

Baidu | Google | Apollo | Waymo | Nvidia | Infineon | Voyah | Dongfeng Motor | Jidu Auto | Geely | Great Wall Motors | Huawei | DJI | Baidu Targets the Tier-1 Intelligent Vehicle Market

While Google dominates the global internet search engine market, Baidu is the leading search engine company in China. Having invested 15 billion US dollars in artificial intelligence over the last ten years, Baidu now views AI as the “differentiating foundational technology that powers all of its businesses.” One of those AI-powered businesses is Apollo Go, an autonomous ride-hailing service like Google’s self-driving car project, Waymo. Baidu has been working on autonomous driving since 2013 and started its robotaxi business in 2017. By mid-year 2023, Apollo Go had already provided 3.3 million rides. While a large majority of those autonomous rides were backed by safety drivers, earlier this year the firm was granted permission to provide fully driverless ride-hailing services in four cities: Beijing, Shenzhen, Wuhan, and Chongqing, with more cities coming onboard in 2024. The percentage of driverless rides has been increasing. In July 2023, 55 % of Apollo Go’s robotaxi rides were driverless, compared with 10 % in August 2022. Customers can hail Apollo Go robotaxis from the Baidu app on their mobile phones.

Baidu Sees an Opportunity to Bring its Solutions to OEMs

Automotive Tier-1 suppliers are struggling to be relevant in this new age of the software-defined vehicle. Baidu sees an opportunity to fill in for what’s lacking. “The industry is changing. There

is the need for a new type of tier one with strong software and artificial intelligence capability,” declared Rob Chu, corporate vice president and general manager of Apollo Self Driving, who spoke at the Automobil Elektronik Kongress this past summer. Baidu’s ASD business unit was founded in May 2021. It is one of three complementary businesses within the Intelligent Driving Group that serve autonomous driving and mobility applications. Apollo Go is another. The third is ACE, Apollo Connected Efficient Mobility, which is focused on smart transportation solutions including V2X. Apart from the Intelligent Driving Group, Baidu’s AI Cloud business serves 10 of the 12 top carmakers and five new energy carmakers in China. In China, new energy vehicles (NEVs) are those that are fully or predominantly powered by electric energy (EVs). Also included are PHEVs, BEVs, and FCVs. Baidu’s autonomous driving and mobility technology is clearly among the world’s most advanced, but the market for it is still young. Baidu’s Intelligent Driving business is not yet profitable.

ASD provides three full-stack intelligent vehicle solutions: autonomous driving, smart cabin, and smart map. The unit achieved Automotive SPICE Capability Level 3 certification in December 2022. Apollo Valet Parking saw its first production start in April 2021. Apollo Highway Driving Pro, which includes assisted driving functions such as highway navigation pilot, city autopilot, and parking in

all scenarios, went into production in October 2022. Apollo City Driving Max (urban, highway and parking) got its production start in September 2023. The solution employs seven HD cameras, four fisheye cameras, 12 ultrasonic sensors, five radar and two lidar sensors. In the future, the lidar sensors will be optional. The Apollo City Driving ASIL-D-rated ECU is water cooled. It employs an Orin-X SoC from Nvidia and a TC399 microcontroller from Infineon.

The market for autonomous features in personally owned vehicles is just getting underway in China. Voyah, the EV manufacturer backed by Dongfeng Motor, will equip the Voyah FREE electric SUV with the Apollo Highway Driving Pro. JI YUE 01, the first mass-market vehicle from Jidu Auto, the joint venture between Geely Holding Group and Baidu, will debut at the end of 2023. The EV will feature Apollo City Driving Max. According to the manufacturer, the feature employs a “lightweight high-definition map,” which has significantly fewer layers and elements and less data volume than traditional HD maps and is therefore 80 % “lighter.” What’s missing from the map is supplied by sensors and Baidu’s autonomous driving algorithms. In April 2023, Baidu’s HD maps were upgraded to OneMap, which updates in real time. Baidu is one of the two leading map providers in China. Its mobile maps have more than 400 million active monthly users.



Apollo Go provides fully driverless ride-hailing services in Beijing, Shenzhen, Wuhan, and Chongqing, with more cities coming onboard in 2024



JI YUE 01, the first mass-market vehicle from Jidu Auto, is expected to debut at the end of 2023

Like Amazon's Alexa and Google Assistant, DuerOS is a Chinese-language voice assistant platform that lets users interact with their devices. Baidu's DuerOS for auto is a version of the platform designed especially for cars. It is installed in more than one million vehicles from 70 carmakers, including GM, Buick, Ford, Cadillac, Mercedes-Benz, BMW, Lexus, Nissan, Toyota, Geely, Great Wall and BYD. ERNIE is Baidu's AI chatbot that uses natural language processing to create humanlike conversational dialogue. According to Baidu, ERNIE's latest version (3.5) outperforms Chat GPT-4 in several

Chinese language capabilities. Large language models like ERNIE promise to expand the boundaries of the conversations people can have with their vehicles. In partnership with the mobility tech company ECARX, Baidu has been collaborating with carmakers to test ERNIE in various interaction scenarios. Some of those functions are expected to debut in future production models from Geely Auto and Great Wall Motors. One of ECARX's founders is Eric Li, who is also the founder of Geely Holding Group.

