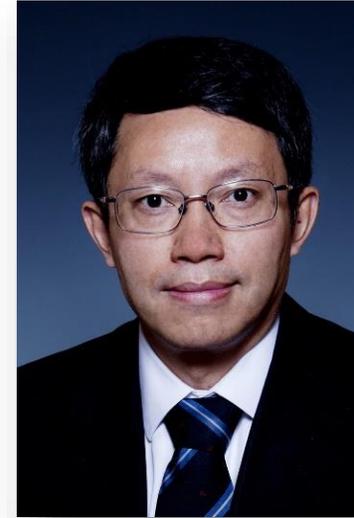


Introduction to Dr. Keqiang Li



- **Professor** of Automotive Engineering, **Tsinghua University**
- **Chairman** of Expert Committee, **CAICV** (**C**hina Industry Innovation **A**lliance for **I**ntelligent and **C**onected **V**ehicles)
- **CTO** of **CICV** (China ICV Research Institute Co., Ltd.)
- **Research interests:** Connected and intelligent vehicles, Vehicle dynamics and control.
- Authored or co-authored over 200 peer reviewed journal papers
- Received more than 80 patents.

The Base Platform of ICV System and Its Industrialization Approach

Keqiang Li

Professor of Automotive Engineering, Tsinghua University

Chairman of Expert Committee, CAICV (**C**hina Industry Innovation **A**lliance for **ICV**)

November 13, 2018

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**Background and Motivation for
ICV Base Platforms**

**Industrialization Approach for
ICV Base Platforms**

New Technology Trend of Automated Vehicles

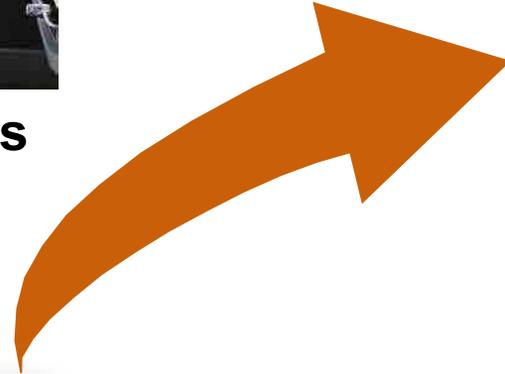


Autonomous vehicles



Intelligent and Connected Vehicles
(ICV/CAV/CAD)

