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# Automotive Memory Chip Industry Research Report, 2022

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The global smart phone storage market size hit US\$46 billion in 2021 when the global automotive storage market size reached about US\$4.5 billion, which is only equivalent to 1/10 of the former. Under development trend of intelligent connected vehicles, automobiles will become one of main growth engines of memory IC industry. By 2027, global automotive storage market size will exceed US\$12.5 billion, with a CAGR of 18.6% from 2021 to 2027.

According to Micron Technology, the automotive storage market in China amounted to about US\$700 million in 2021, and it will jump to US\$1.5 billion by 2023. On the one hand, the growth momentum comes from growth of automobile shipments in China; on the other hand, it also benefits from continuous expansion of automotive memory and memory capacity.

# High-level autonomous vehicles have posed enormous demand for automotive memory capacity, density and bandwidth

At present, main storage applications in automotive market include DRAM(DDR, LPDDR) and NAND (eMMC and UFS, etc.). Low-power LPDDR and NAND will be main growth engines, and the demand for NOR Flash, used for chip startup, will continue to increase. In addition, higher intelligent driving levels will have a direct impact on the demand for GDDR, which is RAM specially used for ADAS floating-point computing chips in vehicles.

More powerful sensors, ADAS/AD integrated systems, central computers, digital cockpits, event recording systems, terminal-cloud computing, vehicle FOTA, etc. all put forward higher requirements for automotive memory. On the one hand, the memory capacity will go up from gigabytes (GB) to terabytes (TB); on the other hand, the memory density and bandwidth will be greatly improved.

For example, NAND Flash mainly store continuous data in ADAS, IVI systems, automotive center console systems, etc. As autonomous driving levels up, the demand for NAND capacity in ADAS has swelled. Generally, L1/L2 ADAS only requires the mainstream 8GB eMMC, L3 needs 128/256GB, and L5 may involve over 2TBt. In the future, the data production, transmission and recording of advanced autonomous vehicles will require higher density and speed, so that PCIe SSD may be adopted.

**Demand of Intelligent Cockpits and ADAS for NAND**

OEM	Model	L2 autonomous vehicle	L3 autonomous vehicle	L4 autonomous vehicle	L5 autonomous vehicle
Intelligent cockpit	Capacity	64-128GB	128-512GB	256-512GB	512GB-1TB
	Type	eMMC	eMMC/UFS	UFS	UFS
ADAS/AD	Capacity	8-64GB	128-256GB	512GB-1TB	1-2TB
	Type	eMMC	eMMC/UFS2.1	UFS3.0/PCIe SSD	PCIe SSD

Source: ResearchInChina

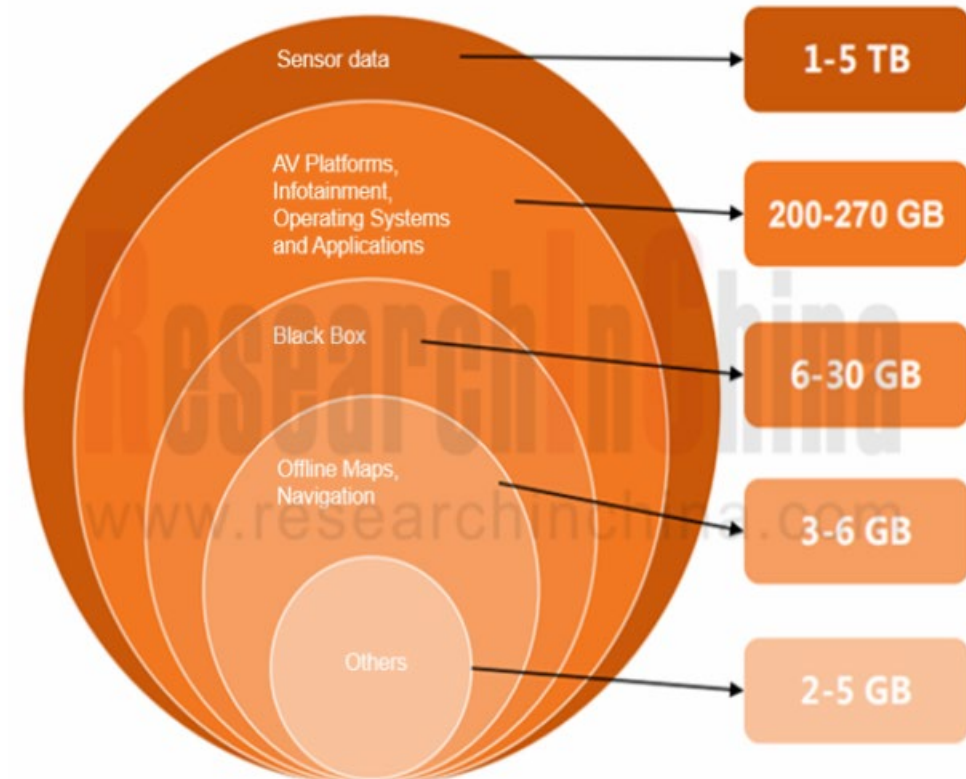
# High-level autonomous vehicles have posed enormous demand for automotive memory capacity, density and bandwidth