The intelligent vehicle market in China is progressing faster than it is elsewhere in the world,

which is similar to how the Chinese electric vehicle market grew to be the world's biggest. According to the China Passenger Car Association (CPCA), China accounted for 63 % of global NEV sales in 2022. Tier-1 suppliers like Baidu who succeed in China will likely succeed elsewhere. In addition to Baidu, two other relatively new tier-1 suppliers, Huawei and DJI, are competing for intelligent vehicle business in China. China will likely also lead the world in adoption of advanced driving functions. Baidu expects greater than 15 % penetration of L2+ level solutions in China by 2026.

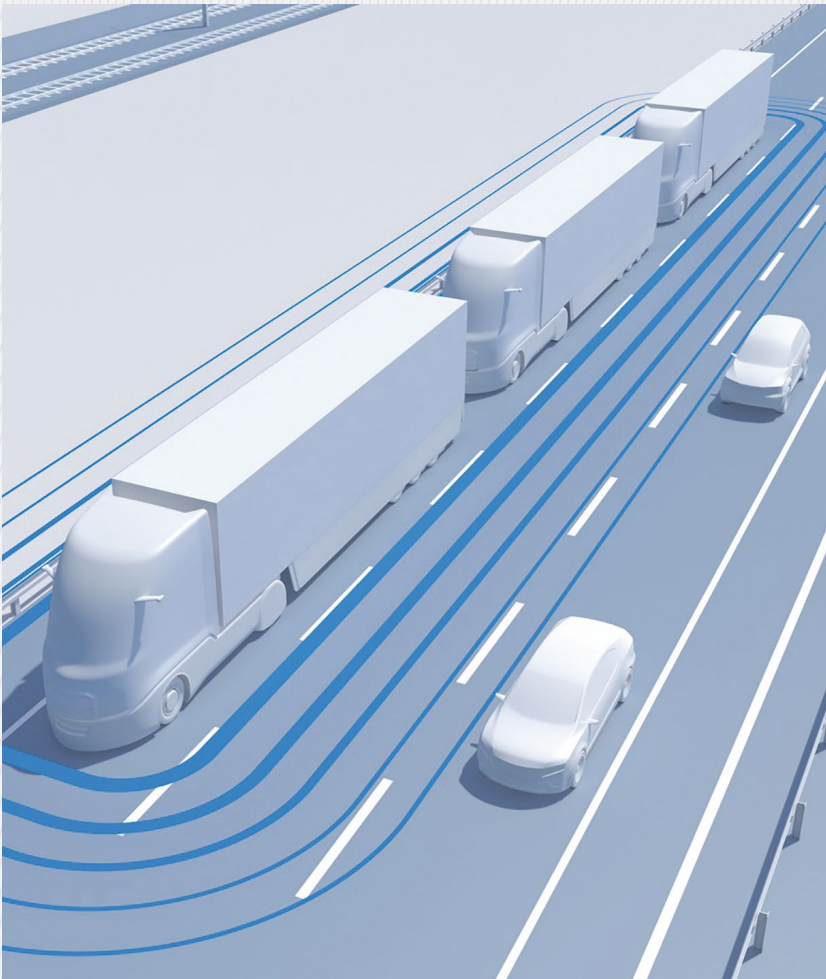
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FEV
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In transportation business platooning would lower TCO and help to counter the manpower shortage

From time to time, we check in with UNECE WP.29 regulators to get clues about how the market for autonomous and connected vehicles is shaping up. Regulations are developed over many months of analysis and arduous negotiations. Ultimately, the regulations represent a consensus between the auto industry and regulators about what is safe and what is practical. GRVA, the Working Party on Automated/Autonomous and Connected Vehicles, has a global perspective. The current chair is German; the vice-chairs are from Japan and China. The U.S. National Highway Traffic Safety Administration (NHTSA) is an active participant. A regulation already exists for features such as the Mercedes Drive Pilot, which autonomously steers, brakes, and accelerates on expressways at speeds up to 60 kph (37 mph), the normal range when traffic density is high. When Drive

Pilot is engaged, the driver does not have to pay attention to the road. The extension of this L3 system to 130 kph (80 mph), was to have been completed by the end of 2022. Instead, regulators are now looking for an early 2024 finish.

More regulations are in the works under the rubric of ADS features. These will come one at a time and will cover increasingly difficult operational design domains. By the end of the decade, it is expected that consumers will be able to buy cars that drive off-expressway in limited domains, and drive at higher speeds on expressways, without the driver having to pay attention. But regulations will require that there is a fall-back driver ready to take over as needed, and a consensus has not yet been reached about the top speed at which automated driving systems will be allowed to operate.

