# VDA Aligned Paper on Intelligent Connected Vehicle (ICV)

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Nowadays, the fact that the development of automated driving is crucial for the whole industry is a global consensus. The development of ICV is not only on the agenda of China's development strategy, but an important enabler for the national energy development strategy as well as a prioritized sector to be developed as a part of the "Made in China 2025" initiative.

Both Chinese and German automotive industries are actively pushing the cross-border communication and collaboration in automated driving sector and continuously reinforcing the cooperation in technology. Vehicles with automated driving technology will bring many benefits including high energy efficient, smooth traffic flow, reduction of the accidents, and low emission, which will expand autonomy for people to create a society where mobility is safe, convenient, enjoyable, and available for everyone.

Nevertheless, the development of such intelligent cars and their connection to each other and with the infrastructure is a huge challenge for the industry. Many stakeholders from different areas need to cooperate for the development of automated driving functions. All systems need to fulfil the highest demands on safety and trustworthiness.

The Development of ICV is not a single technical issue for the automotive industry, but an in-depth challenge of several aspects involving governmental responsibility, market order, legislation & standardization, and social ethics. Therefore, to promote the development of ICV in China, on one hand, requires the technology and resource integration between automotive and other industries. On the other hands, it is essential for the government to take further measures on management, market supervision, legislation environment to eliminate the restrictions on technology development and application.

Therefore, it is crucial to establish a friendly legislation environment with a clear national strategy to accelerate the technology development.

Currently, there are multiple ministries and departments who are responsible for the supervision of automated driving in China, which lead to many uncertainties in legislation areas. However, the industry requires a clear picture of the supervision law and standard so the new technology could be openly tested and introduced into products.

Therefore, we suggest in general:

1. To accelerate the supervision law and standardization process to introduce the automated driving to China.
2. A holistic policy approach should be developed since automated driving involved the integrated legal framework from MIIT, AQSIQ, MPS, SBSM, etc. It is not only benefit the automotive industry development, but also the relevant industry prosperity like telecommunication, map, cyber security, etc.

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## Issue 1: On-road testing and driving on roads

### Challenge

It is allowed to do the automated driving test on the specified public road in some pilot cities after getting the qualification issued by the local government.

However, the vehicle driving tests on highway and city express way, which are important scenarios for the automated driving, are still prohibited.

### Assessment

The automated driving vehicle is not only about the safety concept but also dealing with actual traffic conditions on road testing. The new technology and vehicle integrates the artificial intelligence including machine learning, driving strategy and learning map. By accumulating the diversity of the conditions and scenarios on the road, industry will develop a perfect matching solution and technology.

Compare with the United States, the United Kingdom, Germany, France and Singapore, etc., who are more open and supportive for public road test of automatous driving, and already gave the public road test permission, the Chinese policy seems more strict and conservative, and this will prevent the vital of the new technology development like automatous driving in China.

The diversity of realistic conditions and scenarios can only be provided by real public road. Highway driving with speed of 100 – 120 km/h is one major part of Chinese customer's profile. Chinese customer's driving behaviors and driving conditions need to be simulated and evaluated in order to safeguard the customers' safety on highway from all perspectives while developing the localized vehicle types.

### Recommendation

With measurement to ensure safety and documented procedure, test license for both manned and automated driving should be issued for OEMs or tier 1 responsible for function development to do testing on highway and some city express way. This can be reached in a step wise approach, where a certain public road area is expanded upon in an agreed timeline. China could learn experiences from other countries like Germany who applies gradual open of automated driving vehicles on roads.

In the on-road test, OEM should have the full responsibility to operate the vehicle safely.
Tests with automated driving on public roads should be permitted if the following requirements are fulfilled:

1. Specially trained drivers operate the testing vehicles.
2. The AD functions can be overruled by the driver at any time.
3. Vehicles should have a safety concept certified by a third party.

## Issue 2: HAD map and localization

## Challenge

HAD map is pre-existing knowledge of "AD Brain" from the real world, an essential pre-condition to realize automated driving. It plays an important role in perception, positioning, and planning and decision function of ICVs. "HAD map" plus "high accuracy positioning" is a widely adopted localization technical method for ICVs. The fusion between information from this channel and those from Radar, Lidar and Camera jointly ensures the driving safety of ICVs. High definition map is extremely important for automated driving, especially those have automation level 3 and above.

Currently, there are no China regulatory requirements for HAD map. The regulatory requirements for Electronic navigation map which is applicable to HAD map, could be obstacles to fulfil the technical requirements of Highly Automated Driving.

