REPORT

Bridging the Gaps in Connected Autonomous Driving

Survey reveals five areas automakers are addressing to realize the fully autonomous vehicle

The automotive industry faces major challenges as it strives to integrate disruptive technologies that will enable the connected autonomous vehicle (CAV). Add pressure on carmakers to produce zero-emission vehicles and a drastically compressed design-to-build cycle for the average sedan, and the question isn't when but how to realize this electric CAV vision.

Executive Summary

Keysight commissioned technology research house Dimensional Research to conduct an independent survey of automotive decision-makers. Below are the five focal areas they identified to bridge the gaps in CAV developmental road maps:

- standardize the approach to testing autonomous vehicle (AV) systems
- improve testing technologies to ensure safe AV operation
- pre-empt multiple network connectivity issues
- circumvent automotive cybersecurity risks
- increase resources to mitigate integration challenges

The research finds that…

- Vehicle cost differences is the top barrier inhibiting EV adoption.
- Each AV manufacturer creates their own ADAS solutions.
- Partnerships, new technologies, system integrations, and security risks are leading companies to incorporate more testing to mitigate numerous issues.

KEYSIGHT TECHNOLOGIES

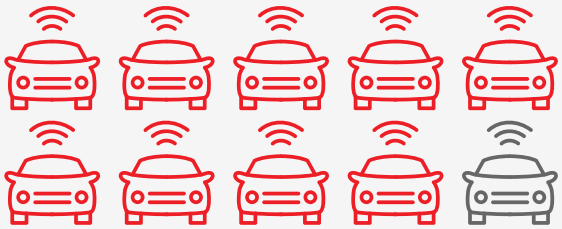
Standardizing the Approach to Testing AV Systems

One of the biggest challenges in the autonomous driving industry is the validation and homologation of advanced driver-assistance systems (ADAS) functions. Homologation refers to the governmental approval process companies must follow to bring vehicles to market. Each AV manufacturer develops its own ADAS and artificial intelligence-driven decision-making platforms. Regulatory frameworks developed for conventional vehicles do not provide a comprehensive assessment of systems used for self-driving technologies.

Ninety-one percent of respondents indicated that standardized tests representing numerous real-life scenarios would help the AV industry better achieve homologation (Figure 1).

Traditional automotive homologation processes aim to ensure the safety of vehicles on public roads. However, the integration of artificial intelligence into AV technology presents new areas of safety verification that are tough to account for with conventional processes. Much work remains for regulatory authorities worldwide to develop compliance standards, even as AV developers continue to push hard at ensuring their designs conform to evolving standards in the meantime.

Should standardized tests representing numerous real-life scenarios be required for all AV systems?



91%

Figure 1. Survey results reveal standardized tests are an important means to help the AV industry meet safety standards

Improving Testing Technologies to Ensure Safe AV Operation

Building confidence in ADAS begins with hundreds of millions of miles of road testing, actual or simulated. A key challenge is testing onboard sensors — radar, lidar, camera, ultrasonic — operating as an integrated unit and sending data to vehicle systems that control steering, braking, drivetrain, and more.

Ninety-three percent of survey respondents said testing technologies need to evolve to ensure that self-driving vehicles operate safely.

To accelerate the validation of AV functionality, performance, and safety, test solution companies are bringing the road to the lab with innovative solutions such as Keysight's autonomous drive emulation platform. Real-time 3D engines emulate dynamic traffic signals to exercise ADAS sensors, combining capabilities for congestion testing with 5G-based cellular vehicle-to-everything (V2X) scenarios that mirror real-world driving situations.

In your experience, will new testing technologies for drive emulation need to be developed to ensure safe AV operation?

93%

Figure 2. Nine out of 10 respondents cite a need for new testing technologies that can emulate real-life traffic scenarios to exercise ADAS sensor functionality

Pre-Empting Multiple Network Connectivity Issues

Connected car technology is standard in modern vehicles, meeting consumer demands for constant connectivity to infotainment, convenience, and comfort. Increasingly, V2X connectivity is assuming a more critical role in machine-to-machine applications. V2X allows vehicles to communicate with one another, with roadside units, and, in the future, even with pedestrians for safety and navigation functions.

The data exchange among vehicles includes the transmission of cooperative awareness messages and decentralized environmental notification messages. It also includes specific trajectory information and sensor data. The end-to-end delay for this information exchange typically ranges from 100 to 10 milliseconds (ms) and, in extreme cases, even down to 3 ms.