More Regulation Problems

WP.1, the Global Forum for Road Traffic Safety, serves as the guardian of the United Nations legal instruments aimed at harmonizing traffic rules. A provision of WP.1 stipulates that, “Automated driving systems in highly and fully automated vehicles should [...] comply with traffic rules,” meaning that piloted driving systems on expressways would be required to go no faster than the speed limit. One knows that cars that don’t keep up with the flow of traffic are not only a nuisance, but they pose a hazard to safe driving. Expressway traffic normally flows at speeds well above the speed limit. We are told that the “lawyers” at the WP.1 have thus far been unwilling to change the rule to say that automated vehicles can exceed the posted speed limits to keep up with the normal traffic flows.

Another difficulty is how to regulate automated driving at intersections controlled by stoplights. In the United States, the traffic rules vary from state to state. Some states require the driver to stop on yellow unless it is not safe to stop. Other states require the driver to stop when red appears. In order to comply with traffic rules throughout the U.S., autonomous vehicle regulations would have to account for the differences.

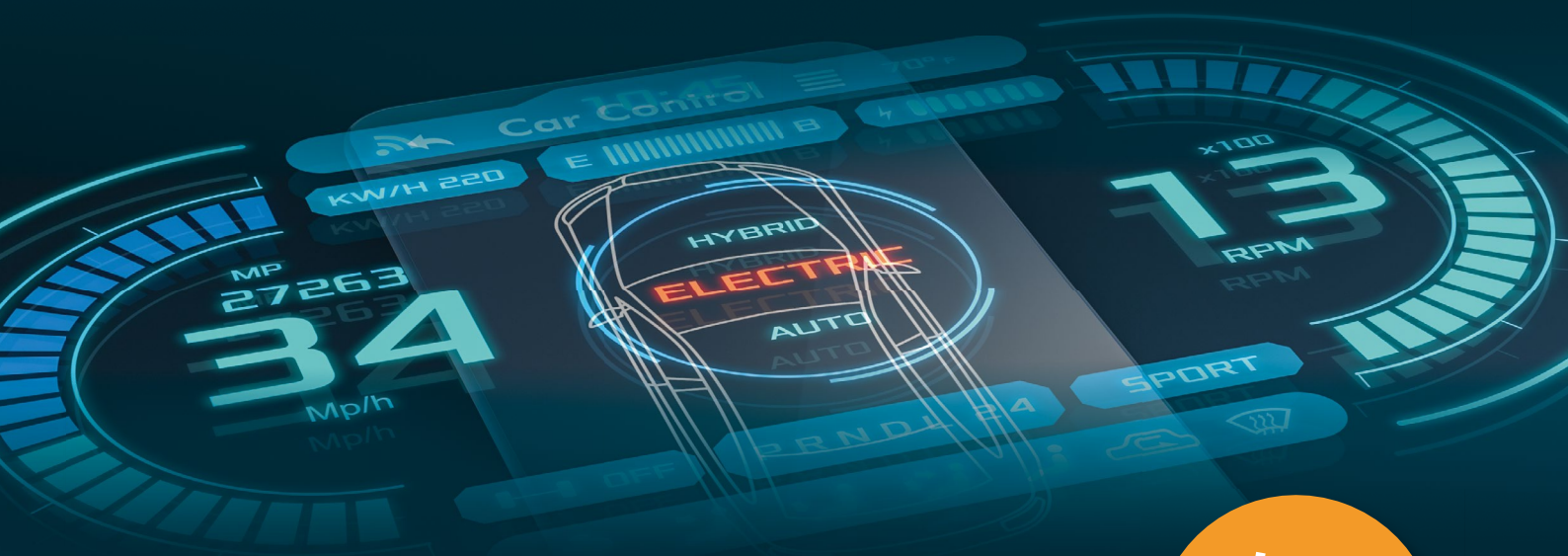
Regulators understand that it is impossible to build a self-driving feature that has a zero probability of failure. As such, autonomous driving without a person in the driver’s seat is in an entirely different category that includes robotaxis, long-haul trucks, low-speed shuttles, and special-purpose vehicles whose domains are tightly restricted. Such vehicles just quit when they fail or have to be driven to safety by a remote operator. Investors have been piling into autonomous trucking companies. The business case is strong, and there is a shortage of long-haul truck drivers. But regulators don’t think that an autonomous vehicle will soon be capable of entering expressways in heavy traffic without a person in the driver’s seat. They won’t be able to change from one expressway to another. Merging into heavy traffic requires the ability to communicate with other vehicles; one vehicle must give way to another. How will an autonomous vehicle know when to give way or when to assert right-of-way? Vehicle-to-vehicle communications could solve the problem but equipping a critical mass of vehicles with V2V communications won’t happen anytime soon.

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