Automation



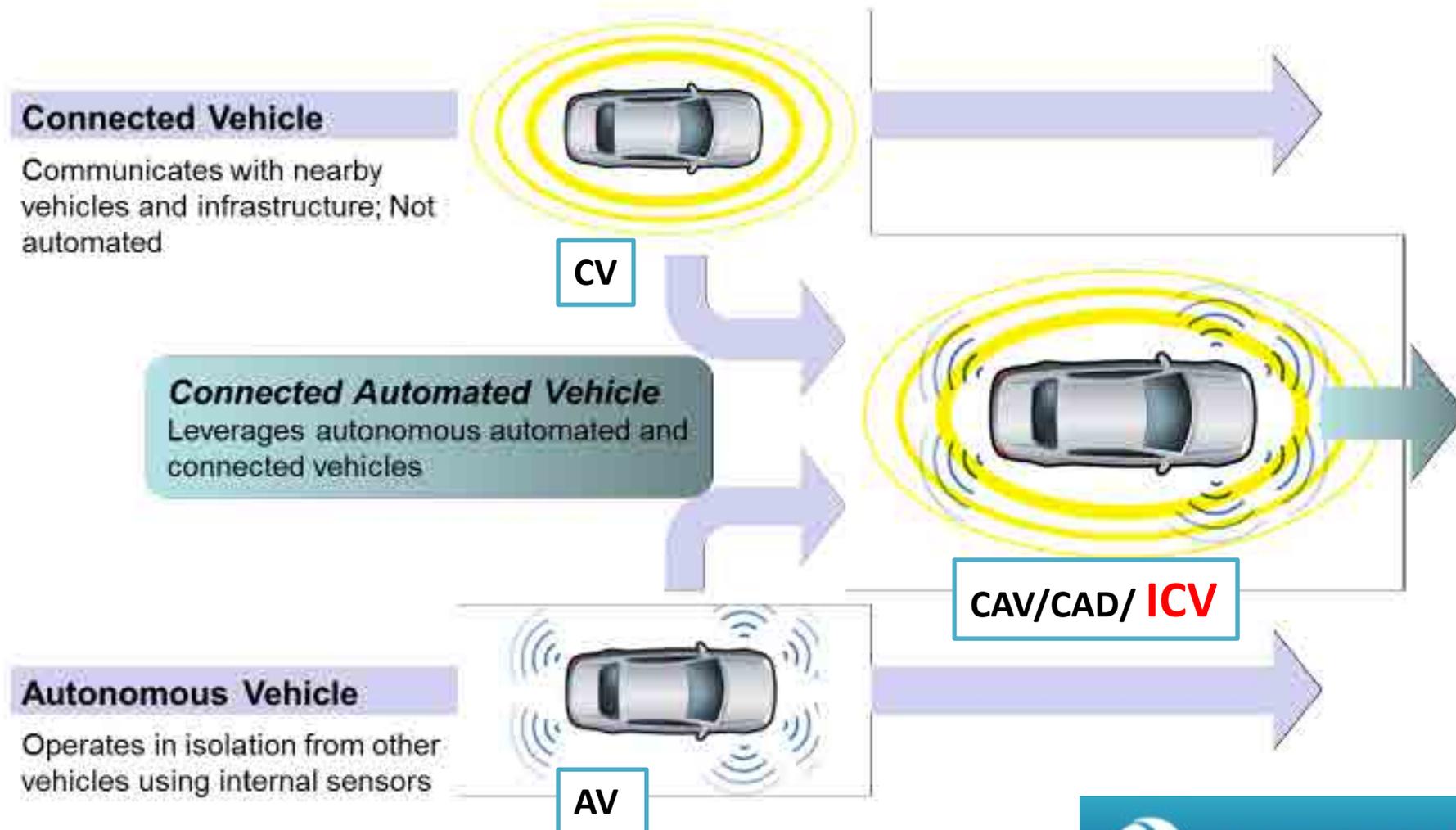
Connection



Connected vehicles

“Autonomous Vehicle” + “Connected Vehicle” = ICV

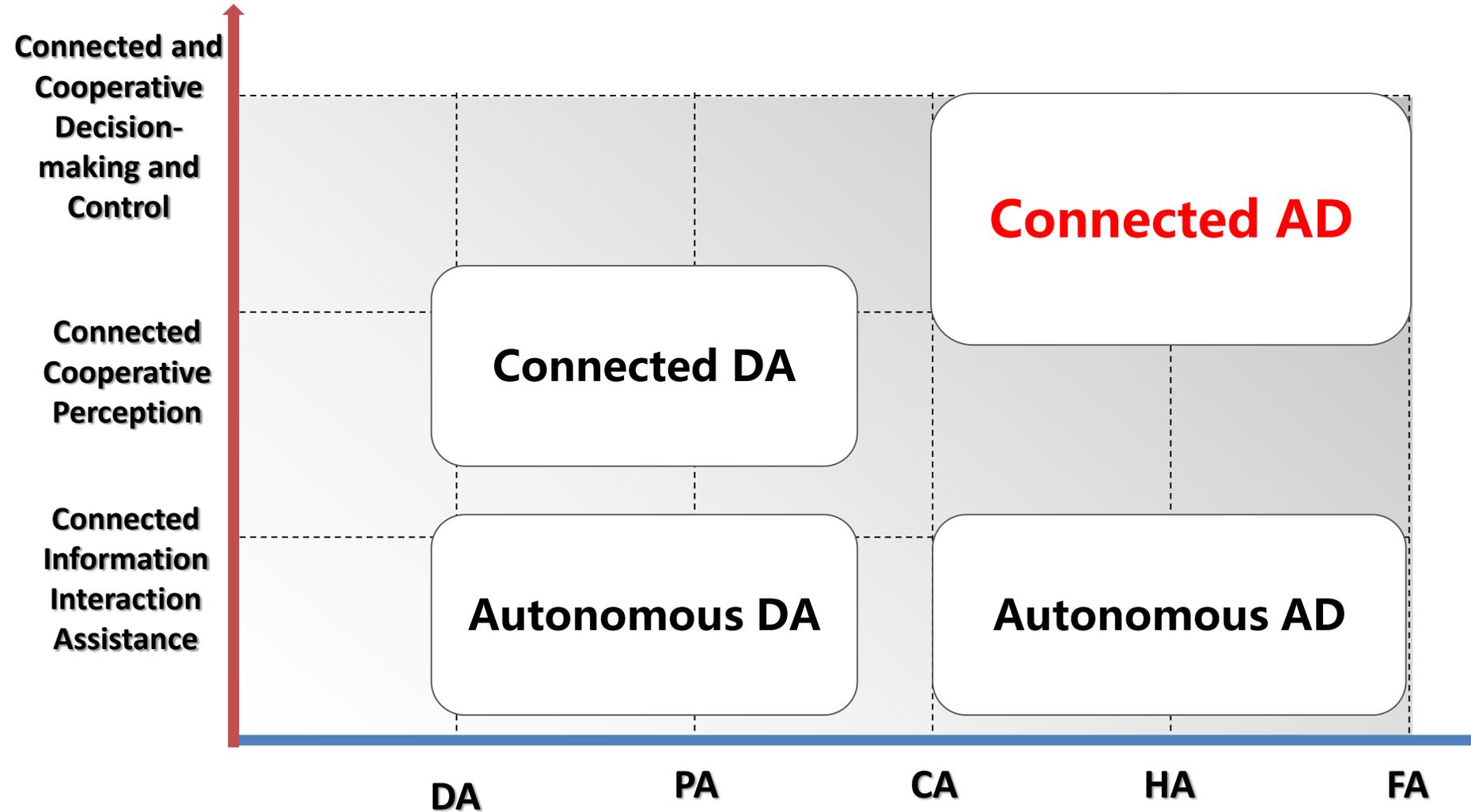
The path toward connected vehicles will ultimately lead to automated vehicles.



Connection Levels of ICV

Connection Levels	Name	Narative Definition	Control	Typical Scenario	Transmission Requirement
1	Connected Information Interaction Assistance	Realize auxilliary data aquisition including navigation and upload of information including driving and driver operation data based on Vehicle-Road and Vehicle-Backend communication	Human	Map, traffic flow, traffic signs, fuel consumption, and mileage, etc.	Low requirement on real time and reliability
2	Connected and Cooperative Perception	Acquire real time surrounding traffic environment data based on Vehicle-Vehicle, Vehicle-Road, Vehicle-Pedestrian and Vehicle-Backend communication, infuse with perceived data by onboard sensors, and then input for self-vehicle decision-making and execution systems	Human and system	Position of surrounding vehicles/pedestrians/n n-motorized vehicles, phase position of traffic light, and road pre-warning, etc.	High requirement on real time and reliability
3	Connected and Cooperative Decision and Control	Acqiure reliable surrouding traffic environment data and vehicle decision-making data based on V-V, V-R, V-P and V-B communication, transportation participants including V-V and V-R interact and infuse data, and then form collaborated decision making and control among the participants.	System	V-V, V-R collaborated control data	Highest requirement on real time and reliability

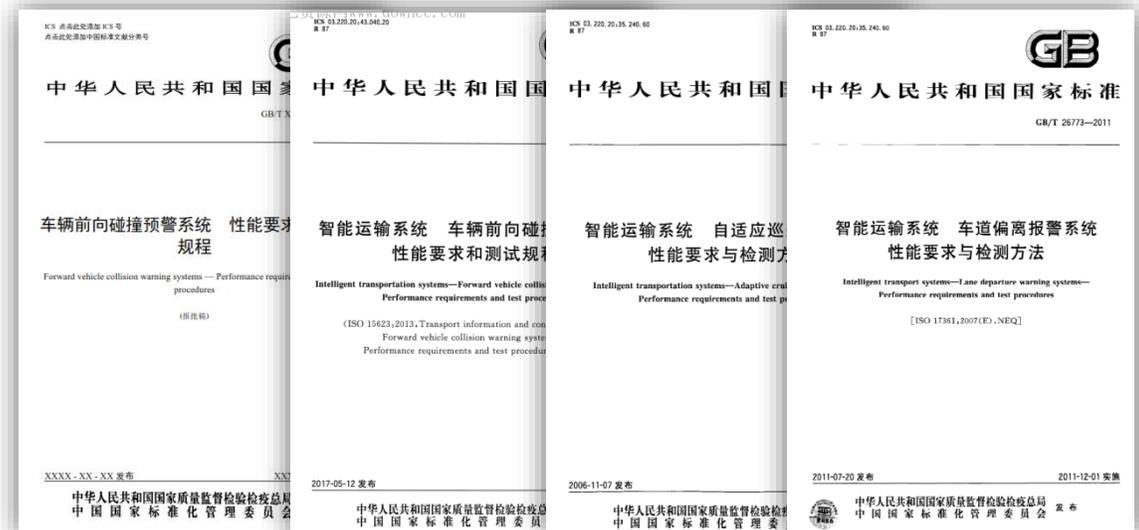
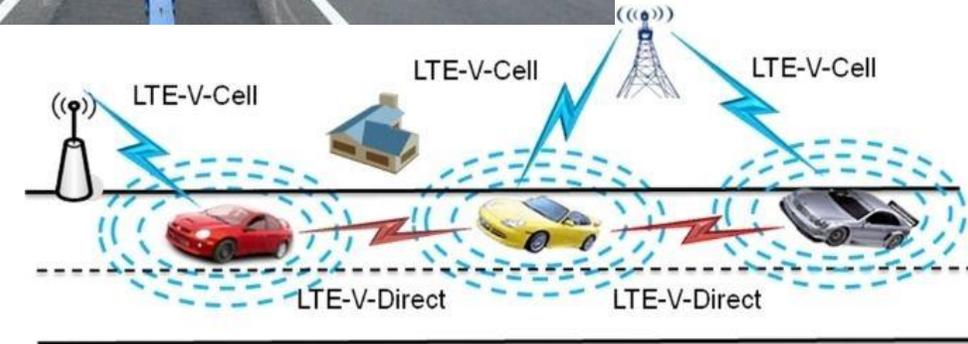
Classification of ICVs



