SPECIAL REPORT:

CHINESE AV AMBITIONS AT RISK AMID TRADE WAR

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Overview

China is betting big on autonomous vehicles (AV). Beijing sees the sector as a showcase for its strengths in the deployment of advanced technologies, including next-generation 5G networks, artificial intelligence (AI), and new energy technologies, and it is investing accordingly. The country has set a target of smart vehicles accounting for half of all auto sales in the country by 2020, with highly automated vehicles—capable of driving without driver intervention—accounting for 15% of sales by 2025.

While China has several advantages when it comes to building a robust AV ecosystem, including the world's biggest automobile market, policy ambitions have run ahead of the reality on the ground. Along with playing catch-up in road testing of AVs, China's AV sector faces substantial risks from the US campaign against Chinese network equipment giant Huawei. Without a successful resolution of the Huawei issue, the planned rollout of China's next-generation 5G network—and by extension its goals for its domestic AV sector—may be delayed or even derailed.

This special report details China's efforts to accelerate AV development. It describes how the escalating US-China tech cold war—including US actions against Huawei initiated in May 2019—threaten to disrupt its ambitions.

Life in the fast lane: Regulatory framework rapidly taking shape

Beijing has identified connected vehicles and AVs and related sectors, such as electric vehicles, as worthy of significant government support under both the Made in China 2025 (MIC2025) industrial policy program and the National Artificial Intelligence Development Plan. The opportunity goes well beyond cars: Communications, entertainment, internet, and media companies are all eager to cash in on the services required to put more autonomous functions and interactive capabilities into vehicles. To capitalize on these opportunities, China has sped up development of AV technology standards and industry guidelines in an attempt to catch up to the US, where domestic carmakers and a bevy of technology startups are thought to be up to three years ahead on underlying driverless vehicle technology.

Chinese ministries have opted for an ecosystem-focused approach—a contrast to the more vehicle-centric approach taken by the US and EU. This has put China ahead of some Western countries in developing the infrastructure needed to support the deployment of AVs once they are ready for large-scale commercialization

China's central, provincial, and local governments are all committing significant resources to boosting the sector. China's main economic planning agency, the National Development and Reform Commission (NDRC), in December 2018 unveiled a three-year plan to make AV development a top national priority. Local governments are also aligning with Beijing, with Chongqing, Guangzhou, Shanghai, and Shenzhen city governments all approving AV open road testing.

Key definitions and terminology:

- **AVs**, also referred to as self-driving cars, are equipped with technology that allow them to drive without the active control or monitoring of a person. There are varying levels of automation, ranging from basic driver assistance, such as adaptive cruise control that automatically slows cars when they encounter obstacles, to fully autonomous driving involving no human input.

- **Interconnected vehicles** are connected to the internet, generally through their own wireless local area network, that enable them to communicate with the driver, other vehicles and connected infrastructure (V2X).
- **Smart vehicles**, also referred to as "intelligent cars," are characterized by "advanced electronic" features and are not necessarily fully autonomous cars.

Key industrial ministries and other government bodies with an interest in AVs have collaborated over the past two years to develop a legal and regulatory structure for the sector. Key players include:

The National Development and Reform Commission. The NDRC is a super-ministry overseeing long-term economic planning and funding for key government strategic industrial programs, such as MIC2025. The NDRC is responsible for setting overarching industry strategies and priorities.

The Ministry of Industry and Information Technology (MIIT). The ministry oversees both the auto and telecoms industries, both of which will be key to deployment of AVs. MIIT is China's interface with the International Telecommunications Union (ITU) on 5G and other mobile communications issues.

The Ministry of Transportation (MOT). The MOT regulates rail, road, air, and water transportation in China and will be involved in many aspects of AV regulation, including intermodal issues involving connected vehicles.

The Ministry of Public Security (MPS). The MPS functions as China's national police force and is responsible for enforcing municipal traffic laws including road safety. It oversees a large traffic monitoring and control and intelligent infrastructure network that will help manage AV traffic in major cities. The MPS will also play a major role in ensuring that cybersecurity standards around AVs are in place and consistent with China's Cybersecurity Law, to include all provisions on data protection.

The Standardization Administration of China (SAC). The SAC is responsible for industrial standards including for AVs, telecommunications, and cybersecurity, all of which will be critical for broad AV deployment. Technical committees under SAC are responsible for specific types of standards. SAC is China's interface with international standards bodies such as the International Organization for Standardization and the International Electrotechnical Commission.

