

MARKET & TECHNOLOGY TRENDS

Premium In-Car Audio Systems Have a Clear Road Ahead

By Anne-Françoise Pelé

For audiophiles and music enthusiasts, sound quality is a paramount consideration wherever they happen to be, including the car. Premium audio systems are now a staple in high-end luxury vehicles, and the steady demand for a more personalized and natural in-car audio experience is driving the growth of new artificial-intelligence features and speaker configurations.

More than 16 million premium automotive audio systems will be shipped by 2025, according to SAR Insight & Consulting's latest report on the topic, "In-Car Audio Distribution: The Connection Between Audio and Vehicle Brands." Cars will be available by then with 3D immersive audio, noise-cancellation solutions, speakerless systems, voice assistant platforms, OLED displays, digital dashboards, and embedded operating systems supported through cellular wireless connectivity, the report predicts.

Shortly after the report was released, EE Times Europe consulted Dennis Goldenson, director of artificial intelligence and machine learning at SAR Insight & Consulting, for a deeper assessment of the transformation and penetration of premium audio system solutions servicing the connected automotive market. An important takeaway was the expanding role of artificial intelligence in personalizing the audio experience for drivers and passengers, enabling natural interactions between the car and the driver, and enhancing contextual safety.

EE TIMES EUROPE: What do you mean, exactly, by "premium audio system solution"? What technology or feature makes it premium?

Dennis Goldenson: Good question. Over the years, there have been various definitions applied to premium audio systems — everything from number of speakers, surround sound, and watts per device to the associated brand. In fact, there are a wide range of perspectives and a lack of industry consensus on the components and features that characterize a premium audio system.

SAR Insight defines premium audio system solutions as head units that have been provided to the OEM by a "brand" audio manufacturer. Examples would include standard brand-name car audio systems such as Harman, Bose, Bang and Olufsen, Bower & Wilkins, Burmester, and Meridian. Consumers' preferences for reliable brands that translate into vehicle and sound quality continue to be



significant factors in the growth of premium audio systems and features.

EETE: What does AI audio processing bring to in-car systems?

Goldenson: Companies contributing to the automotive market are realizing how artificial intelligence can deliver smarter audio signal processing within the vehicle. This technology brings a whole range of enhancements to in-car systems, including natural-language processing, speech recognition, and selective noise-canceling solutions as well as customized infotainment systems with personalized vehicle settings, content, and recommendations that learn from a vehicle occupant's preferences.

EETE: What are the promises of AI for future cars in terms of infotainment and safety?

Goldenson: AI-powered infotainment systems will know the type of music that appeals to a stressful driver and calm his or her nerves. AI-powered voice assistant platforms with advancements in speech recognition and natural-language processing will

allow the driver to engage with their in-car systems in a simple, intuitive way, whether for navigation, temperature settings, or entertainment features.

Autonomous driving is one of the key application areas of artificial intelligence and machine learning. Autonomous vehicles will be equipped with various sensors, such as cameras, radar, and LiDAR, which will help them better understand their environment and surroundings. These sensors generate a massive amount of data that will require significant computational capacity with low latency. To make sense of the data produced by these sensors, there is a need for real-time processing capabilities.

When it comes to safety, we will see the rise of decentralized AI, which will be located closer to the assets and devices that are carrying out functions. Highly sophisticated machine-learning models that are powered by neural networks will be optimized to run on the edge, delivering real-time diagnostics on vehicle performance and safety.

When you talk about game changers, there is no question that AI and real-time audio processing will be transformative for the automotive industry, as they have been across markets. AI will be the key in maximizing connectivity and helping us move closer to mobility services and fully autonomous driving.

EETE: SAR predicts that there will be over 16 million premium audio systems shipped globally by 2025. What's the status today? Could you elaborate on this growing trend?

Goldenson: We estimate that premium audio system volumes in new vehicles grew from just under 13 million units globally in 2020, a modest 3% growth from the previous year (2019). Close to one-fifth of new vehicles produced globally now include a premium audio system. With over 50 million mid-range and luxury vehicles being produced annually in 2020, growing to 70 million by 2025, we can expect to see a growing trend in the advancement of network-enabled infotainment systems. Premium sound systems will continue to remain in demand as new in-car audio with well-known brands promotes features such as immersive audio, streaming content services, voice recognition, and noise-cancellation solutions to meet the growing expectations of the "connected" vehicle consumer.