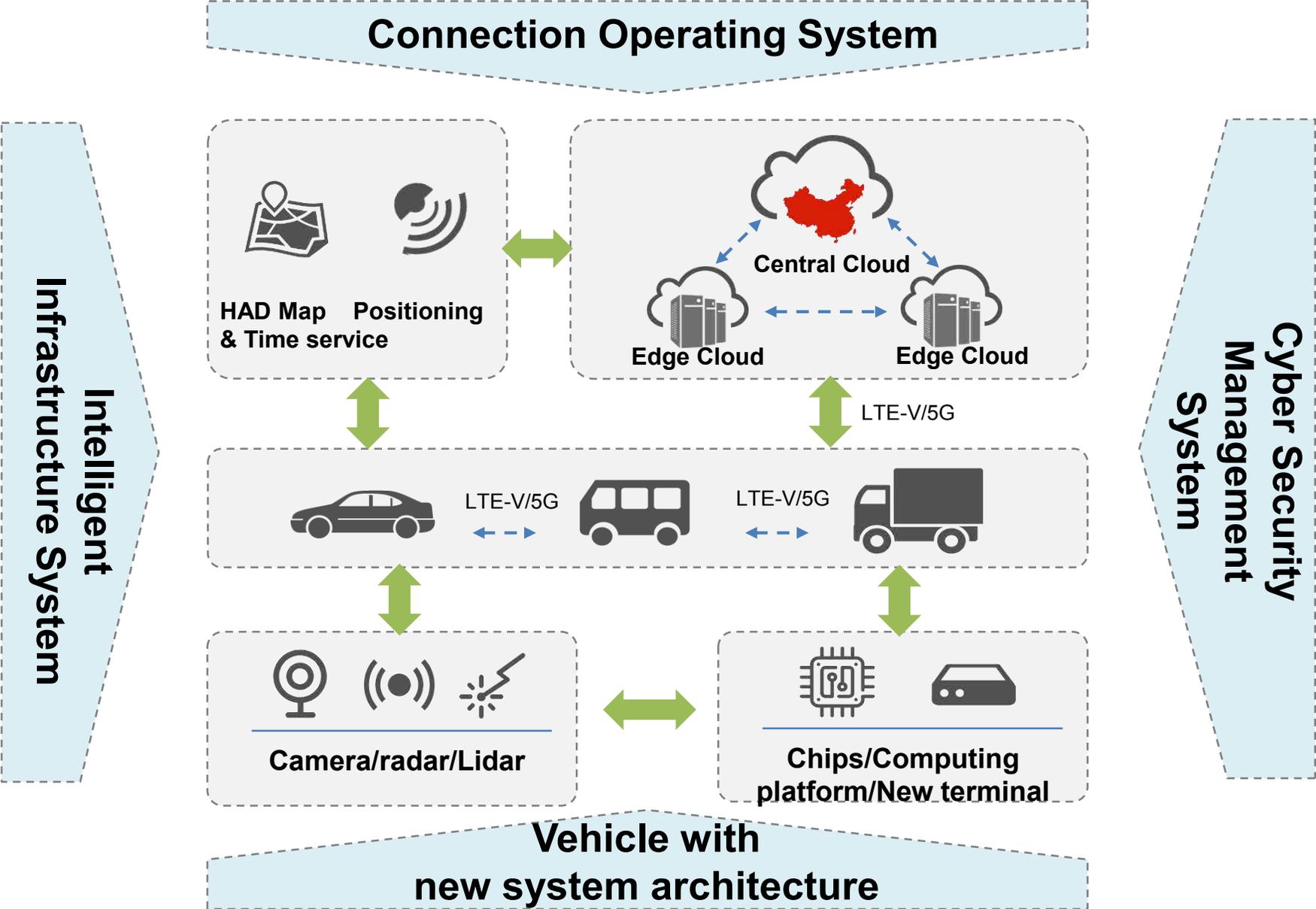
China Solution of ICV

What is the China solution of ICV?

- **Meet the infrastructure standards in China**
Meet standards of infrastructure including road, mapping data, V2X communication and transportation rule in China.
- **Meet the connection operation standard in China**
Meet the standards of ICV admittance qualification, network operation supervision, cyber security in China.
- **Meet the new architecture standards of automotive product in China**
Meet the standards of new architecture of automotive product in China, such as the standards of intelligent terminal, communication system, cloud platform, gateway, driver assistance system and autonomous driving system.



The System Architecture of the China Solution ICV



CONTENTS

**Background and Motivation for
ICV Base Platforms**

**Industrialization Approach for
ICV Base Platforms**

 In Beijing, the establishment of CICV (China ICV Research Institute Co., Ltd.) is for the national ICV innovation center.



The China ICV Industry Alliance was established on June 12, 2017. Minister of Miao Wei of MIIT served as Director of Alliance Steering Committee. Minister Miao suggested that **the Alliance should take the lead in establishing the National ICV Innovation Center**



The innovation center is launched jointly by C-SAE, CAAM and the Alliance.

The relying units mainly include industrial alliances, and universities, vehicle and parts enterprises, information and communication enterprises.

The operation subject of innovation center is China ICV Research Institute Co., Ltd. (CICV).



China ICV Research Institute Co., Ltd. was established on March 19, 2018.

The registered address is Beijing Economic-Technological Development Area, with **a registered capital of 1.05 billion Yuan** at the end of the year. The company is located in the southwest of Beijing.



The innovation center shareholder units are gradually increasing



- ❑ The 12 founding shareholders invested 600mio CNY, each with 50mio CNY, so far all investments have been in place.
- ❑ The second round of 9 investors have been reviewed and approved by the board of directors, the registered capital will rise to 1billion CNY.
- ❑ **Currently a number of international companies are in discussion with the Innovation Center to be in the third round of investors.**



Initial Tasks of CICV

Principles of first stage tasks selection

- Provide *demanding support service of foresight and fundamental research* for crossover industrial development;
- Provide *cross-field common and crossover base modules, middleware units, and base platforms* for various enterprises (**no competition with existing companies**).

CICV Tasks (First Stage)

Break-through on 7 common technologies

ICV Development Strategy

ICV Cyber-Physical Systems Architecture

ICV Technology Standards

Level 4 ADS under Chinese Standards

Automated Driving and Automotive AI

Intelligent Security and HMI

Test Assessments and Base Databases

Industrialization support for 5 base platforms

ICV Base Computing Platform

ICV Base Terminal Platform

ICV Base Cloud Control Platform

ICV Base HAD Map Platform

ICV Base Cybersecurity Platform

Industrialization Support for 5 Base Platforms of ICV System

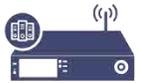
1. ICV Base Computing Platform

Build Chinese standard ICV base computing platform framework, research in heterogeneous base hardware and software, and develop toolchain, realize decoupled and modularized H/S design, assure flexibility of H/S selection and high efficiency and high quality of product development.



2. ICV Base Terminal Platform

Provide uniform interfaces for in-vehicle and external communications and HMI of ICV, simplify complexity between various modules of AD vehicles, integrate functions of modules including multi-modal communications, routing gateway, multi-modal positioning and HMI, build a new generation of ICV-oriented onboard intelligent platform products.



3. ICV Base Cloud Control Platform

Provide dynamic base data including vehicle operation, infrastructure, transportation environment, and traffic control to intelligent vehicles and their users, control and service agencies, the platform has base service mechanism that covers data storage, data maintenance, big data analysis, cloud computing and cybersecurity, etc. it is a base support platform that meets practical application demands of ICV.



4. ICV Base HAD Map Platform

Formulate standards and norms of HAD map, research in common technologies of HAD dynamic base map generating and application, initiate SOP of HAD dynamic map base data, provide fundamental assurance for national geographic cybersecurity and ICV industry development.



5. ICV Base Cybersecurity Platform

Build up terminal-to-terminal security protection and a 3-level in-depth protection system of “Cloud-Tube-Terminal” for ICV in aspects of standard system, security framework, detecting technologies, monitoring technologies and supervision platform, etc.