Autonomous vehicles boast more and more internal and external perception devices, including front cameras, internal cameras, high-resolution imaging radar, LiDAR, etc., and they will exploit high-density NOR Flash(QSPI, xSPI, etc., for chip startup) and DRAM(LPDDR3/4, LPDDR5, GDDR, etc.) widely.

At present, L1-L2 autonomous vehicles largely use LPDDR3 or LPDDR4, with the bandwidth of 25-50 GB/s. The bandwidth requirement is raised to 200GB/s for L3 autonomous driving, 300GB/s for L4 and 500GB/s for L5. Therefore, LPDDR5 and GDDR6 with higher bandwidth can simplify the system design of high-level autonomous vehicles.

Counterpoint's data shows that in the next decade, the memory capacity of a single vehicle will reach 2TB~11TB, catering to the requirements of different autonomous driving levels.

Data Storage Requirements of L4 Autonomous Vehicles, 2025E



Source: Counterpoint

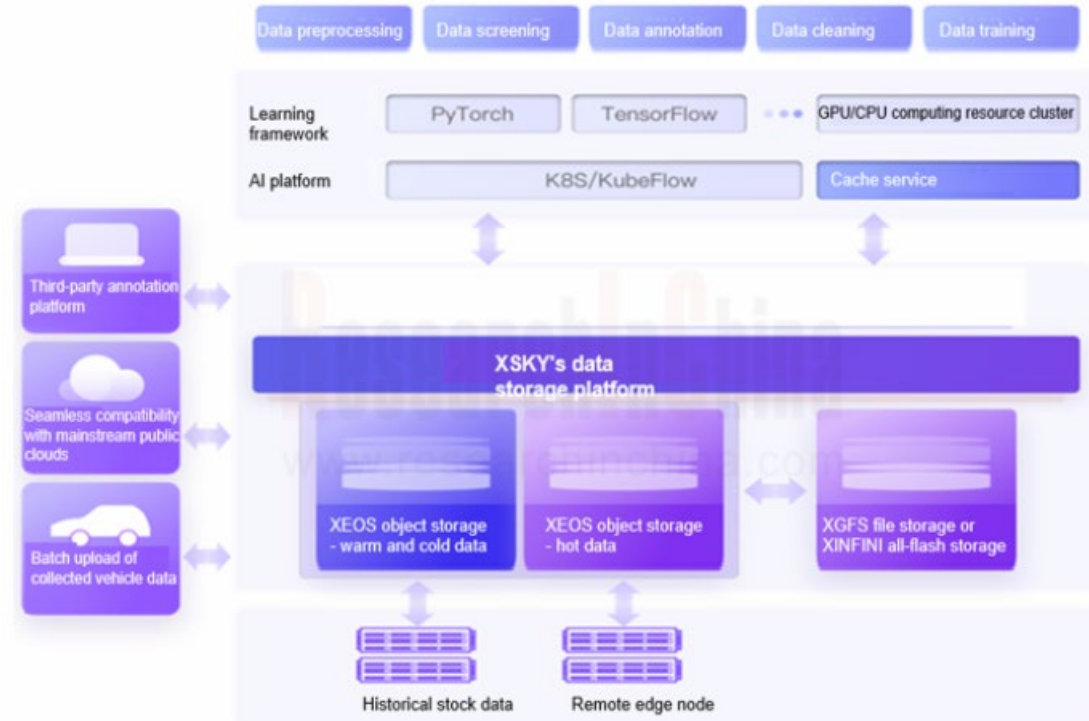


# High-level autonomous vehicles have posed enormous demand for automotive memory capacity, density and bandwidth

At the same time, autonomous driving is driven by data. The development of ADAS platforms needs massive road test data from cameras, radar, LiDAR, GPS and the like. These data are uploaded to the cloud for storage, AI training, simulation testing and verification. A one-hour L2 or L4-L5 road test probably generates 2TB or 16-20TB of data correspondingly, so that a single road test will produce 8-60TB of data, and the entire development cycle will churn out exabytes (EB) of data.