SAE International has defined six levels of driving automation. Working in tandem with ADAS, V2X connectivity will help autonomous driving technology cross the chasm toward Level 3 autonomy and push toward higher autonomy levels beyond geofenced driving zones. However, a challenge is meeting low-latency and high-bandwidth requirements for mission-critical V2X functions that work in conjunction with ADAS and infotainment applications. Mitigating network interference, congestion, and lack-of-signal impacts will also be important for the self-driving car to evolve (Figure 3).

Emerging technologies leveraging 5G New Radio (NR) standards address these challenges by improving communications reliability and reducing latency. These technologies support one of 5G's most important use cases — ultra-reliable low-latency communications (URLLC). URLLC is one of several use cases supported by 5G NR standards for enabling Level 5 driving automation. With a latency of no more than 1 ms and connection reliability of at least 99.999%, URLLC guarantees the highly secure communications essential for AV applications.

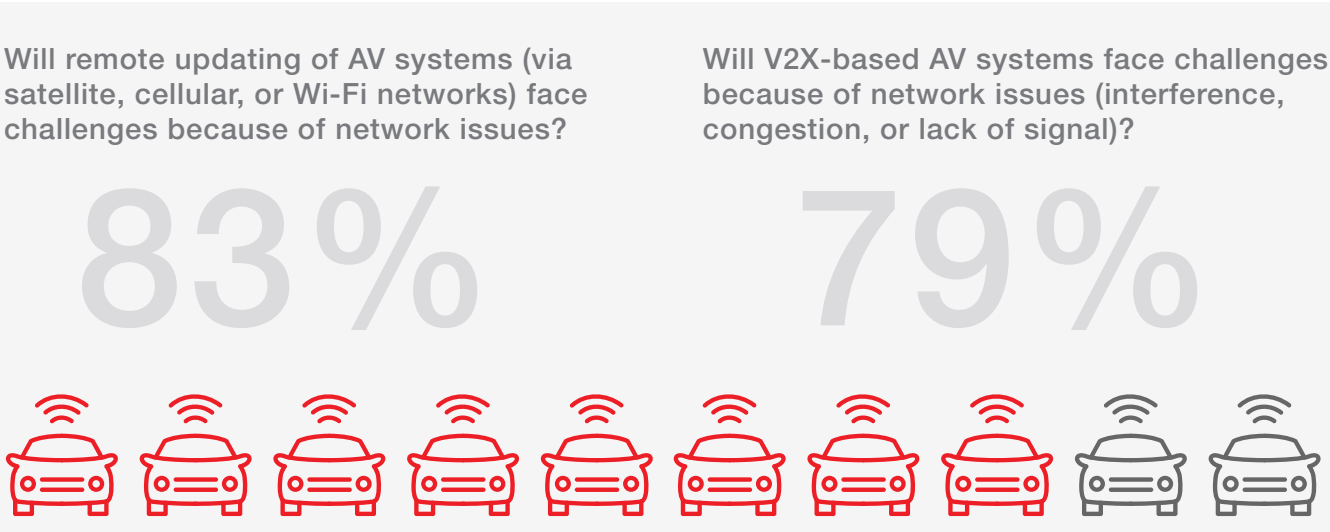


Figure 3. Faster and more reliable connectivity will help solve AV network challenges

Circumventing Automotive Cybersecurity Risks

The survey revealed that two out of three respondents believe AVs are susceptible to hacking (see Figure 4). With increasing connectivity, automotive cybersecurity is a vital issue in the nascent AV market. Risks include simple hacks like unlocking a car door or lowering a window and more dire issues such as stealing personal and financial information.

Even more ominous potential breaches include remotely taking control of the vehicle's functions. There is also the concern of updating firmware and applications securely for the modern CAV, a supercomputer on wheels.

One way automotive design and test engineers secure cars is by using a holistic intrusion protection strategy. This approach combines hardware security validation with software to stress-test potential attack interfaces against a dynamic library of threats.

Automotive cybersecurity developers aim to stay ahead of hackers. Developers must constantly update their test plans and run them against a "live" application and threat intelligence (ATI) library. For example, Keysight operates ATI subscription services spanning years of knowledge gained from attack information to help developers validate their security applications.

