Storage Chips for In-Vehicle Computing Applications

Today's automotive sector is computer-intensive and rapidly transforming next-generation vehicle architectures, driving systems, passenger experiences, manufacturing, and, of course, supplier ecosystems. Tomorrow's vehicles will use even more computer technologies, especially software, storage, and connectivity.

The convergence of three lanes of technology (Connected, Autonomous, and Electric) propels the automotive industry changes, along with the increased flow of services for vehicle operation (the vehicle itself), services leveraged by the vehicle (mobility), and data-driven services (IoT platforms).

These trends are most apparent when we consider **autonomous driving**, which automates the decision and control of vehicles by leveraging perception results based on multiple sensors.

Many automotive companies have made enormous investments in autonomous driving, a market valued at USD 22.22 billion in 2021, and expected to reach USD 75.95 billion by 2027 (CAGR of 22.75%, 2022-2027)[1].

The recent proliferation of computing technologies (*e.g.*, sensors, computer vision, machine learning, and hardware acceleration), and the broad deployment of communication mechanisms (*e.g.*, dedicated short-range communications or DSRC, cellular vehicle-to-everything or C-V2X, and 5G) have enabled the emerging autonomous driving market.

Further growth requires improving **vehicle perception capabilities**, creating opportunities for sensors proliferation, new sensing technologies, and the corresponding storage needs.

Autonomous vehicles of the future will require **lots of storage (and different types of storage)** to collect data from LiDAR, radar, cameras, and other sensors as well as in-vehicle infotainment, navigation systems, and maintenance data.

Autonomous vehicles are not the only trend driving change in the automotive industry.

94% of the industry's high-level executives polled agree digital technologies create exciting opportunities for vehicle architectures and driving experiences-- and will require greater cooperation among stakeholders[2].

In less than five years**, digital technologies will empower standard new vehicle** features, including user interfaces via mobile apps (50% agree), streaming movies and TV (47%), remote enablement of new/add-on features (46%), subscription-model pricing for key features (46%), safety and driver assistance (45%), along with over-the-air software updates (43%)[3].

Driven by the internet of vehicles and autonomous driving technologies, the storage demand from onboard electronic applications is increasing day by day.

As vehicles become more complex, researcher *IDC*[4] says **the management of data from computing to storage becomes the most challenging aspect** of vehicle development and operation.

The amount and complexity of data generated by each vehicle will vary depending on the incorporation of different technologies.

The key areas of data consumption, creation, and communication include:

- Advanced Drivers Assistance Systems (ADAS) functions
- Infotainment, navigation, and the digital cockpit
- Connected data – the data sent to and from vehicles via communication with outside systems (infrastructure)

In-Vehicle Storage Needs

Depending on the type of vehicle, the storage capacity per vehicle will range from 1 TB to nearly 11 TB by 2030, according to *Counterpoint Research*[5].

The forces at play that determine in-vehicle storage needs include:

▪ The role of memory in automotive manufacturing has designers of safety-critical systems **relying upon Dynamic Random-Access Memory (DRAM) for diagnostic coverage** for their system safety objectives[6].

▪ Vehicles will need to **retain at least the last 30 seconds of data for post-accident forensic examination**. This could require 32 GB or more than 200 GB, depending upon how many sensors are in the vehicle.

▪ In-vehicle infotainment systems have become more immersive with features like speech recognition and 4K displays. From a hardware perspective, the lines between infotainment and Advanced Drivers Assistance Systems (ADAS) are increasingly blurred as these functions share resources, making the functional safety of these systems paramount. **Infotainment systems need from 8 GB to 256 GB of embedded NAND**. New options (in-vehicle gaming, movies) will grow storage requirements significantly over time.

▪ Cities and countries plan to adopt technologies to interact with the vehicle to improve safety and traffic. While still in the early stages, growth in the use of sensors and computing in vehicles and transportation infrastructure will inspire **an increase in the amount of data used, stored, and communicated by municipalities**.