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EETE: While always-listening systems could save lives in automotive human-machine interfaces, they also raise concerns about the user's privacy protection. How can we guarantee privacy for the user? Are players in the microphone, ASIC, or application-processor sectors developing technologies in that sense?

Goldenson: There is no question that privacy and security issues associated with always-on devices — whether at home, on a smartphone, or in a vehicle — are demanding increased attention. Reviewing the latest government regulations [reveals] that existing legal legislation is not sufficient to protect consumers. I do have concerns about the impact that connected cars will have on users' private information. As cars increasingly become connected and automation is turning into reality, data privacy needs to be prioritized.

The interesting challenge with AI and computer algorithms is the dichotomy between needing to continue collecting data to process, learn, and reason about the world while, at the same time, identifying data collection, processing, and storage solutions that protect the end user. AI-related communications and transferring information back and forth through the cloud can raise security and privacy concerns.

This is perhaps where the benefits of edge computing in the vehicle can be considered. Certainly in automotive — where real-time data is critical — more data is being processed at the edge or local level, thereby reducing security attacks, which happen during data transfer over a network. Companies across the ecosystem, from IC component and technology software and hardware providers to Tier One [suppliers] and OEMs, can differentiate themselves in the market by securing and processing critical data to enhance the driving experience and address security and privacy concerns.

EETE: A fierce competition is taking place among audio technology vendors. Who is leading the race? Who are the followers, the challengers, the changers, and the nichers?

Goldenson: I don't think I can answer this question, given the numerous innovators driving audio technology. Let's just say the audio technology companies that create differentiated voice solutions, noise cancellation, immersive audio, or streaming IP experiences to set themselves apart from the competition will be leading the race based on our trend analysis. At SAR Insight & Consulting, we work with various audio companies across the supply chain, from IC component to software- and hardware-enabling technologies to device manufacturers. In our experience, the companies that offer not only differentiated products and services, but accurate and reliable solutions that are compatible with AI and connectivity and build brand confidence with end users, are usually the leading competitive companies.

EETE: More and more strategic partnerships between automotive OEMs, Tier One suppliers, and audio technology leaders are taking place. What do you see coming out of these collaborations?

Goldenson: There is clearly a growing number of strategic partnerships between OEMs, Tier Ones, and technology firms looking to create a competitive advantage and differentiate their connected vehicle and feature offerings. One of the areas for strategic partnerships is within the audio space. Here are recent examples across the ecosystem:

- Sennheiser and Continental have collaborated on a speakerless immersive sound system. The new audio system has zero speakers and combines AMBEO 3D audio technology from Sennheiser with Ac2ated Sound from Continental to render 3D sound.

- BMW Group and Amazon Web Services (AWS) have formed a strategic collaboration to develop cloud-based software systems to provide complete turnkey solutions from development, engineering, and manufacturing to sales, management, service, and supply chain operations.
- Fiat Chrysler Automobiles (FCA) is partnering with Amazon to create Alexa Custom Assistant, a custom voice assistant, with its own custom features, that will work side by side with the Alexa voice assistant.
- Hyundai and Harman recently announced a noise-cancellation system called Road-Noise Active Noise Control (RANC) to reduce in-cabin noise.
- DSP Concepts and Bose are collaborating to bring Bose's QuietComfort Road Noise Control within DSP Concepts' Audio Weaver audio-signal-processing environment. This collaboration means that carmakers using Audio Weaver, such as Tesla, Porsche, or BMW, could offer Bose's QuietComfort RNC to their vehicles.

There is no question that automotive, Tier One, and audio technology suppliers continue to recognize growth opportunities and are leveraging strategic partnerships in an effort to take advantage of them.

EETE: In your opinion, what are the untapped opportunities in the in-car audio market? What are users asking for that audio technology vendors should develop?

Goldenson: I've spent considerable time reviewing automotive audio technology developments, and the untapped opportunities appear to be similar to the audio needs of consumers at home and on mobile devices.

These include in-car audio systems that deliver superior audio quality in the form of immersive audio with 3D sound impressions, new speaker configurations and positioning to optimize sound, digital and interactive dashboards to enhance infotainment UX, AI voice assistant platforms that provide useful and functional information and vehicle performance, active noise cancellation technology that diminishes unwanted in-cabin noise, and personalized online streaming content and metadata programming that takes advantage of 5G wireless networks to enhance the driver and passenger in-car multimedia experience.

There are a lot of exciting developments and growth opportunities within the connected vehicle audio market. These are transformative times in the advancement of in-car audio technology solutions.

Anne-Françoise Pelé is editor-in-chief of *EE Times Europe*.