In your experience, how likely is it that an AV system will be hacked?

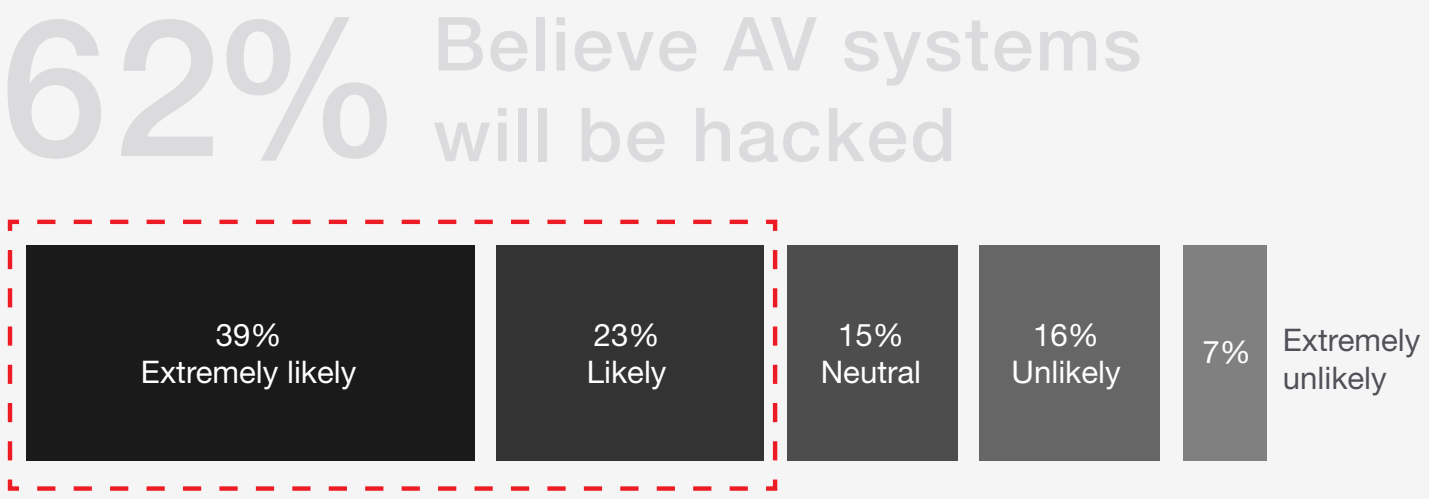


Figure 4. Automotive cybersecurity issues may pose threats for both privacy and security for AV owners

Increasing Resources to Mitigate Integration Challenges

Another area of emerging importance is how to tackle integration challenges as electric, autonomous, and connected technologies converge. Here are the top three respondent insights with regards to automotive technology convergence:

- Ninety-eight percent of automotive partnerships will face integration challenges.
- Ninety-five percent indicated they are doing more testing to mitigate integration issues.
- Testing budgets mirror automakers' focus on EVs / AVs and new testing solutions and practices.

Figure 5 illustrates the top areas where automakers are investing.