China's unified approach to developing industry guidance and standards could help accelerate the development of the AV sector. In the US, by contrast, there is mounting concern within industry that overlapping jurisdiction between federal and state authorities is creating confusion in the marketplace. The NDRC in January 2018 issued a draft Strategy for Innovation and Development of Intelligent Vehicles laying out the following timeline:

- **2020:** China will establish a systematic framework for technology innovation, industrial ecosystem, and infrastructure network development, laws and standards, product regulations, and information security. Smart vehicles are to account for half of all new cars sold in China. In big cities, 90% of all highways will be covered with a functional network to allow vehicle-to-vehicle, vehicle-to-infrastructure, and vehicle-to-pedestrian communications (V2X). This will still be built primarily on 4G LTE networks.
- **2025:** China will have a fully formed ecosystem around smart vehicles, and nearly 100% of all new vehicles will be smart. Scalable high-level intelligent vehicles will be on the market, and the V2X portion of the infrastructure will be based on 5G technology.
- **2035:** China will be a global leader in smart vehicles and infrastructure.

The NDRC strategy probably overstates China's ability to meet the targets for AV sales and ecosystem development. The NDRC acknowledges that in addition to the physical infrastructure, a robust legal infrastructure must also be in place. To this end, the agency stresses that China will eliminate legal barriers for market access, issue national regulations for road testing on public roads, and strengthen research into autonomous driving systems. Moreover, the term "smart vehicles" covers not only fully autonomous cars, but all vehicles with advanced tech capabilities. This allows greater flexibility in Beijing's ability to measure progress toward the ambitious benchmarks outlined in the strategy.

The NDRC strategy acknowledges that **a number of legal and regulatory issues will need to be resolved** prior to widespread AV deployment—updating China's traffic and digital mapping laws, determining liability for traffic accidents involving AVs, establishing smart vehicle safety management systems, and strengthening smart vehicle cybersecurity and data privacy protections. **These are issues that regulators are also struggling with in other major AV markets such as the US and the EU.**

China AV regulatory environment rapidly evolving

Role	Government Entity
The NDRC oversees long-term planning and funding for key government strategic industrial programs, such as Made in China 2025. The NDRC is responsible for broader industry strategies and priority setting.	NDRC
The MIIT oversees both the auto industry and the telecommunications industry in China. Both will be key to the deployment of autonomous vehicles. MIIT oversees China's rollout of 5G networks, and is also the regulator for AV testing rules. MIIT is also China's interface with the International Telecommunications Union (ITU) on matters pertaining to 5G mobile issues.	MIIT
The MOT is responsible for broad regulatory issues around rail, road, air, and water transportation in China. MOT will be involved in many aspects of AV regulation, including intermodal issues involving connected vehicles.	MOT
The MPS functions as China's national police force and is responsible for municipal traffic flows and monitoring and other safety issues. MPS manages a large traffic monitoring and control network that would be part of or complementary to intelligent infrastructure that would help manage AV traffic in major cities. The MPS would also play a major role in ensuring that cybersecurity standards around AVs are in place and consist with China's Cybersecurity Law, to include data protection.	MPS
The SAC is responsible for setting standards across China's industrial base, including for AVs, telecommunications, and cybersecurity, all of which will be critical for broad AV deployment. Technical committees under SAC are responsible for specific types of standards. SAC is China's interface with international standards bodies such as the ISO and IEC.	SAC

Source: Eurasia Group

Large municipalities jockeying for leadership

The Beijing provincial government issued the country's first local regulations for AV road testing in December 2017. Known as the Beijing Regulations, these have been implemented on a trial basis in the absence of national-level rules and have influenced road-testing rules being developed by local governments nationwide.

Several other cities have also approved AV testing. Testing rules in Chongqing, which manufactures nearly 3 million cars annually, accounting for 11% of China's total vehicle production, are especially significant. Their publication indicates the city is ramping up efforts to promote the production of AVs while maintaining its place as China's premier auto manufacturing hub.

Meanwhile, Shenzhen is emphasizing the city's role as a central node in the Digital Silk Road and Greater Bay Area (GBA) initiatives to promote its local testing regulation. Overall, China has granted more than 100 license plates to 32 companies for AV testing in 14 cities, underscoring the country's efforts and progress in encouraging AV testing. These local plans have played an integral role in the central government's regulatory efforts as MIIT and other key ministries tend to incorporate their elements into national rulemaking, including the National Guidelines on Road Tests for Self-Driving Vehicles in April 2018.