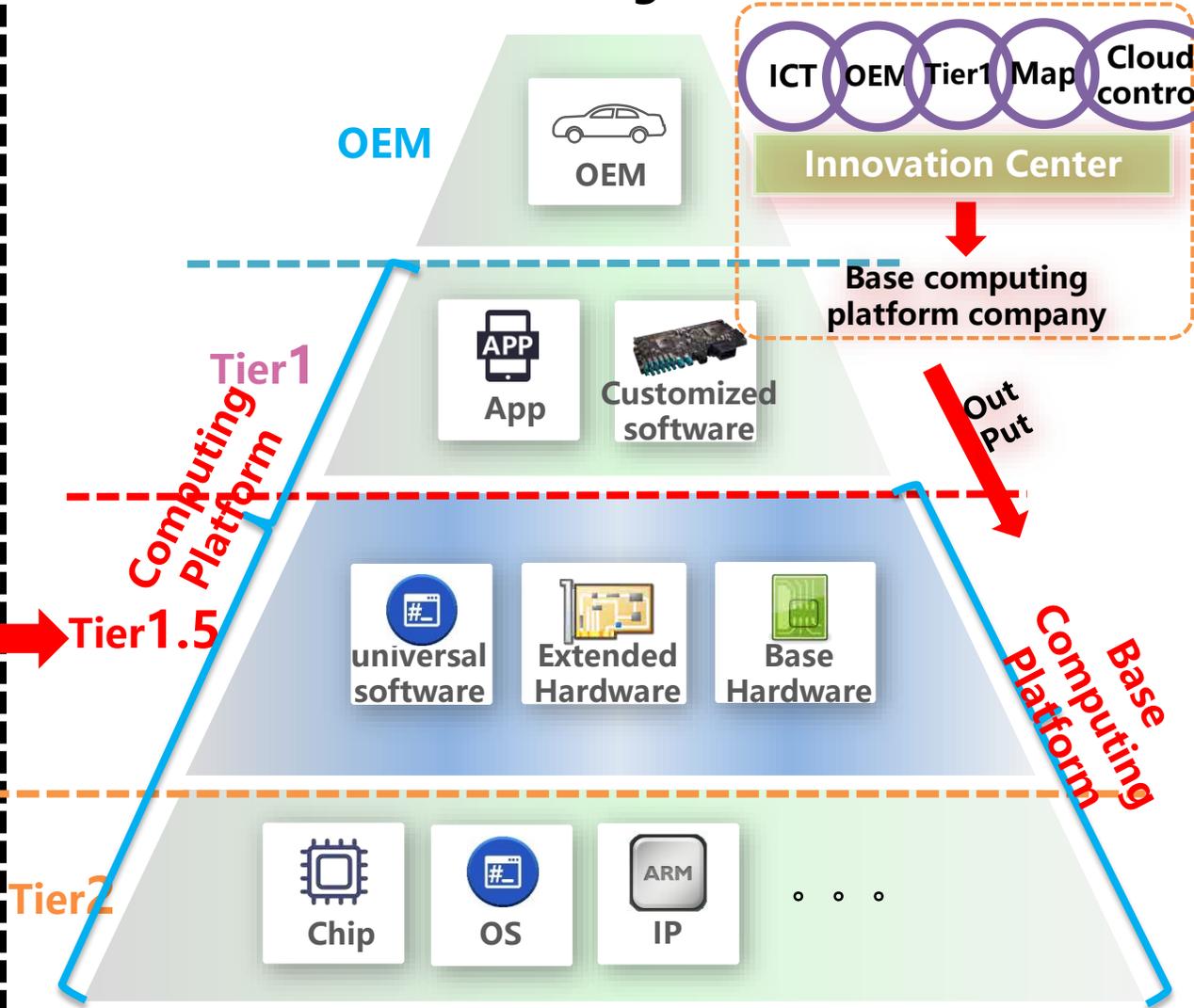
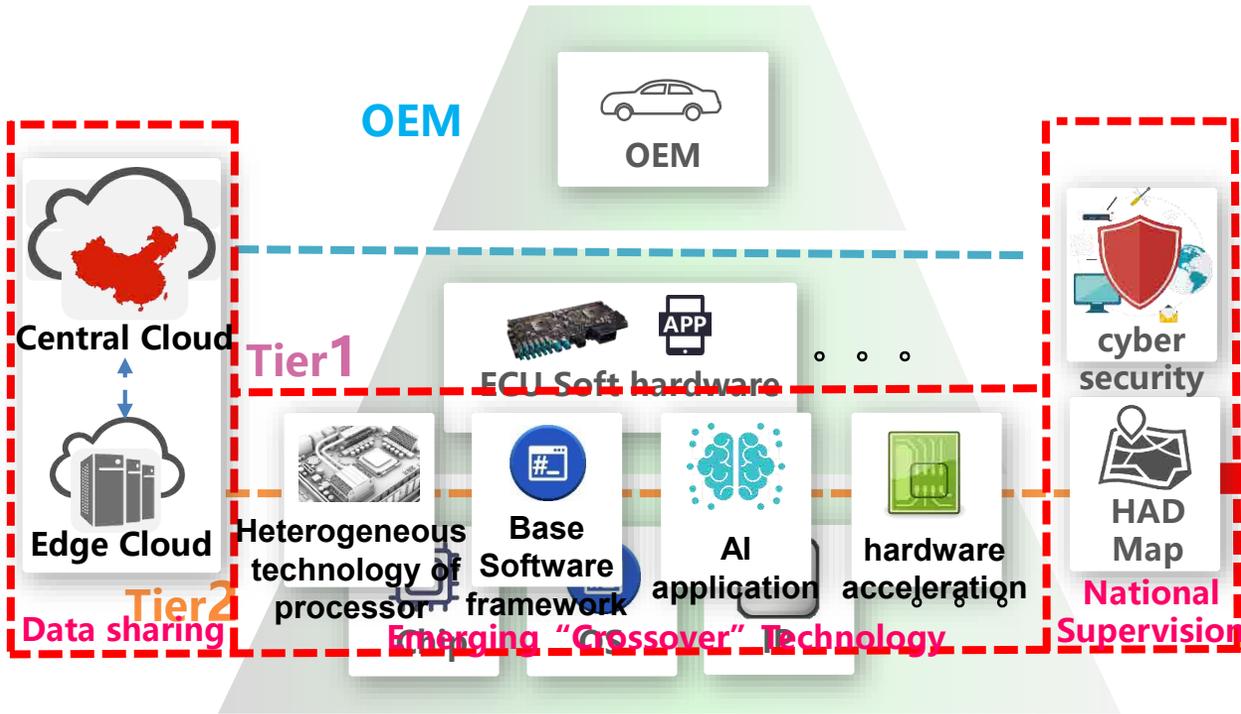