1. As a technical solution to assure geo-info security, Clause 4.1 of "GB 20263-2006 Electronic navigation map security treatment technology requirements" stipulates: "Spatial position technical processing is mandatory before electronic navigation map is published, sold, spread, showed, and used." (The "Spatial position technical processing" is also known as "scrambling", "shifting" or "encryption")

2. "Clause 6.12 of "GB 20263-2006 Electronic navigation map security treatment technology requirements" stipulates: "Elevation information with higher accuracy than 1:1,000,000" is in the scope of "information prohibited from expression"

3. Article 1 of <Notification about rules for Electronic Navigation Map administration> stipulates: "Electronic navigation map data collection shall be undertaken by units with accordingly qualification."

## Assessment

- **Scrambling of HAD map and GNSS Scrambler**

  Scrambled "HAD map for automated driving", plus the scrambler on-board (unknown localization shifting), have negative impacts to positioning, control accuracy and reliability of the Automated driving system, leading to a serious safety degradation. These impacts include but are not limited to:

  1) Coding of the scrambler does not follow requirements of "GB/T 34590-2017 Road Vehicle-Functional Safety Part 6 Product development- Software level" which is formulated by CATARC. Requirements of necessary "Automotive Safety Integrity Level" (ASIL) could not be satisfied.

2) Map distortion can cause wrong lane judgement of the leading vehicle. Automated driving vehicle could fail to correctly judge whether a vehicle in front of it is in the same lane. AD vehicle might not initiate proper longitudinal and lateral control in time, therefore drivers and passengers will suffer from uncomfortable travel experience and could be exposed to higher crash risks.

3) When an automated driving vehicle detects some new landmark, it will upload the information to the map supplier with coordinate. Map supplier will update the map accordingly after the correctness of information has been verified, and deliver it while requested. Currently, the vehicle and distance between vehicle and landmark are expressed in different coordinate system (vehicle: GCJ02; distance: WGS84), so, additional error will be introduced to calculated landmark coordinate. For some automated driving solution, the coordinate of landmark will be used for relative localization. The error which exceeds technical specification tolerance could lead to crash accidents.

- **Elevation Expression**

  "Prohibiting to express elevation information with higher accuracy than 1:1,000,000" has negative impact to Automated driving which includes but are not limited to:

  1) For viaducts, there are vehicles running both on and underneath. Elevation information is important for an AD vehicle for localization. Lack of elevation accuracy will lead to wrong localization. Automated driving system might take wrong control strategies.

- Surveying and Mapping Qualification

  As described before, an AD vehicle will play the role of perception terminal of dynamic map operated by map supplier, the mapping itself is done by the mapping suppliers, jointly accomplish map learning task without surveying and mapping purpose. Keeping AD vehicles from data collection for qualification reason will keep dynamic map from real time update. This will have a negative influence on AD vehicle positioning and accident precaution.

## Recommendation

- Scrambling of HAD Map

  1. To eliminate the negative impact from map scrambling to automate driving with precondition of state security, we proposed: Allow serial production AD vehicle to **use unscrambled HAD map** with premise below:

  1) Contents of HAD map data will be limited only for control purpose, e.g. lanes, signs etc. Irrelevant infrastructure data will be not included in a HAD map.
  2) HAD map data will be only used by automated driving system for vehicle control purpose. It shall not be displayed via HMI (Human Machine Interface), or be copied via any technical methods.

3) The amount of map data cached in the vehicle can be reduced to a small number of networks.
4) The OEMs use the map services, and the map suppliers own and process the HAD map.

2. In short term,
1) Demonstration Areas and pilot projects which allow to use unscrambled HAD map could help to prove the validity of the above proposal and speed up AD vehicle R&D.
2) Develop GNSS scrambler which guarantees GNSS key performance (Accuracy, Availability, Integrity and Continuity) and proper Automotive Safety Integrity Level (ASIL), and improve map encryption algorithm to reduce map distortion.

- **Elevation Expression**

  Propose to allow elevation information by HAD map.

- **Surveying and Mapping Qualification**

  Propose to allow AD vehicles to upload geographic information with cooperation with map supplier who is under authority's supervision.

## Issue 3: Data collection, transfer and storage

## Challenge

For ICVs in China data collection, storage, processing and transfer out of China are restricted by two laws: Surveying and Mapping Law and the Cybersecurity Law.

1. Under the Surveying and Mapping Law data collection, storage and processing of raw geo-information needs to be conducted by a licensed organization, licensed equipment and licensed personnel. Geo-information is a key term in the law which covers shifted or un-shifted GPS, short videos or sensor data of street views, altitudes or other attributes of geographical elements and artificial facilities. Geo-information covers data relevant for SD maps, HD maps and functions that rely on sensor/video input (such as ADAS). The term geo-information is broadly defined and the relevant authority NASG currently takes a conservative interpretation.

2. Foreign-invested entities are restricted from obtaining the highest level Surveying and Mapping license allowing all types of data collection and processing related to survey and mapping activities.