The importance of 5G and Huawei

Next-generation 5G data networks are the linchpin of China's AV strategy. Beijing's plans for its next-generation network call for the rollout of standalone 5G networks on a commercial scale by 2020. This buildout will be led by China's mobile network operators, making heavy use of Huawei equipment.

5G is important for AVs because it will support ultra-reliable low latency communications—capabilities that are not possible on existing 4G networks and that will be required for some AV and connected car applications to be viable in dense urban environments. For China, 5G is a source of first-mover advantage in AVs. If it can deliver

on its ambitious buildout plans, 5G mobile coverage could reach a critical mass in some large cities well before automobile manufacturers in other countries have access to a similar platform, giving China a significant head start over the US and EU in building a functioning AV ecosystem. For more on China's 5G strategy and China's potential to gain first-mover advantage in key 5G-enabled applications such as AVs (please see Eurasia Group Special Report, The Geopolitics of 5G, 6 November 2018).

China views AVs and 5G as key components of its innovation-driven economic development strategy. Senior government officials are encouraging non-traditional automotive companies to seek partnerships with vehicle manufacturers to spur innovation and competition in the field of autonomous driving. While many hurdles remain for significant numbers of connected vehicles or AVs to be deployed in the near term, **Beijing is signaling the industry—via regulatory innovation and financial support—to move ahead in 2019 and pick up the pace in 2020.**

There is a catch, however. As of June 2019, US government action against Huawei has cut off the firm's access to US technology, creating significant uncertainty about China's ability to meet its targets for its standalone 5G rollout. **If Huawei were to be crippled or put out of business by the US actions, it would significantly hinder China's ability to support AV development within previously anticipated timeframes—likely further roiling US-China relations and potentially delaying the rollout of an economically significant technology.**

Nuts and bolts of AV testing

AV testing has ramped up since MIIT released national guidelines for AVs and interconnected cars in April 2018. Provincial and municipal governments can evaluate local conditions to choose test areas for AVs, issue license plates, and need only to brief the MIIT, MPS, and MOT twice a year on the road tests, according to the guidelines. MIIT has said foreign companies can apply for road tests in China provided they put safety first and are willing to assume full responsibility for any accidents.

Baidu, named by the government to spearhead the country's development of self-driving cars, received the first batch of license plates to conduct trials in Beijing. The company has also been given authorization for open road tests in Fujian province. In March, China issued licenses to Shanghai Automotive Industry Corporation (SAIC) and electric vehicle startup NIO to begin testing self-driving vehicles on a 3.5-mile section of public road in Shanghai's Jiading District.

China AV regulation timeline

Regulation	Regulator(s)	Date Issued
Strategy for Innovation and Development of Intelligence Vehicles (Draft Strategy)	NDRC	January 2019
Three-Year Action Plan to Enhance Core Competitiveness in the Manufacturing Industry (2018-2020).	NDRC	January 2018
Implementation Plan for the Commercialization of Key Technology for Intelligent Vehicles.	NDRC	January 2018
Administrative Rules on Intelligence and Connected Vehicle Road Testing (Trial)	MIIT, MOT, and MPS	April 2018
the Final Guidelines for the Establishment of National Standards System of Telematic Industry (Intelligent & Connected Vehicles	MIIT and SAC	December 2017

Source: Eurasia Group

China has a comparative advantage over the US and EU because it can develop new greenfield infrastructure designed to facilitate AVs faster. For example, Beijing will soon begin construction on a highway extending to the new, planned city of Xiong'an in Hebei province. The 100-kilometer motorway will devote two of its eight lanes to AVs. Xiong'an—a priority project for President Xi Jinping—is being built from the ground up to leverage AVs and smart city infrastructure (please see Eurasia Group note, China: Development of high-tech city offers challenges and opportunities for foreign firms, 17 April 2017).

That said, China is still trying to catch up to the US in terms of public road testing. Until recently, Chinese companies wanting to test AVs on public roads have had to do so in the US, where US states such as California and Texas have been allowing this type of testing on public roads for years. The US Congress is now in the

process of passing laws that would standardize AV technology and safety standards nationwide. The House of Representatives approved a bill last September laying out a framework for federal autonomous vehicle regulation, which will speed up deployment of AVs in the country. However, the legislation stopped in its tracks when its companion bill, the AV START ACT, stalled in the Senate. Although several Senators in April 2019 announced plans to revive the legislation, meaningful progress remains to be seen. Meanwhile, the US Department of Transportation will seek public opinion on how to transfer autonomous driving technologies to city buses, long-haul buses, and transit systems. The department also plans to unveil revised self-driving car guidelines this summer.