Definition of computing platform / base computing platform

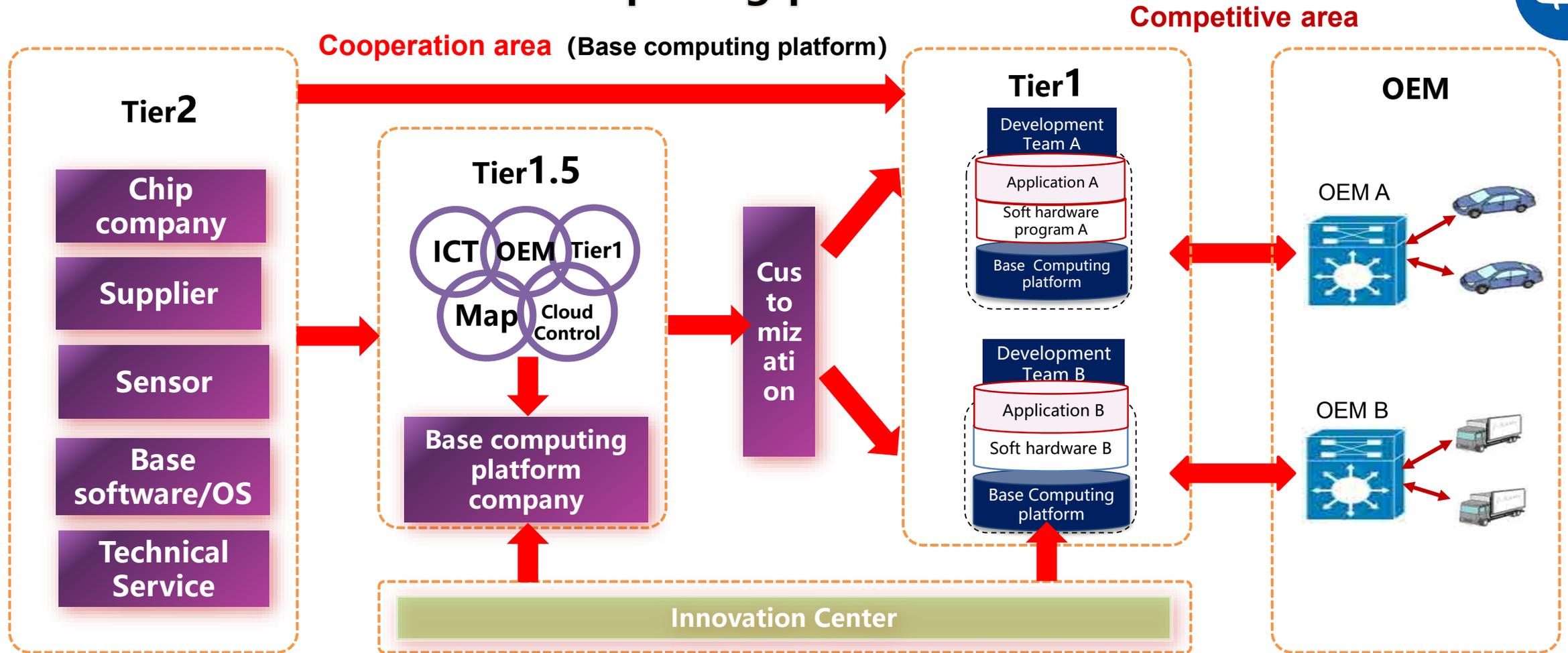


Industrial chain of conventional automotive electronics

Industrial chain of automated driving electronics



Business model of base computing platform



With the broad **industrial resources** of Tier 2, access to **base technology** of platform company, and the open third-party developing platform, suppliers of automated driving program, Tier 1, and OEMs could establish **top-level application, demonstration, verification environment**, so to develop **Chinese eco-industrial chain of computing platform**.

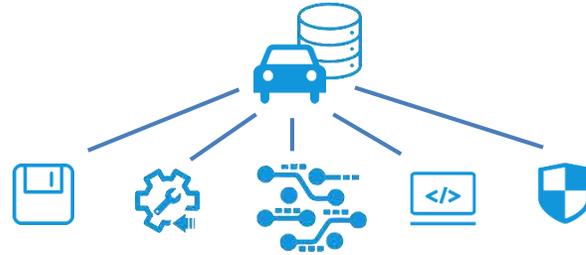
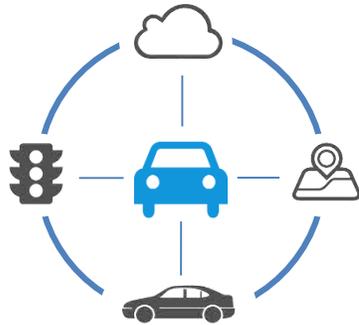
Definition of Base Cloud Control Platform

Cloud Control System

Base Cloud Control Platform

standardized
interconnection

common technical support



Cloud Control Application Platform

Industry chain application

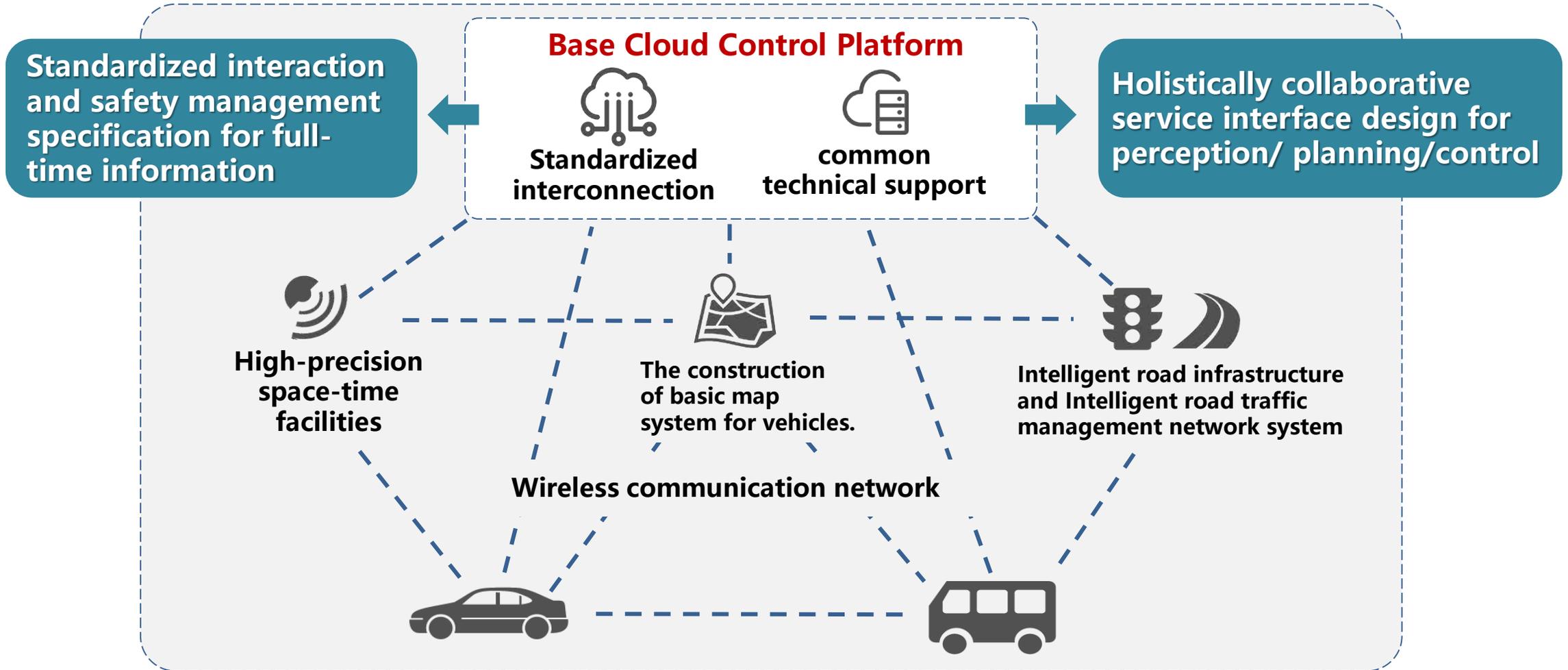


- Standardized communication protocol, reduce the difference in understanding when multi-domain collaboration is achieved.
- Design standardized infrastructure system deployment and segmentation implementation path for the practical application requirements of vehicle and various resources interconnection.