▪ The amount of software in vehicles will increase, growing the demand for storage on a per-vehicle basis. **Over-the-Air Electronic Control Units (OT-capable ECUs) will require about double the existing embedded storage memory to handle upgrades**. Different automotive architectures may reduce the number of ECUs by consolidating functionality but overall storage (on a per-vehicle basis) will still increase. Domain or zonal architectures may centralize storage, but overall storage will still increase.

▪ To ensure safety while driving, memory must be able to withstand violent vibration, voltage instability, frequent power outage, wide temperature change, greater amounts of dust, and strong interference in the vehicle environment. **Harsh physical environments demand robust memory for vehicles**.

▪ There is no speed limit for memory storage: for vehicles, the memory interface is critical so the faster the performance, the better. Such **interfaces as UFS and the newest PCIe generation can offer faster performance** than the older standards previously used.

▪ To collect data for future project development, the industry uses **crowdsourcing for real-world operational data**. For this, today's production vehicles have storage needs from 32 GB up to 1 TB depending on the make, model, and features.

▪ And it's not just consumer vehicles that require memory chips. Autonomous trucks will be running on our roads long before passenger cards.

▪ Another less recognized trend is the rise of autonomous tractors. The autonomous farm equipment market will be worth US$150 billion by 2033[7]. At CES 2022, John Deere revealed its autonomous tractor with six pairs of stereo cameras, granting 360-degree obstacle detection and allowing calculation of distances[8]. Of course, **memory chips are planted in every autonomous tractor**, so the self-driving system can harvest useful data.

EXECUTIVE SUMMARY

A modern car can easily have more than 3,000 chips[9]. Electronics are responsible for 40% of a new car's total cost – and that's expected to be 45% by 2030[10] because of autonomous driving features and the increasing popularity of electric vehicles.

While the digital revolution in the auto industry is underway, the hardware tech driving that change is fueled by memory and its bandwidth.

High-performance computing functions that run algorithms for perception, planning, and control in autonomous driving systems require faster, higher-capacity memory subsystems. Storage needs are increasing dramatically every time processing power increases.

Experts are very clear on this point: automakers and their OEM suppliers will need to incorporate new digital technologies and capabilities into their vehicles, and these companies will need to **turn to specialists for the skillsets they need, broadening their current partner ecosystems**[11]. That's true for storage and it's happening today.

FOOTNOTES

1 Mordor Intelligence

2 Molex Survey

3 Molex Survey

4 IDC

5 Counterpoint Research

6 Design News

7 Future Farming

8 Deere.com

9 New York Times

10 Car and Driver

11 Molex Survey

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Innovative Solutions in Storage

BIWIN is your best choice for a specialist partner for in-vehicle storage solutions.

BIWIN provides vehicle electronics with storage solutions supporting large capacity, low power consumption, sturdy design, a wide range of working temperatures, and a wide range of voltage options.

BIWIN features storage chips for these Industry Applications:

- Vehicle navigation system
- entertainment system
- driving monitor
- dashcam
- ADAS assisted driving system
- smart networking
- smart dashboard