These policies have proven appealing to Chinese firms like Baidu, which applied for a self-driving test permit in California in 2016 and logged nearly 2,000 miles between October 2016 and November 2017. The tests also required 48 instances of human intervention, termed qualifying disengagements, which demonstrates impressive results but still significantly behind industry leaders like Waymo.

Chinese authorities are also blocking foreign automotive firms from mapping Chinese roads, citing concerns over national security. The restrictions, which apparently do not apply to domestic automakers, stem from authorities' fear that foreign companies could gain access to the locations of sensitive military and security installations. Foreign automotive firms looking to sell AVs into the Chinese market must work with a licensed, local firm to gain access to high-definition maps they need to make their systems work. There are currently 13 licensed Chinese companies for high-definition mapping, including Baidu, Alibaba-owned AutoNavi, and NavInfo, which counts Tencent as an investor.

Indeed, foreign firms operating in China may currently gain access to these mapping licenses exclusively through joint ventures. Ford, for example, announced in October 2018 that it is the latest foreign AV developer teaming up with Baidu to test self-driving vehicles in China in a 2-year agreement. This is expanding on their existing partnerships focused on developing AI and connectivity.

Chinese regulators are also boosting their domestic firms' competitiveness and erecting barriers to foreign suppliers to AV companies through catalogue restrictions. Automakers, for example, have reportedly had to switch from South Korean and overseas-sourced electric batteries deemed higher quality to approved Chinese brands. The approach suggests that the state wants to avoid foreign dominance of the autonomous driving sector by favoring local firms and encouraging strategic partnerships with domestic champions.

Commercial Roadmap

Chinese companies are developing plans to boost the market penetration of smart cars. Chinese telecom equipment giant Huawei and 13 of China's leading automakers, including SAIC and BYD, in April jointly issued a cellular vehicle-to-anything (C-V2X) roadmap. A senior MIIT official attended the roadmap's unveiling. C-V2X communication is a high-speed platform that allows vehicles to communicate with one another via direct short-range communications or cellular networks. The announcement follows Huawei's September 2018 debut of a C-V2X cooperative ecosystem, which aims to bolster innovation and promote the commercialization of the technology and highlights China's rapidly evolving C-V2x industry. According to the roadmap, the automakers plan to mass-produce C-V2X enabled cars in the second half of 2020.

AV uptake in China: 5G, data issues, and standards at forefront

Several surveys suggest that the Chinese public may be more accepting of AVs than people in other countries, such as the US, because they have greater trust in the technology and feel more secure about sharing personal data. Studies have found that among Americans who did not want to ride in AVs, a lack of trust ranked at the top of their concerns, followed by safety. However, it is also important to note the data privacy has become one of the most hotly debated topics in China over the past few years. The proliferation of sensors attached to AVs could allow for real-time, street-level monitoring anywhere AVs are deployed, giving companies and governments unprecedented access to information that could be used for both marketing and surveillance.

China is also likely to be a leader in rolling out next generation 5G networks at scale and proving the commercial viability of major uses of the technology in cases such as AVs, though the recent US action against Huawei will complicate the rollout. So-called full standalone 5G networks will be key to enabling broad deployment of AVs in urban areas and along major highways. The advanced networks will enable many of the capabilities required by AVs, and the car industry will be among the first sectors to be transformed by 5G technology. Offering ultra-low latency, ultra-high bandwidth, and reliability, 5G networks will enhance safety and efficiency in the transportation sector.

Chinese companies have been trialing aspects of 5G deployments with AVs for more than two years. In June 2017, China Mobile, SAIC Motor, and Huawei jointly completed the first demo of 5G-based remote driving technology in China. During the demo, which took place in Shanghai, the remote driver was able to accurately drive a car from tens of kilometers away, enabled by the 5G network's ultra-high bandwidth and ultra-low latency (please see The Geopolitics of 5G, 6 November 2018).

Chinese carriers, working with municipal governments, auto makers, and technology companies are attempting to put in place major infrastructure to support large-scale AV deployments. In early 2019, China Mobile announced a pilot program to roll out a city-scale grid of roads supporting both mobile services and smart transportation in the city of Wuhan. China Mobile had installed more than 30 base stations in Wuhan by the end of 2018 and plans to install 2000 more before the end of the year. China Mobile has also begun applying for AV driving permits, which will be required to allow AVs to share roads with traditional vehicles, as opposed to the dedicated lanes being designed for the highway AV scenarios linking Beijing and Xiong'an.