- Provide basic and common technical services for the specific application of ICV , including data security management, storage, operation and maintenance, big data calculation, simulation and test evaluation technology, etc.
- Provide a series of standardized development interfaces and toolsets to address business needs such as heterogeneous integration and interoperability

- Provides intelligent, efficient, energy-saving ICV driving applications, as well as a series of new automotive applications including shared cars and electronic payment.
- Provide collaborative business applications for test development systems, public service systems, insurance systems, and healthcare systems.

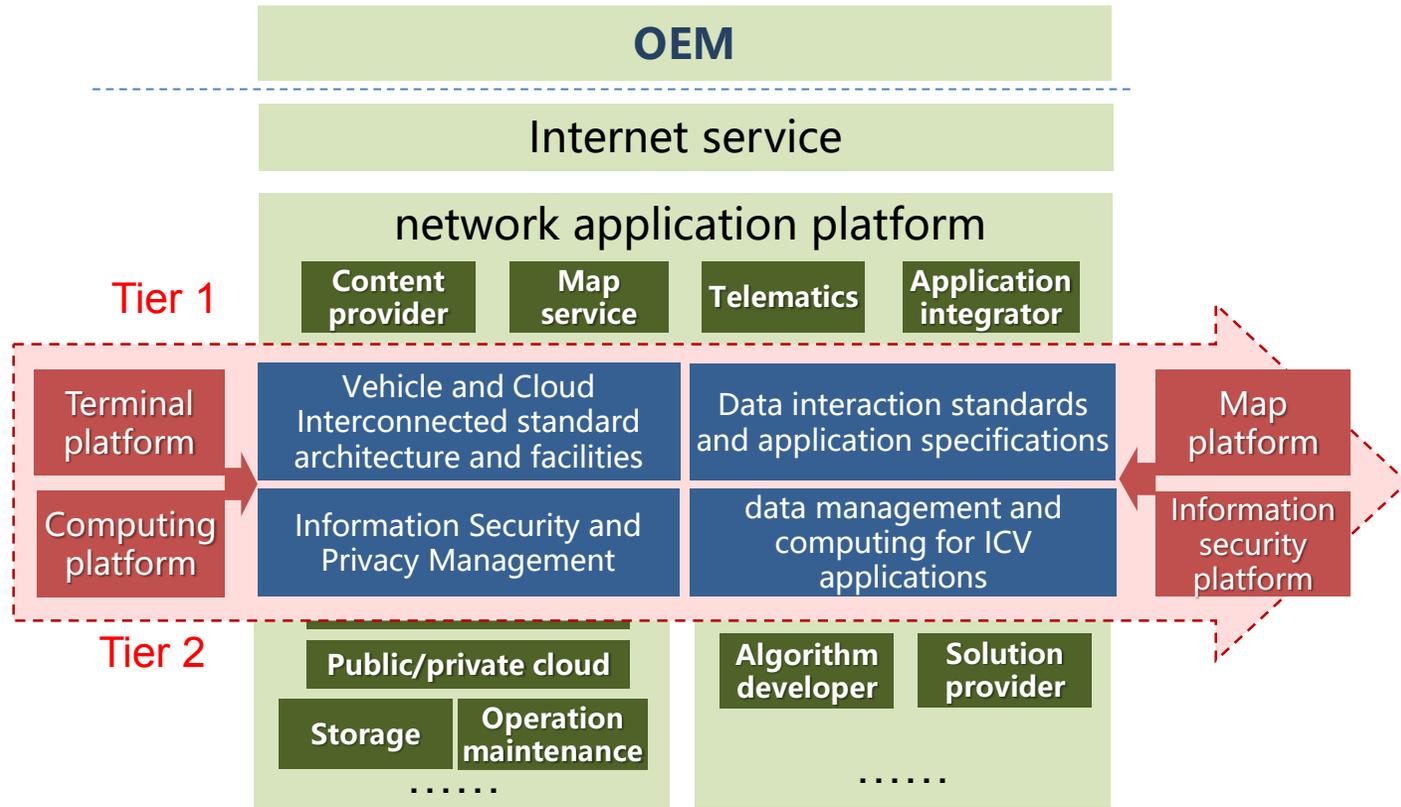
The Base Cloud Control Platform is the “Cloud Brain” for the operation of ICV



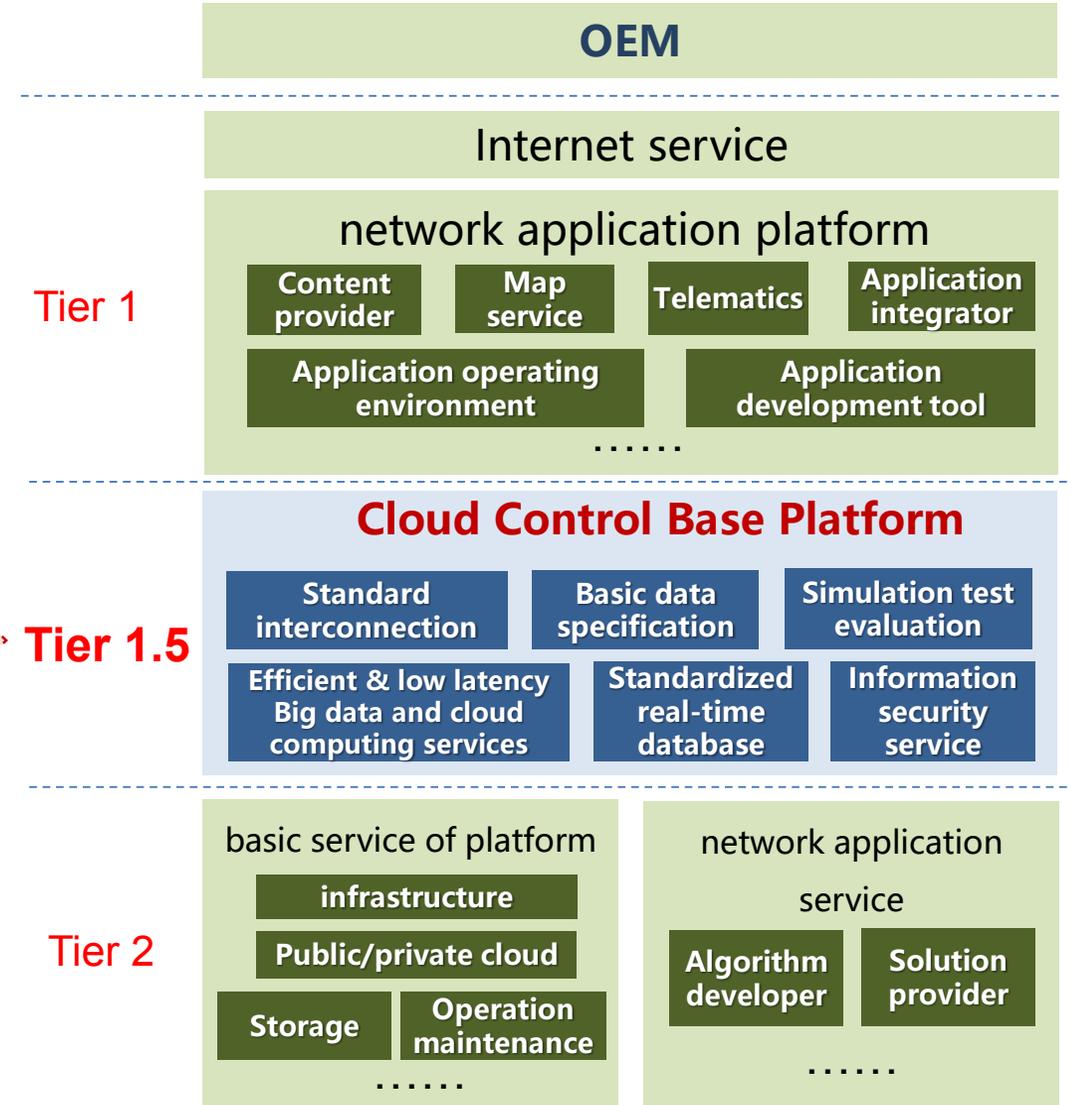
The Cloud Control Base Platform is a **data collaboration center, the computing center and resource optimization configuration center** that supports the practical application of ICV

