Technical Article

4 Audio Trends Transforming the Automotive Industry

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The automotive industry is focused on creating a comfortable driving experience – but without compromising fuel efficiency or manufacturing costs. Original equipment manufacturers (OEMs) are refreshing their audio system architectures frequently to enhance the user experience and ensure safety by incorporating new audio technologies.

Techniques using microphones, amplifiers, loudspeakers and advanced digital signal processing can help enable background noise reduction, clearer voice communication between passengers, and emergency and high-fidelity hands-free voice calling. These are the four audio trends transforming automotive audio design.

Trend No. 1: Active noise cancellation systems

As is already well established in the consumer electronics industry, OEMs are increasingly adopting active noise cancellation. Conventional noise-cancellation techniques such as passive insulation and specialized tires make vehicles heavier and reduce fuel efficiency. Active noise cancellation methods can achieve the same benefits, while weighing less compared to passive insulation methods and without affecting fuel efficiency.

An active noise cancellation system works by strategically placing between two and six microphones throughout the interior cabin of a vehicle; see Figure 1. These microphones measure interior noise and transmit audio data to an audio subsystem that in turn puts out an anti-audio signal to built-in loudspeakers. Since these are the same loudspeakers used for audio playback applications, the addition of an active noise cancellation system comes at a relatively low additional cost.

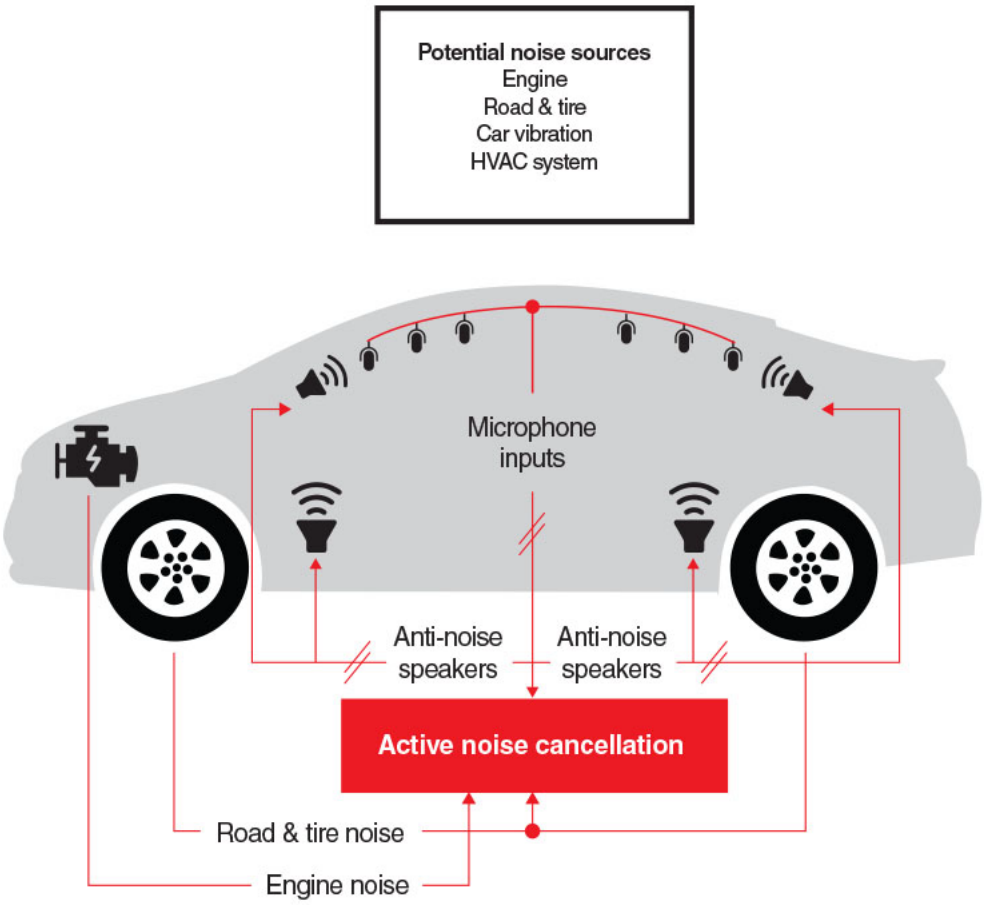

Figure 1. An active noise cancellation system uses microphones and loudspeakers to reduce in-cabin noise

An active noise cancellation system for entry-level cars uses two to four microphones, whereas high-end cars use as many as eight microphones.