This has triggered huge market demand for autonomous driving cloud storage. In China, there are many cloud service providers that offer product solutions for autonomous driving data cloud storage, including Tencent Cloud, Alibaba Cloud, WD My Cloud, Sugon ParaStor, YRCloudFile, XSKY and so on.

## XSKY Efficient Data Platform for Autonomous Driving



Source: XSKY

# As the functions of intelligent cockpits become more and more diversified, larger storage capacity is constantly in demand, and storage technology is constantly innovating

With the wide application of central integrated digital cockpits, DRAM has evolved from DDR2 and DDR3 to LPDDR4, LPDDR5 or GDDR. In addition, the interface of mobile phones has transferred from eMMC to UFS, so will smart cockpit memory chips. It is also possible for high-end models to adopt PCIe SSD.

The cores of both UFS and eMMC interfaces involve NAND flash, but their control interfaces follow different protocols. The maximum communication rate of eMMC is 400MB/s, relative to 1,160 MB/s of UFS. The communication speed directly affects the startup time and software loading time of vehicles, which offer varying experience. In response to the demand for faster startup, reading and writing, the storage in the cockpit field must support UFS2.1 at least. Qualcomm's third-generation 8155 cockpit SoC has already endorsed UFS interfaces.

**Qualcomm's Third-generation 8155 Cockpit SoC Supports UFS Interfaces**

I/O	Description	Snapdragon™ Auto 6155	Snapdragon Auto 8155	Snapdragon Auto 8195
Memory	EBI	LPDDR4X 2x 16 bit 1555 MHz	LPDDR4X 4x 16 bit 2092 MHz	LPDDR4X 8x 16 bit 2092 MHz
	SD/eMMC	SD 3.0 and eMMC 5.1 8-bit SDC1 4-bit SDC2 -	SD 3.0 - 4-bit SDC2 - 4-bit SDC4	SD 3.0 - 4-bit SDC2 - 4-bit SDC4
	UFS	1 lane UFS 2.1 gear 3	2 lane UFS 2.1 gear 3	2x 2 lane UFS 3.0 gear 4 rate A
	Quad-SPI	1x 4 lane (2x CS)	1x 4 lane (2x CS)	2x 4 lane (2x CS)

Source: CSDN

# As the functions of intelligent cockpits become more and more diversified, larger storage capacity is constantly in demand, and storage technology is constantly innovating

The intelligent cockpits of newly launched models demonstrate the increasingly powerful storage capacity:

- ◆ Xpeng P7 launched in 2020 is equipped with Qualcomm Snapdragon 820A with 8G memory + 128GB storage, enabling users to download more automotive Apps, supporting applet expansion, and featuring both practicality and fun;
- ◆ The next-generation SA8155P-based ZEEKR intelligent cockpit, available in ZEEKR 001 unveiled in 2021, has an 8-core CPU of the 7 nm process, with 16G memory and 128GB storage.
- ◆ Li L9 which debuted in 2022 comes standard with two Qualcomm Snapdragon 8155 chips with 24G memory and 256GB high-speed storage, which together form a powerful computing platform.

## Intelligent Cockpit of Li L9












# Chinese storage suppliers accelerate deployment in the promising automotive storage market

The requirements for automotive storage products are much higher than those for consumer electronics. Automotive-grade storage products have to take a long R&D and verification cycle, undergo a complicated certification process, comply with IATF16949, ASPCIE and ISO 26262, and satisfy the standards of some automakers, such as GMW3172 and VW80000. As a result, this market poses high barriers to entry and embodies obvious oligopoly.

Overseas storage vendors such as Micron, Samsung, SK Hynix and Microchip still dominate the development of the automotive storage industry as monopolists. Among them, Micron enjoys the global market share of over 45%. In 2021, Micron launched its industry-leading automotive LPDDR5 certified by ISO 26262 ASIL-D, with the maximum capacity of 128GB.