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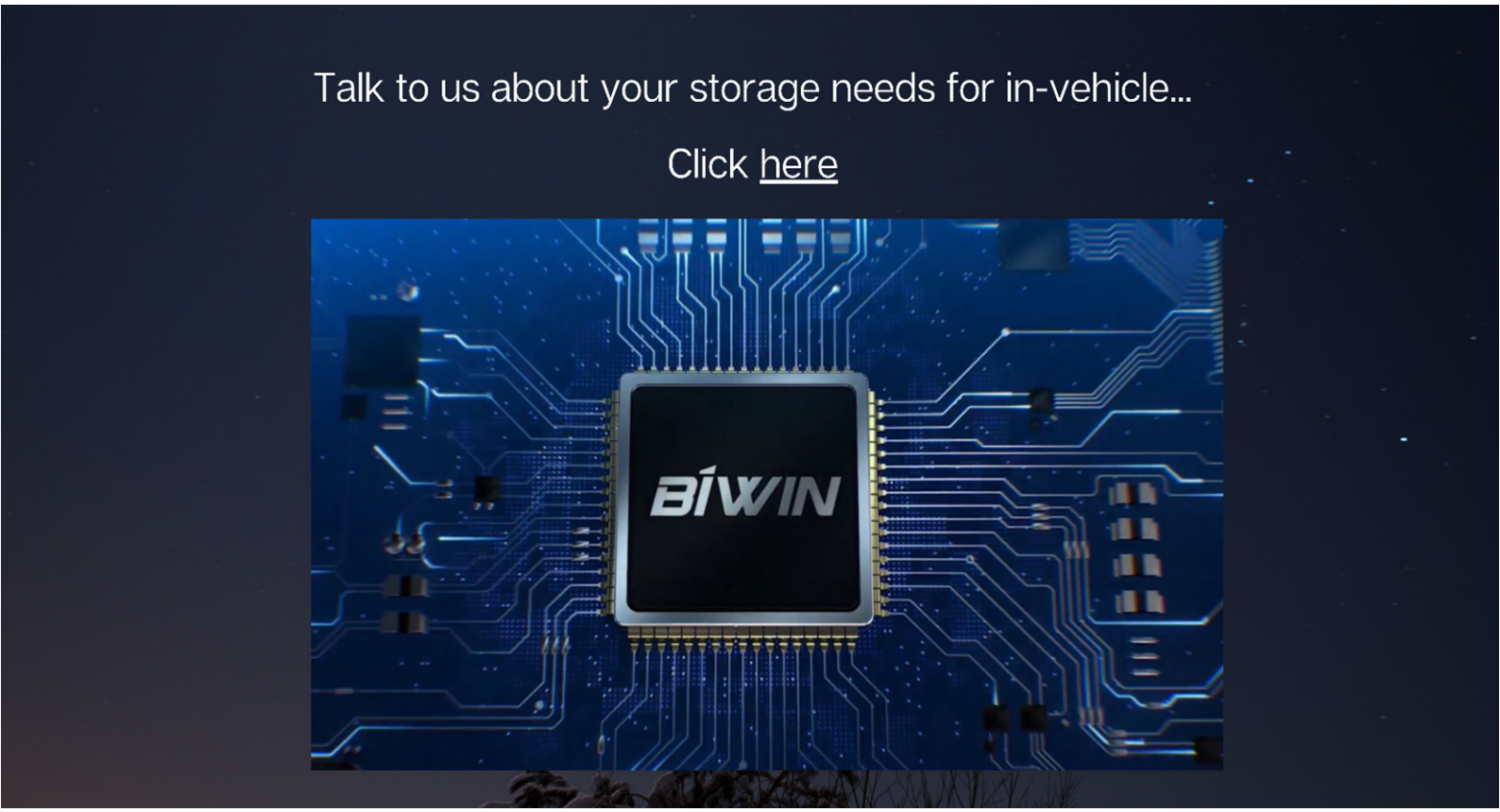

FEATURED PRODUCT

1 Reinforced design for challenging environments

BIWIN's onboard SSD adopts an IC bottom-filling technology which enables the PCB and the chip to adhere more firmly. The SSD adopts a high-strength metal shell to protect internal components. There's our customized reinforced interface which not only makes the physical connection stable, but also has a strong plug-and-pull resistance to effectively reduce failure rate. It also ensures the stability of data storage in bumpy and vibrating driving environments.

2 V-REC algorithm optimization and power outage protection

BIWIN uses V-REC algorithm optimization to conduct special firmware tuning to keep the onboard SSD from decelerating in high-density reading and writing modes. In addition, BIWIN's onboard SSD features a built-in power detection chip to monitor the power supply in real-time. Once an abnormality is discovered, power outage protection is immediately enabled to ensure the reliable transmission of cache data to the flash memory. This avoids firmware failure and provides reliability for the onboard application's storage data.

3 Compliance with automotive-grade standards

To ensure the reliability of onboard electronic products, the automotive industry has established many high-quality and high-standard regulations. BIWIN has passed the IATF 16949 automobile quality management system certification, and we guarantee the designed solution is not only suitable for your onboard applications but will also function reliably in harsh driving environments.

4 Customized storage solutions

With our independent software, hardware, and firmware development capabilities and storage algorithm development abilities, BIWIN can quickly tailor onboard application storage solutions for customers as well as offer a choice from our wide product range.