolby Atmos bitstreams over the A^{2}B protocol, and the implementation of Dolby Atmos decoding in the SHARC DSP, car OEMs now can choose from an extended palette of options to create an optimal and highly efficient solution that perfectly suits their needs."*

► ANALOG DEVICES