Definition of cloud control platform/ base cloud control platform

The network service industry chain of traditional automobile

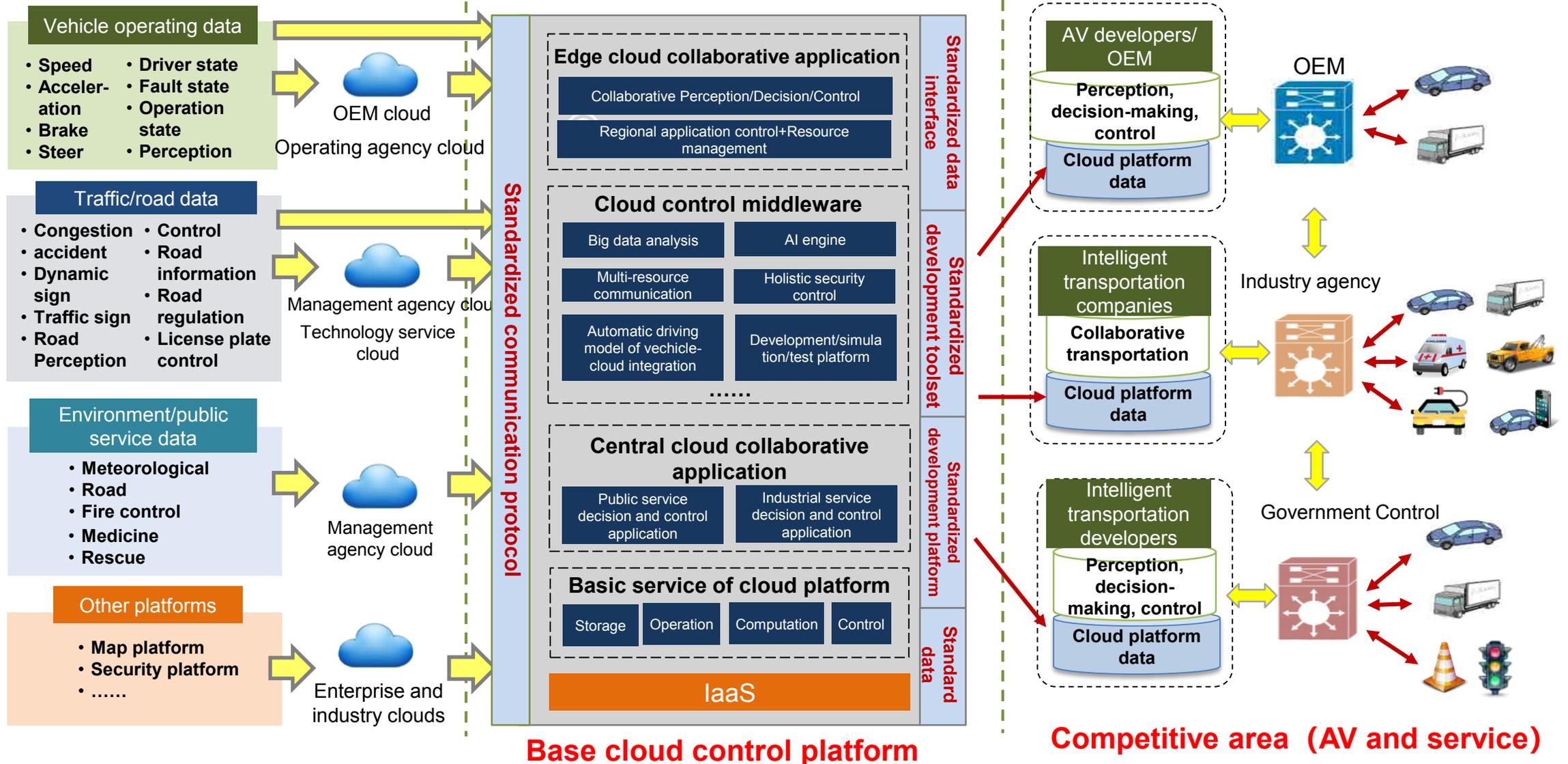


The network service industry chain of ICV



ICV Base Cloud Control Platform—Business Model

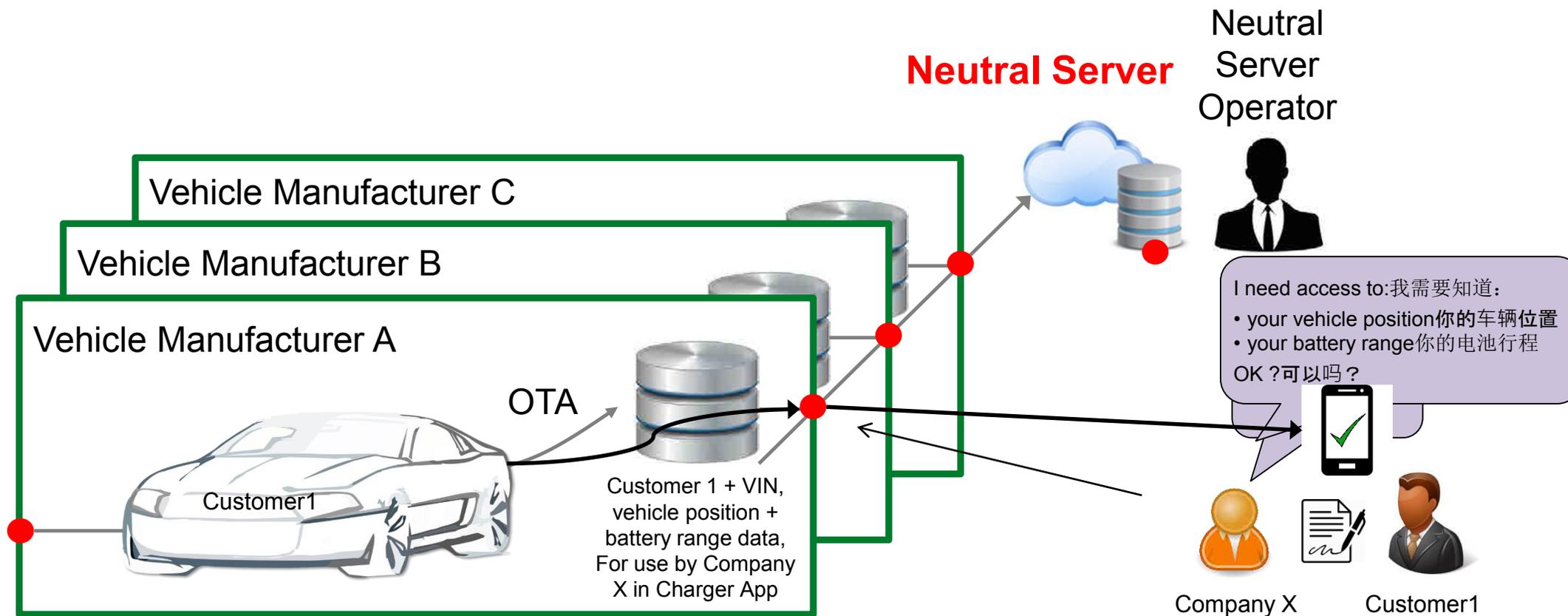
Base Cloud Control Platform provides multiple types of base data and network service support for ICVs and government supervision. With the data and service, AV developers, intelligent transportation companies and developers can adopt the differentiation strategy for each specific market.