Xiong'an New Area

The Xiong'an New Area (XANA) project, unveiled in April 2017, is one of President Xi's signature infrastructure initiatives. Beijing plans to invest $313 billion and double the city's current population to more than 2 million by 2022. Smart infrastructure will be integrated throughout the 2,000-square kilometer (km) metropolis with AVs an integral component in its public transport system. Lanes for AVs will also be constructed on a new 100-km freeway to connect Beijing with the new area.

The efforts in Xiong'an and Wuhan appear so far to be primarily driven by political factors rather than clear commercial use cases.

Speed bumps ahead

With new technologies such as 5G and AVs coming together rapidly, there is a chicken and egg situation in which **the supporting infrastructure must be built out at some scale to determine the types of use cases that could eventually prove commercially viable**. The complexity around AV deployment—which will rely on a combination of infrastructure upgrades, 5G networks, and data centers using artificial intelligence to improve vehicle situational awareness and reliability— means this process will likely take some time.

Washington's decision to place 5G leader Huawei on the Commerce Department's entity list has created major uncertainty for China's rollout of nationwide 5G network connectivity (please see Eurasia Group special report: Huawei suppliers forced to choose sides, with Taiwan players critical, 30 May 2019). This in turn has major implications for the automobile industry and the development of autonomous and connected vehicles. **If the US action is not reversed, Chinese carriers' ability to deploy full standalone 5G base stations at scale will be delayed, with unknown impact on the now sizeable AV sector and its supporting industries.**

Key Chinese ministries involved in the AV and telecommunications sectors such as the NDRC, MIIT, and MOT are likely attempting to determine the way forward for one of China's most dynamic sectors in light of the impact of US-China relations and a growing technology cold war.

Appendix:

A survey of China's key AV players: the big, the small, the niche

Even before Beijing stepped up efforts to move the industry out of the research and development phase and into building alliances and pursuing real use cases, many Chinese companies had jumped into the AV fray, including telecommunications carriers, large internet companies, automakers, and a host of niche players in areas such as artificial intelligence, sensors, and other technologies that will support autonomous vehicle and smart infrastructure deployments.

China autonomous vehicle testing record

Beijing's road test report assesses the autonomous driving capabilities of vehicles with at least 100,000 km traveled under a variety of conditions without an accident. This is a common milestone for self-driving vehicle trials. Notably, Baidu's results place it at the forefront of domestic AV development and correspond with the February 2019 road test report by the Californian Department of Motor Vehicles in the United States. The reports suggest that the Apollo system has boosted the AV driving distance by test cars by as much as 818% between 2017 and 2018. According to recent reports, Beijing has designated 123 km for road tests across 44 roads. Beijing also led the pack in terms of autonomous vehicle registrations with more than 54 registered and accounting for more than 50% of the total nationwide.

Company	# of vehicles with test license	# of qualified test vehicles	Total test distance (km)	Total test distance (miles)
Baidu (北京百度网讯科技有限公司)	45	45	139,887.70	86,922.30
NIU (上海蔚来汽车有限公司)	2	1	2415.3	1500.8
BAIC BJEV (北京新能源汽车股份有限公司)	1	0	235.1	146.1
Daimler (戴姆勒大中华区投资有限公司)	2	2	476	295.8
Pony.ai (北京小马智行科技有限公司)	2	2	10,132.90	6,296.30
Tencent (腾讯大地通途（北京）科技有限公司)	1	1	259	160.9
Didi Chuxing (苏州滴滴旅行科技有限公司)	2	2	78.1	48.5
Audi (奥迪（中国）企业管理有限公司)	1	1	80.9	50.3
Total	**56**	**54**	**153,565**	**95,420.90**

Sources: Beijing Municipal Commission of Transport, Eurasia Group

Baidu: Baidu is transforming itself from an internet search engine into an AI company, with autonomous driving now one of its top priorities. Baidu's pilot fleet in 2018 logged approximately 140,000 km (86,922 miles) in Beijing and accounted for 91% of total miles tested in the city, according to a report from the Beijing Commission of Transport. Indeed, Baidu also outranked other industry leaders in terms of the most test license plates (45) and the most vehicles on the road. In addition, Baidu already has attracted 130 partners to its opensource development platform for AVs, dubbed Apollo, including Nvidia, Microsoft, Ford, Daimler, Intel, and Delphi. By partnering with other companies, Baidu can secure access to vast quantities of real-world driving data that it can leverage to train algorithms as part of its overall autonomous driving ecosystem development.