Trend No. 2: In-cabin communication systems

Also called in-vehicle communication systems or in-car communications systems, in-cabin communication is just what it sounds like: it enables clear communication among occupants while inside the car. As shown in Figure 2, an in-cabin communication system works by strategically placing two to eight microphones to pick up the speech of each passenger, adaptively enhancing the speech of the person talking, reducing unwanted noise, and then playing the speech on the car audio loudspeaker system.

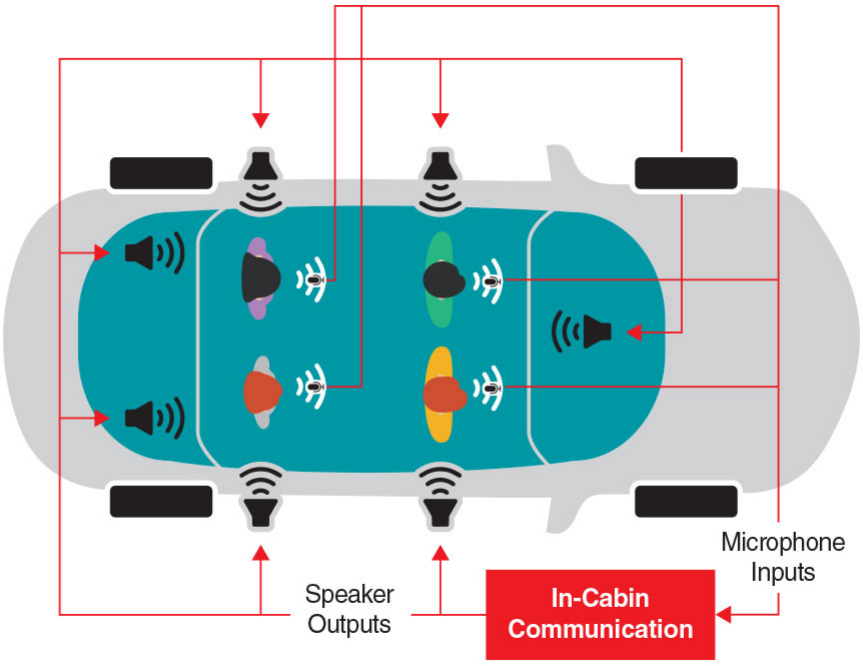

Figure 2. An In-cabin Communication System

Keep up with the challenges of today's microphone-based automotive applications

Learn more about TI's new PCM6260-Q1 automotive audio ADC with integrated programmable mic bias, boost and input diagnostics.

Trend No. 3: Emergency calling (eCall) systems and hands-free voice systems

As shown in Figure 3, an eCall system typically has one or two microphones for direct audio communication between the car and local emergency services in case of an emergency. A connectivity module digitizes and transmits the microphone signal to emergency operators. The speech from the emergency operator is played back on dedicated loudspeakers inside the car.

Like eCall systems, hands-free voice systems have between one and eight microphones, or an array of beamforming microphones, to enable clear voice calls and voice commands.

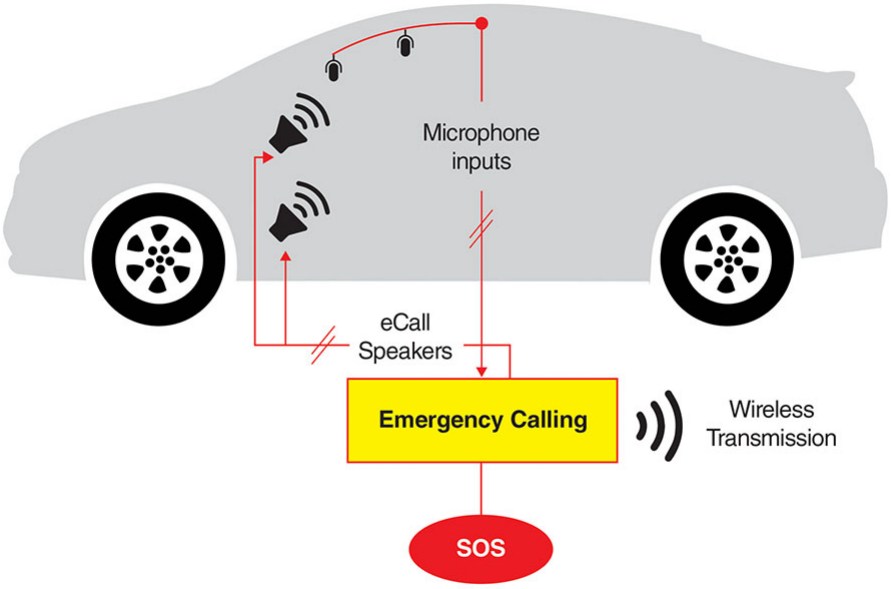

Figure 3. How an eCall System Works

Trend No. 4: Centralized audio hubs

Looking ahead to future implementations, many OEMs are considering a centralized audio hub (shown in Figure 4) that would aggregate active noise cancellation, in-cabin communication, eCall and hands-free microphone inputs, digitize these audio signals, and send the digitized signal to each respective audio subsystem for further processing.