**Some Global Automotive Memory Chip Vendors**

Company	Region	Product type	Profile
 Samsung	South Korea	NAND, DRAM	The world's leading memory chip company provides automotive embedded storage certified by AEC-Q100
 SK Hynix	South Korea	NAND, DRAM	In December 2021, SK Hynix announced that it has completed the first phase of the transaction to acquire Intel's NAND and solid-state drive (SSD) business, making it become the second storage enterprise in the world.
 Micron	U.S.	NAND, DRAM	The global storage vendor has launched a number of automotive-grade eMMC, UFS and LDDR products.
 Kioxia	Japan	NAND, DRAM	The company was spun off from the Toshiba conglomerate as Toshiba Memory Corporation in June 2018. It became a wholly owned subsidiary company of Toshiba Memory Holdings Corporation on March 1, 2019, and was renamed Kioxia in October 2019. KIOXIA automotive UFS and e-MMC support a temperature range of -40°C to +105°C, and meets AEC-Q100 Grade 2 requirements.
 Microchip	U.S.	EEPROM, SRAM, NOR Flash	The world-renowned vendor in EEPROM, NOR Flash and SRAM has launched a number of storage products that meet the requirements of automotive regulations.
 Macronix	Taiwan, China	NOR Flash, niche NAND, niche DRAM	The company has been deeply involved in the field of automotive storage for a long time, and is currently developing 3D NOR Flash technology independently.
 GigaDevice	China	NOR Flash, EEPROM	GigaDevice's SPI NOF Flash ranks first in China and among the top three in the world by market share.
 Dosilicon	China	SLC NAND, NOR Flash	The company offers automotive-grade SLC NAND and NOR Flash products.
 Ingenic	China	SRAM, niche DRAM	In 2020, Ingenic acquired ISSI, an American storage vendor, and launched a number of SRAM and DRAM products that meet automotive regulations.



# Chinese storage suppliers accelerate deployment in the promising automotive storage market

In recent years, Chinese memory chip vendors have made great efforts in automotive storage products:

**SRAM:** Ingenic has been focusing on independent CPU, SoC and AI engines for many years. In 2020, it acquired 100% stake in Beijing ISSI. By virtue of intellectual property rights, it can completely avoid the impact of the sanctions imposed by the United States government, independently develop and produce SRAM in line with automotive regulations, and produce niche DRAM. Ingenic has reached close cooperation with auto parts vendors such as Bosch and Continental.

**EEPROM:** Giantec Semiconductor, a leading EEPROM enterprise in China, launched GT24C512B, a high-reliability automotive A1-grade memory chip, in August 2022, which can withstand erasing and writing for up to 4 million times at room temperature, and has been applied to OBC, VCU and other related fields.

**NOR Flash:** GigaDevice has delved in the field of NOR Flash for many years. By market share, it ranks first in China and third in the world. The GD25 series launched by GigaDevice is the only mass-produced NOR Flash in China that meets AEC-Q100, with the storage capacity of 2Mb~2Gb.

In addition to OEMs, there is another type of storage players in China, like Longsys, BIWIN Storage Technology and Powe, who buy wafers and particles from IDMs and purchase master chips from third-party master chip vendors, then conduct packaging tests through their own or third-party packaging and testing factories, and produce storage products of different storage types, interfaces and standards.

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  - 5.6.5 Automotive-grade SPI NOR Flash Memory Chip
  - 5.6.6 SPD Product Series
- 5.7 Puya Semiconductor
  - 5.7.1 Business
  - 5.7.2 Automotive-grade NOR Flash Product Line
  - 5.7.3 Automotive-grade EEPROM Product Line
- 5.8 Fudan Microelectronics
  - 5.8.1 Business
  - 5.8.2 Automotive-grade Storage Product Planning
  - 5.8.3 Automotive EEPROM Memory Chip
- 5.9 Longsys
  - 5.9.1 Business
  - 5.9.2 Self-developed Low and Medium-capacity Memory Chips
  - 5.9.3 Automotive Memory Chip Product Line
  - 5.9.4 FORESEE Automotive-grade UFS (1)
  - 5.9.5 FORESEE Automotive-grade UFS (2)
  - 5.9.6 FORESEE Automotive-grade eMMC Certified by AEC-Q100
  - 5.9.7 Automotive Electronic Storage - Overall Solution for Personal Cloud Services
  - 5.9.8 Automotive Electronic Storage - Automotive Data Backup Disk
  - 5.9.9 Open Innovation Lab Boosts Automotive Storage Business
  - 5.9.10 Self-developed 10nm ASIC Memory Chip Test System
  - 5.9.11 Total Quality Management Creates High-quality Automotive-grade Storage
- 5.10 Macronix
  - 5.10.1 Business
  - 5.10.2 Automotive-grade NOR Flash Product Line
  - 5.10.3 Automotive-grade NAND Product Line
  - 5.10.4 ArmorFlash Memory Application
- 5.11 BIWIN Storage Technology
  - 5.11.1 Storage Business
  - 5.11.2 Automotive Storage Solutions (1)
  - 5.11.3 Automotive Storage Solutions (2)
  - 5.11.4 Automotive Storage Product Line



## Beijing Headquarters

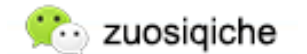
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