Baidu unveiled the latest version of its opensource Apollo platform in January at the Consumer Electronics Show in Las Vegas. Apollo 3.5 features support for the latest sensor suites, and Baidu claims it has updated perception algorithms to handle sensor fusion in urban residential and city center areas. Previous versions of the platform have claimed added security and more robust positioning, control, and cloud simulation capabilities. The Apollo program is a more inclusive alternative to privately-developed platforms from

competitors like Waymo, which has generated its own software and hardware. Baidu also plans to launch self-driving cars this year in cooperation with manufacturers JAC Motors and BAIC, as well as Chery Automobile Co. Baidu also plans to launch an AV fleet of a 100 "robo-taxis" in Changsha in the second half of 2019. The vehicles will operate on 210 kilometers of city road, which has been outfitted with V2X technology that enables self-driving cars to improve vehicle safety and navigation by connecting with smart infrastructure. In October 2018, the company signed a contract with Volvo to develop Level 4 self-driving passenger cars and mass produce vehicles for the mainland market, and also finalized an agreement with Ford to test self-driving cars on Chinese roads for two years. According to a joint statement, the American automaker's self-driving system has already been equipped with Apollo. Udelv, a California-based delivery company, also plans this year to launch autonomous delivery vans in the US, which run on the Baidu Apollo 3.5 software platform.

Robin Li, chairman and CEO of Baidu, said at the 13th National People's Congress in Beijing in March 2018 that a national investment fund for developing the self-driving industry should be set up and that national-level policies to speed up the industrialization of self-driving vehicles should be introduced. However, Baidu has been subject to an extremely high turnover of its top AI talent, with many of them departing to start their own companies after being able to raise a large sum of venture capital quickly. Indeed, both Pony.ai and JingChi were funded by former Baidu employees.

Baidu also dominates the field in making detailed high-definition maps needed for autonomous cars to get around safely. The company believes that in the long term, HD maps in China will be a much bigger business than Baidu's search business is today. According to Baidu's COO, the company will sell HD maps as a service to customers such as automakers who will either opt to charge service fees or bake the cost into the overall vehicles' price. Baidu announced earlier this year that it is partnering with mapping company TomTom to integrate its HD maps into the Apollo autonomous-vehicle software.

Pony.ai: Established in 2016, the California-based self-driving car startup raised $214 million last year from a combination of Chinese and American investors, with the round led by China's Clearvue Partners and Eight Roads Ventures. US-based firms Sequoia Capital China and Redpoint China Ventures may also lend the company momentum to launch self-driving cars in both the US and China. The company opened its second office in Guangzhou last year, largely because of the region's government strong support for self-driving cars. In February, Pony.ai launched a self-driving ride-hailing fleet for employees and "self-affiliates" in China. The company will expand and broaden its autonomous pilot zone, PonyPilot, within Guangzhou from here out. The company's AV fleet accrued more than 10,000 km total test distance in 2018. Pony.ai also announced in April 2019 that it created an internal team to develop fully autonomous trucks and freight delivery vehicles. These autonomous pilots will begin extremely small in scale and grow the area of service as they gain confidence in their ability to map and navigate that specific zone, but this is a strong start for a very young company.

JingChi: Just one-year-old, the tech startup producing AVs set the goal of expanding its fleet to 100 to 200 units by the end of 2018. JingChi also plans to set up an industry fund worth 10 billion yuan (approximately $1.44 billion) with Guangdong province to explore new business opportunities. JingChi also announced that it would build an AI research center in Guangzhou. Last September, Nvidia GPU Ventures invested with a group of Chinese venture capitalist firms in JingChi. The company is expected to leverage the AI of Nvidia's Drive PX hardware to power its autonomous driving system. Baidu launched a lawsuit against JingChi last year over claims of autonomous driving trade secret theft but settled after JingChi joined its opensource autonomous driving platform as a cooperative partner in March 2018 and its CEO stepped down. JingChi in September 2018 also announced a strategic partnership with Guangdong Unicom, a subsidiary of China Unicom, on 5G networks and applications. Both companies pledged to establish a "5G Joint Innovation Lab" focused on Level 4 self-driving technologies. Guangdong Unicom also provides 5G network coverage across Guangzhou International Bio Island for JingChi.ai to develop and test AVs.