3. Under the Cybersecurity Law and the draft "Measures on the Security Assessment of Cross-border Transfer of Personal Information and Important Data" personal information and important data collected or generated in China need to be assessed before transferred overseas. Transfer of this data outside of China first requires an internal assessment, which may trigger an assessment of the relevant authority if certain criteria are met (according to the draft Measures and may be subject to further change). The mechanism allows a restriction on which data will be allowed to transfer outside of China. The terms in the law and draft measures are broad, vaguely defined (e.g. important data) and can be applied to many industries. Due to the scope and status of the law and draft measures, the exact interpretation for each industry sector is not yet clear.

## Assessment

The restrictions on data collection, storage, processing and transfer out of China can have a great negative impact for R&D and series ICVs going forward for the following reasons.

**Collection of geo-information:**

- Collection, storage and analysis of environment data is essential for testing and developing on component levels (such as radar, camera etc.) and on AD functional level for driving strategies, self-localization and location-based functions.
- Collection and analysis of data from customer cars is necessary for several reasons amongst which are: 1. fleet information for traffic efficiency, safety and learning maps and 2. Improvement of AD functions over time.
- OEMs and suppliers are not licensed organizations, their test vehicles and customer cars are not licensed vehicles and the drivers are not licensed personnel. Collecting geo-information during

R&D and on a backend from series fleet without an appropriate license is therefore currently restricted. Processing this data is also restricted.

- If all activities related to geo-information (GPS, SD-map, HD-map, videos, sensor data) require a cooperation with a licensed mapping partner, this would put OEMs and suppliers in strong dependency and restrict open innovation and competition.

**In-China storage:**

- As main parts of R&D for foreign enterprises are done outside of China, the data collected in China is often required to be transferred out, for example for hardware-in-the-loop tests, software-in-the-loop tests, training of machine learning algorithms or simulations.
- Data from customer cars are necessary for improvements of AD functions over time for example through error analysis.
- Limiting a transfer of this data would slow down innovation and localization of AD for China.

## Recommendation

- **OEMs and suppliers should be permitted to handle appropriate data**
  A standard should be developed with a precise and innovation friendly data classification of geo-information into:
  1) **Geo-information with national security interest:**
     a) Location information + sensor data/images of the static world such as roads, bridges, buildings etc.
     b) Location information + data used for mapping (detected map inaccuracies...).
  2) **Geo-information without national security interest:**
     a) Location information + environmental meta data (Hazard detected, hazard type, hazard velocity…).
     b) Dynamic and static data (video, radar, etc.) without location information (critical structures erased from images).
  3) **Other data**

  The regulatory framework should be adjusted such that OEMs and suppliers are permitted to freely handle geo-information without national security interest (2) and other data (3), both for their R&D work and on a backend from fleet data (with customer consent or legitimate interest). Geo-information with national security interest (1) should remain to be handled in cooperation with a map supplier who is under authority's supervision.

  **Arguments:**
  1) Environment data is essential for ADs amongst others for safe operation. As the technology is still in an early stage, restricting the access to this data will slow down innovation significantly.
  2) Fleet learning is used to improve ADs safety and quality over time. Not allowing OEMs and supplier's full access to fleet data will slow down improvements significantly.
  3) RTM requires customer NEVs to collect geo-information and send it to a government backend. Due to the collection of geo-information this regulation is in conflict with the

Surveying and Mapping law. An adjustment of the latter to harmonize the regulations is recommended.

4) Collection of GPS data and other location based information is necessary in many smart devices in order to create value-added services for the customer. This is already being done in million smart phones for applications such as shared bicycles, ride-hailing and many other location based services.

- **Transfer of appropriate AD data outside of CN should be allowed**

  Appropriate AD data (not critical from the perspective of national security or personal security & safety) should be allowed to be transferred out of China.

  Such data should include:

  - Geo-information without national security interest.
  - Specific types of personal data: pedestrians' faces & vehicle licence plates (un-anonymized)
  - Aggregated customer data (Big Data).
  - Anonymized customer data.
  - Customer data with consent.

  **Arguments:**

  1) A broad restriction on data transfer outside of China would have negative impact on both domestic and foreign entities. Chinese companies that have R&D centers outside of China, such as Baidu and Didi in Silicon Valley, also have to transfer their data for analysis outside of China.
  2) When a human does a driving mistake only the individual learns. If an AD vehicle experiences a new driving situation, both current and future fleet vehicles can learn from this. Machine learning based on fleet data is the future-proof way to improve the quality and safety of AD vehicles. This is important to have a fast transition to autonomous driving.

     Only if all globally available data (for example from rarely seen traffic situations) can be used, maximum improvements are possible.