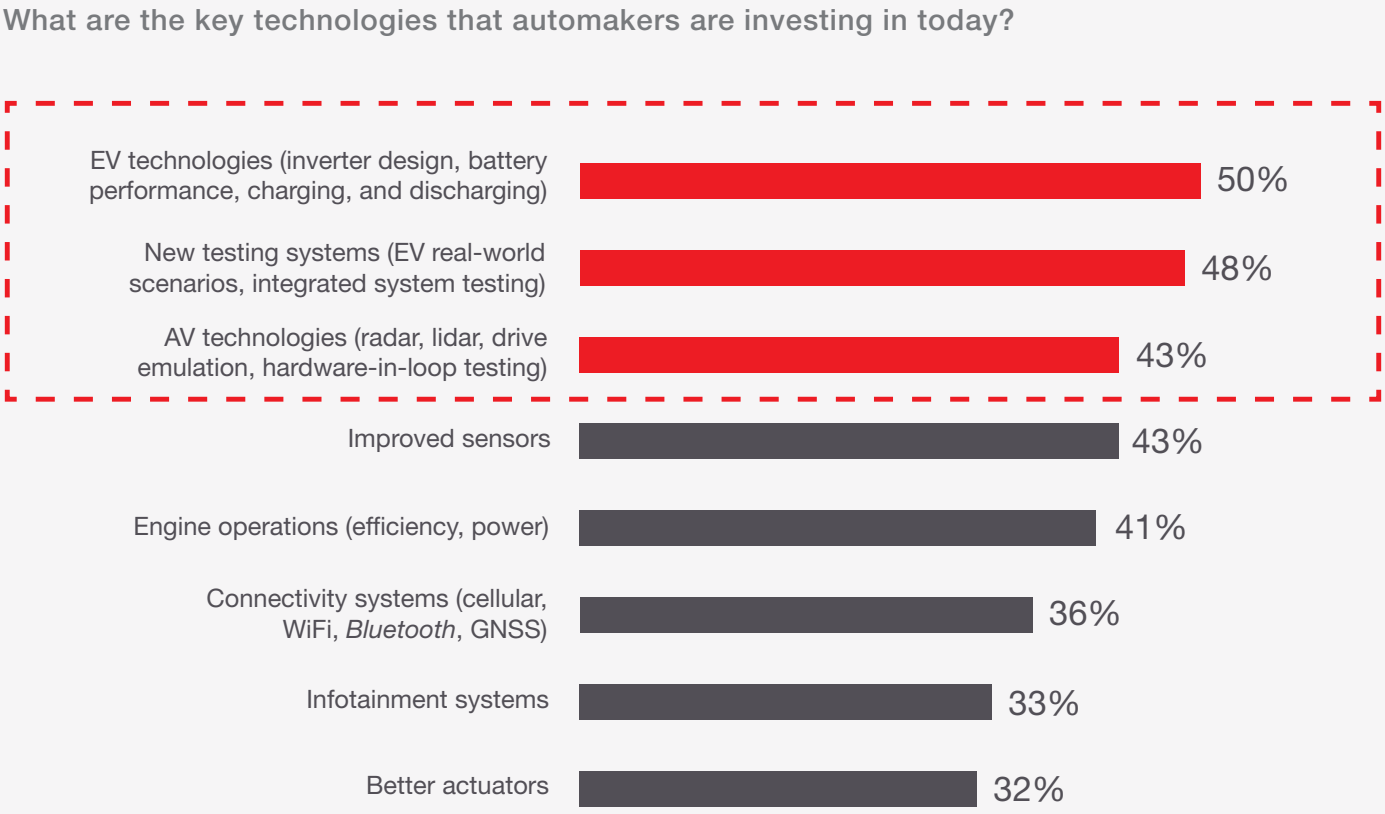


Figure 5. Top EV and AV technologies that automakers are investing in today

Ideally, CAV technologies can improve vehicle efficiency and reduce overall transportation energy use through improved control and optimization. However, developers are working hard to address key challenges before self-driving (electric) vehicles can cruise alongside human-driven vehicles. Priorities include how to do the following:

1. Validate the software for ADAS sensors, V2X systems, and vehicle subsystems such as brakes and accelerators via time-synchronous testing in the lab. Emulating in the lab how the vehicle behaves in real-life traffic situations can widen the coverage of test scenarios and speed up design verification and functional validation before proceeding to actual road testing.
2. Harness the capabilities of CAVs to reduce overall energy use via optimal routing and speed harmonization. This will require rigorous testing of integrated V2X communications between vehicles, vehicles and roadside units, and vehicles and pedestrians. It will also require testing of telematics control units and ADAS functionalities.
3. Optimize trade-offs between the benefits of CAV and its need for more power with vehicle electrification designs. These include how to better harness regenerative braking energy from the EV and improve overall onboard power conversion efficiencies from the power device level to subsystems and electric powertrains.

Exciting times are ahead for developers of connected self-driving cars. As the world moves toward zero carbon emissions, such cars will increasingly be electric. While there are challenges ahead, many new design and test solutions are available to help drive automotive innovations toward Level 5 autonomy.

Explore Solutions

Autonomous Drive Emulation Platform

Connected Car Design and Test Solutions

Automotive Radar Signal Generation and Analysis Solutions

E-Mobility Solutions

Automotive Power Electronics Test

About the Survey

Dimensional Research invited automotive industry professionals at all seniority levels to take part in a survey on their companies' participation with AV and EV vehicles and the technology that enables them. A total of 302 qualified participants completed the survey in December 2020. All participants worked directly with AVs and EVs. Responsibilities included design, hardware, software, testing, and manufacturing. Participants were from all five continents.

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