Tencent: Tencent has been a relative latecomer among China's largest tech firms to delve into the auto sector. Last September, Tencent and Guangzhou Automobile Group agreed to collaborate on internet-connected cars,

a strategic pact that pushed Guangzhou Auto share prices higher. The two parties will work together to explore investment in areas such as auto-related e-commerce, new energy cars, and auto insurance. Tencent's auto-related investments include Nio, Didi Chuxing, and a 5% stake in Tesla. The US EV maker is preparing to start production of the mass market Model 3 this year, but it is yet unclear how it will collaborate with Tencent on more specific projects. In April, Tencent also announced plans to develop software for AVs with South Korean automaker Hyundai Motor Co. In May, it unveiled its first collaborative opensource platform for 5G-connected vehicles. The two companies will collaborate on research and development for safety and security systems for self-driving cars, according to their preliminary agreement. They are also reportedly considering ways to incorporate Tencent's popular messaging app, Wechat, in developing car models tailored to the Chinese market.

Alibaba: Alibaba announced in mid-April that it has been conducting self-driving vehicle tests, joining its rivals Baidu and Tencent in the artificial intelligence driven industry. The company is looking to hire 50 more self-driving specialists for its AI research lab. Alibaba has previously formed partnerships with SAIC Motor and Dongfeng Peugeot Citroen to equip cars with its Al operating system. Alibaba is now running road tests of AVs on a regular basis and has the capabilities for open road trials; its goal is to achieve Level 4 autonomous capability, which means cars can self-drive in most conditions without human intervention.

Alibaba's research into the technology began in March 2018, when Wang Gang, a former professor of Nanyang Technological University, was recruited as chief scientist of Alibaba AI Labs to lead the project. The move is seen as an extension of Alibaba's ambitions to connect devices and manage city traffic via "smart brains," an artificial intelligence hub that utilizes big data to automatically deploy public resources and amend defects in urban operations. It's "smart brain" system is operational in the company's hometown of Hangzhou, where it's focused on traffic management and has reduced travel times by 10% since its launch. Therefore, Alibaba would have an advantage over Baidu via its automotive operating system that allows for two-way communication with technology such as smart brain.

Alibaba has also ventured into manufacturing semiconductor chips necessary to fuel its AV development and decrease reliance on US exports. In September 2018, Alibaba launched a new subsidiary that focuses on developing AI-based microchips and computing systems. These core technologies are critical to enabling not only vehicles with fully autonomous capabilities, but also smart cities and Internet of Things applications. Alibaba in October 2018 also launched a new partnership with China's Ministry of Transport Research Institute of Highways (RIOH) to digitally transform the country's infrastructure and build smart roads. The project is based on Alibaba's Intellisense base station, a hardware device that is designed to integrate within the operating environment of AVs, ranging from streetlights to billboards.

Horizon Robotics: Horizon Robotics, which provides facial recognition systems for some of Beijing's busiest subway stations, is investing heavily in embedded AI as the future of facial recognition and AVs. The company was founded in 2015 by former Baidu executive Kai Yu, who set up the search-engine company's deep learning research institute in 2013. Horizon makes AI chips and algorithms for facial recognition that can identify up to 200 people in real-time. Horizon raised up to $600 million in a February funding round that valued the company at $3 billion. It counts Intel among its early investors and hopes to power more than 100 million smart cameras by 2020. Horizon's smaller-than-a-postage stamp circuit board is called "Journey 1.0," which was showcased inside a General Motor Co. GMC Yukon XL at the Consumer Electronics Show in Las Vegas in January. The processor can detect as many as 200 targets—including pedestrians, vehicles, and lane markings—in real time and help the driverless car avoid collisions. Horizon signed a "cooperative agreement" with South Korean telecom SK Telecom in November to collaborate on Level 4 autonomous driving solutions, as well as HD updating solutions and advanced driver assistance system devices. Horizon anticipates "breakthroughs" over the next year for automotive-grade processor architecture, according to a company spokeswoman.

Horizon Robotics is an example of China's resolve to move up the manufacturing value chain by focusing less on commodity smartphones and TVs, and more on sophisticated semiconductors and artificial intelligence that can help cars drive themselves or spaceships land on the moon. However, China has so far failed to break the dominance of Intel and Qualcomm in making central processing units, which are brains of computers and smartphones. A growing number of China chip start-ups, including Yu's Horizon, are emerging to challenge the incumbents.

Cambricon: Cambricon Technologies is a two-year-old Beijing-based startup that develops intellectual-property (IP) cores and processors for deep-learning acceleration. In 2017, it received $100 million in funding from the Chinese government. Among its first customers is Huawei, which uses a Cambricon core in the Kirin 970 smartphone chip. Cambricon released China's first AI chip, the 1A, last year, stating that it was the world's first commercialized neural network processor chip. The 1A is designed for smartphones, security surveillance, unmanned aerial vehicles, wearables, and autonomous driving devices, and offers significantly enhanced performance per watt compared to traditional processors when performing mainstream artificial intelligence algorithms.