     Because of the machine learning approach every new AD vehicle can make use of the combined driving experience of all previous vehicles.
  3) Any type of modification on the raw video image (or other sensor data) will mortally or vitally influence the machine learning outcome, because then the machine is trained with "fake" reality. In another word, modified sensor data is useless for Automated Driving R&D activities. For instance, blurred pedestrian faces and vehicle license do not exist on real roads. In this case, un-anonymized personal data should be allowed to keep aboard temporarily (during the machine learning development phase).
  4) The automotive industry is a highly connected and globalized industry with very specialized expertise located in different countries around the world. To be able to integrate this expertise for AD in China a knowledge exchange – and data exchange - with the centers of expertise is necessary.

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## Issue 4: Homologation related standards

### Challenge

ICV bring new challenges for technical regulation and homologation system concerning new technical trends such as electrification, digitalization, automation and connectivity. With increasing level of automation, the automotive industry will reach a point, where a number of traditional regulations are no longer effective and sufficient.

Under this circumstance, the UNECE regulation and homologation system for automated driving vehicles have been already started to research and develop under UN WP.29. On China side, it's necessary to further enhance the related international harmonization, especially with UN WP.29. Otherwise, there will be homologation challenges for future automated driving in China, because the most of effective GBs for type approval are mainly referred to the UNECE regulations.

Ministry of Industry and Information Technology (MIIT) and Standardization Administration of China (SAC) jointly issued a guideline for the establishment of ICV standard system in 2018, in which states that China aims to develop more than 400 standards Incl. GB, GB/T and industrial standards for ICV towards 2025 and the standard system will play a leading and supportive role in the development of ICV industry. But the challenge we are facing now is that there is no apparent boundary between mandatory and recommended standard. GB/T and industrial standards as recommended sometimes are also introduced into homologation or market entry requirements like for NEV.

### Assessment

The safety testing and assessment system for traditional vehicles based on a practicable number of crash tests under well-defined worst case conditions has been maturely established and widely accepted. For highly automated driving vehicles, to provide proof that a robot can drive safely would need billions of test kilometers under different environments and conditions. It would take thousands of vehicles dozens of years to do this. How to establish generally accepted criteria and methods as well as scenarios and situations for the testing and homologation of automated driving functions and connectivity functions is still under discussion and research worldwide.

The German automotive industry maintains the opinion that a standardized procedure in the field of testing and experimenting is necessary, for the securing and approval of higher levels of automation. To that end, the PEGASUS project has been set up in Germany since the beginning of 2016 to find and define an acceptable process using hardware in the loop and software in the loop simulation and verification that could be accepted as proof that the technology for automated driving is safe.

The Informal Group on ITS/Automated Driving (IWG on ITS/AD) was set up in 2014 and further GRVA WG was set up in 2018 under the UN World Forum for Harmonization of Vehicle Regulations (WP.29) with the purpose of establishment of internationally harmonized technical regulations in the future and discussing relevant issues for the practical application of the AD technology.

From China side, one new Sub-Committee 34 for Intelligent Connected Vehicles under TC114 was established in April 2018. It's responsible for developing the national and industrial technical

standard in the fields of ADAS, AD, vehicle Information Security & vehicle connectivity, coordinating with other technical committees from ICT industry, proposing the integrated method on future automated driving testing assessment and management system, improving the communication and harmonization with international standardization organizations (WP.29, ISO). The new SC34 will be an overarching role to steer the long-term standardization on ICV.

## Recommendation

1. To enhance the exchange channels on development of automated and connected vehicles in terms of technical regulations and testing assessment system both China and Germany side. To have the globally harmonized regulation & standardization on ICV via transparent standardization procedure and full involvement of international companies.

2. To set up Technical Assessment Committee & Process to evaluate the innovations concerning ICV (which are not regulated yet or conflict with current existing technical regulations), and grant approvals accordingly to encourage & promote the technical innovations.
3. To adopt GB standards for mandatory homologation both for imported and local produced vehicles as the bottom-line requirements to ensure the technical compliance of the ICV products and cost-effective solutions to the market;
4. To only adopt other standards for voluntary use to promote technical innovation and performance. Other standards refer to recommended standards such as GB/T, QC/T and other industrial standards, local standards. These standards usually define the technical specification with higher quality level. The usage of these standards of OEMs should be encouraged but not mandatorily required in the homologation or other market entry administration rules;
5. To avoid the situation like NEV which adopts lots of GB/T with short preparation time. The development of ICV is a long-term target not only from technical evolution side but also from the standardization side and both need enough time for sufficient preparation and necessary validation. The design of ICV needs to carefully follow the technical regulations issued by authorities and needs enough lead time to bring the compliant product to the markets;
6. To adopt the suggestions and conclusions in the “Applicability Analysis of Laws and Regulations for Intelligent and Connected Vehicles” released by CATARC.