The method of access to vehicle generated data

VDA

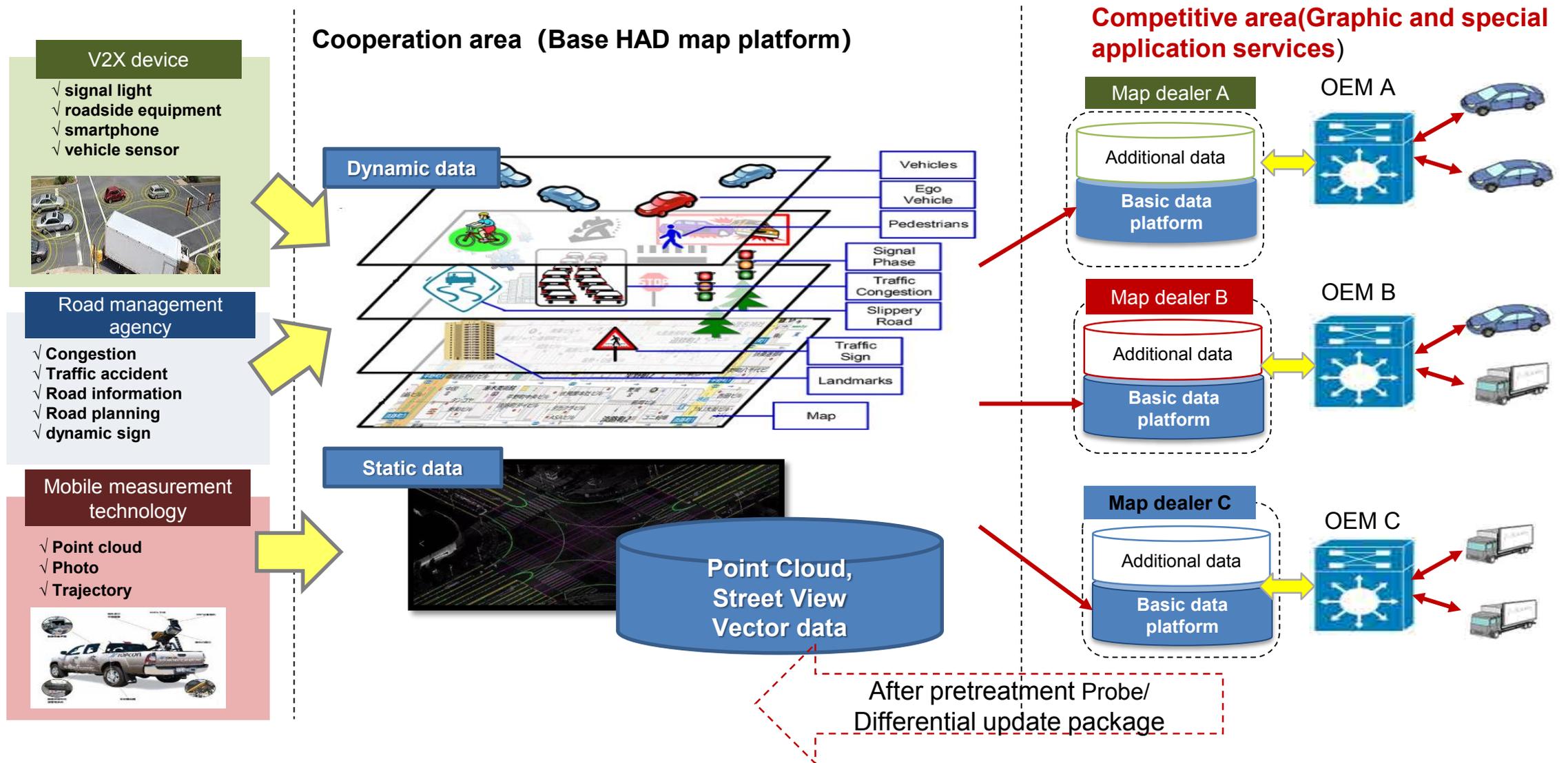
Role of the neutral server



Charger App = vehicle position + battery range + charging station location + charging station status

Base HAD map platform—Business Model

Take autonomous driving as an example, map platform completes base data acquisition and releases, while various planners/OEMs keep upper-level operation and maintenance for the business.

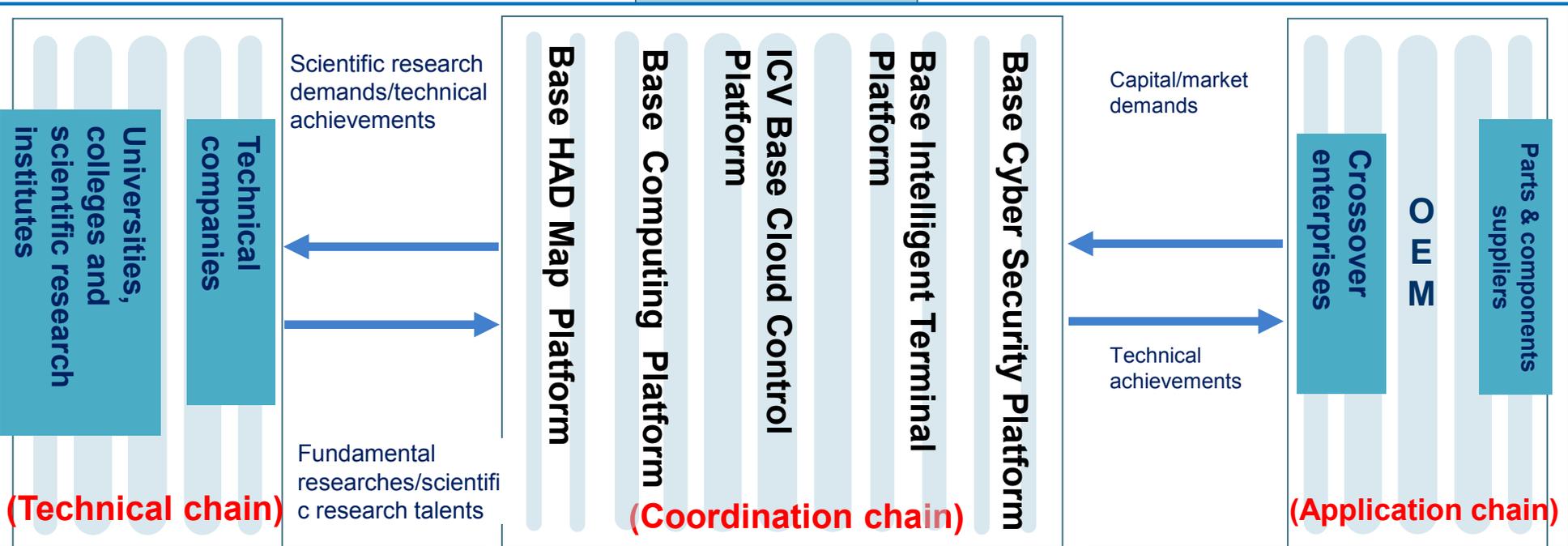


Synergies by Industrialization of the Five Base Platforms

National development strategy

Top-level design

Tremendous demands in the industry



(Technical chain)

(Coordination chain)

(Application chain)

Bottom-level design

Fundamental research

Key techniques

Industrial applications

The end

Thank you for your attention