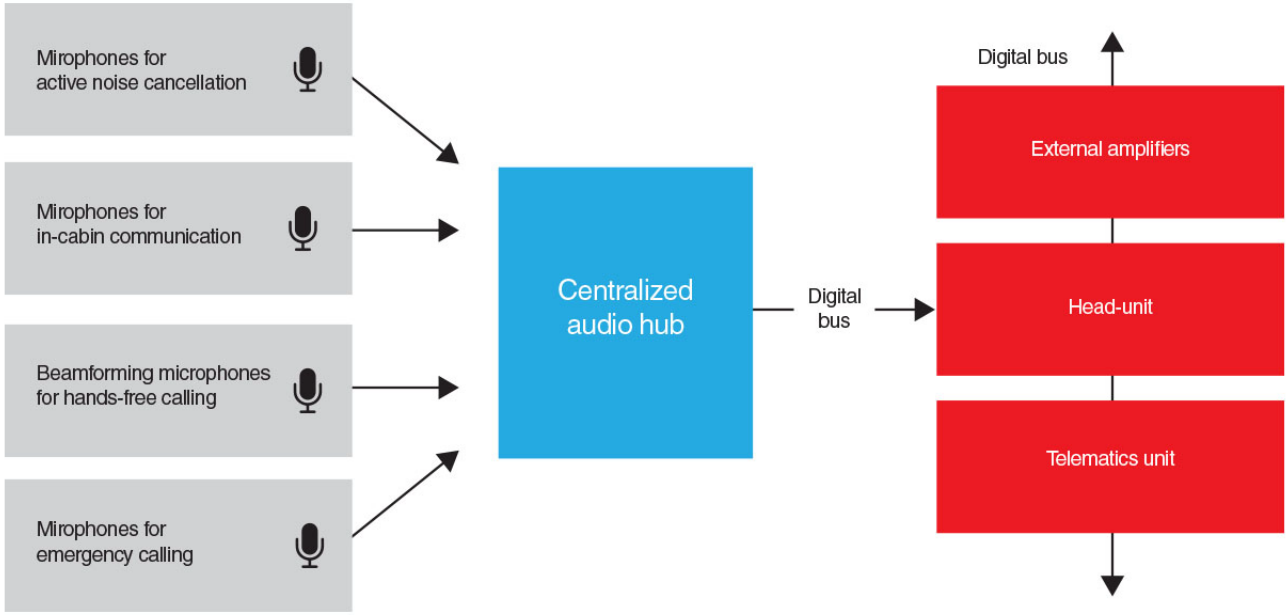

Figure 4. A centralized audio hub module

As trends in active noise cancellation, in-cabin communication and hands-free beamforming pick up, a centralized audio hub will reduce the amount of microphone routing required, the implementation complexity, and the cost associated with microphone cables.

To accommodate the short- and long-term vision of OEMs and Tier 1 manufacturers, Texas Instruments developed the PCM6260-Q1 multichannel audio analog-to-digital converter family; Table 1 lists the various devices in the family.

Table 1. The PCM6260-Q1 device family

Device	No. of inputs	Boost converter	Microphone bias	Microphone diagnostics
PCM6240-Q1	Four analog	✓	✓	✓
PCM6260-Q1	Six analog	✓	✓	✓
PCM6340-Q1	Four analog	x	✓	✓
PCM6360-Q1	Six analog	x	✓	✓

These devices support analog and digital microphone and line inputs and integrate a programmable high-voltage microphone bias and input fault diagnostics. They provide a flexible digital filtering scheme with linear-phase and low-latency filters, multiple second-order infinite impulse response filters per channel, and high-pass filters. The PCM6260-Q1 family supports a flexible data output and control interface, allowing several devices to use the same output data and control the interface bus. The devices have general-purpose inputs/outputs, fine phase and gain calibration schemes, and a digital mixer and summer to optimize system performance.

The adoption of these new audio technologies in cars – while requiring major architecture changes – promise to bring a richer driving and in-car communication experience.

Additional resources:

- Read more about automotive active noise cancellation techniques in *Electronic Products*.
- Learn more about the PCM6260-Q1 family of automotive audio ADCs in the app note, *Scalable Automotive Audio Solutions Using the PCM6xx0-Q1 Family of Products* .

- Learn how to use PCM6260-Q1 in microphone and line-input applications in the app note, *PCM6xx0-Q1 Use-Case Scenarios in Automotive Audio Applications*.

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