SAIC: A state-owned enterprise, SAIC was established in 2011 and has since ranked as China's largest automaker with a 25% share of the domestic market in 2018. As the only Asian company in the 5G Automotive Association, SAIC is a key player in AVs development and has two self-driving groups within the US and China. Both units have forged partnerships with HD mapping companies and self-driving solutions providers, including the US-based DeepMap and AutoX. To date, SAIC Motor has completed at least two generations of ICV platforms and 5G telematics platforms, in addition to road tests under diverse conditions. SAIC unveiled a new partnership agreement last year with Intel to develop Level 3-5 AVs. The company intends to develop self-driving cars for structured and unstructured roads by 2020, with the next generation technologies adapted to all traffic scenarios by 2025.

BAIC BJEV: Founded in 1992, BAIC BJEV is an electric vehicle division of the state-owned automaker Beijing Automotive Group. Since 2015, the company has invested 7% of its operating revenue—more than $290 million—to research and development. The company in April 2018 deployed the Darwin System, an artificial intelligent system for vehicles that provides self-driving and automated parking capabilities. According to its five-year plan, BAIC BJEV plans to provide its full range of product offerings with self-driving or intelligent connective technologies by 2020. It also plans to debut its Level 2.5 mass-produced autonomous car model in 2020 with Level 3 and Level 4 models to follow in 2022 and 2025 respectively

Build Your Dream (BYD): BYD is a 16-year-old Xi'an-based automaker and leading electric vehicle maker. The company in September unveiled its first open ecology for smart cars, the D++ opensource AV technology platform. The platform was issued as part of its Qin Pro special developer edition and will allow over-the-air (OTA) updates and open more than 340 sensors and 66 control lights gradually in order to incorporate AI, cloud computing, 5G, and blockchain into the structure of a vehicle. BYD also announced last September plans to mass produce Level 3 self-driving cars with Baidu in 2021, though they did not clarify a specific number of units.

Guangzhou Xiaopeng Automotive Technology (Xpeng Motors): Founded in 2014 by He Xiaopeng and Xia Heng, Xpeng Motors is one of China's foremost electric AV companies. The company raised $587 million in August 2018 in its latest series B+ funding round, which was led by Primavera Capital and Morningside Venture capital. Xpeng is one of several homegrown automakers that emerged over the last decade as the government launched special manufacturing permits to auto startups, which are increasingly investing billions of dollars in the core technologies that underpin next generation vehicles. Indeed, the company in April unveiled its Level 3 AV, the P7, and confirmed plans to implement various phases of L3 intelligent driving features in its new models beginning in 2020 through its partnership with global leader in artificial intelligence computing Nvidia and its domestic partner Desay SV. The vehicles will be specially designed with the Chinese market and road conditions in mind.

A survey of the key players in autonomous vehicles in China: the big, the small, the niche

Company	Description	Known Partners
Baidu	Known in the West as the Google of China, Baidu is fast transforming itself from an internet search engine into a world-class AI company, with autonomous driving being one of its top priorities.	JAC Motors and BAIC, Cherry Automobile, Volve and Ford
Pony.ai	Established in 2016, the California-based self-driving car startup completed a $112 million Series A funding round earlier this year. Morningside Venture Capital and Legend Capital, two Chinese venture firms, led the round.	NVIDIA
Jingchi	A year-old tech startup producing autonomous vehicles has set the goal of expanding its fleet to 100 to 200 units by the end of 2018.	Guangdong Unicon, NVIDIA
Tencent	Tencent has been a relative latecomer among China's largest tech firms to delve into the auto sector.	Guangzhou Automobile Group, Nio, Didi Chuxing, Tesla
Alibaba	Alibaba announced in mid-April that it has been conducting self-driving vehicle tests, joining its rival Baidu and Tencent in the artificial intelligence driven industry. The company has sought 50 more self-driving specialists for its AI research lab.	SAIC Motor, Dongfeng Peugeot Citroen
Horizon Robotics	Horizon Robotics, which provides facial recognition systems for some of Beijing's busiest subway station, is investing heavily in embedded AI as the future of facial recognition and autonomous vehicles. The company was founded in 2015 by former Baidu executive Kai Yu, who set up the search-engine company's deep learning research institute in 2013.	N/A
Cambricon	Cambricon Technologies is a two-year-old Beijing-based startup that develops intellectual-property (IP) cores and processors for deep-learning acceleration.	Huawei

Source: Eurasia Group

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