Construction and Application of Identifier Resolution in Automotive Industrial Internet

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Abstract: Identifier resolution system in the automotive industrial Internet is necessary for building a fully interconnected infrastructure with people, machines, factories, products and clients. The resolution system can not only ensure the comprehensive interconnection and efficiency of research and development, procurement, production, sales, and after-sales service in automotive industry, but also promote the integration of automotive industrial data, which facilitates the integrated development of traditional automotive manufacturing and the industrial Internet. This paper focuses on processes and methods of building identifier resolution system for the automotive industry and summarizes the construction and development of secondary node in the automotive industrial Internet in order to explore a suitable road to a rich and completed application ecosystem.

Keywords: industrial Internet; identifier resolution; secondary node; auto industry

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1 Introduction

Gone through mechanization, electrification and automation, the world's industrial communities now move towards a digital, networked and intelligent era, which promotes the rapid development of the industrial Internet in the automotive industry. With the development of the industrial Internet, it is increasingly urgent to develop flexibility, intelligence and informationization in the automotive industry, where different kinds of resources including equipment, parts, products and customers need to be connected to achieve the integrated development of traditional automotive manufacturing and industrial Internet. The construction of identifier resolution system for the industrial Internet has brought a glimmer of light to the development of the automotive industrial Internet.

At present, the Chinese automotive field is facing major opportunities and challenges. On the one hand, under the great pressure of competing with foreign-invested and joint venture car companies, Chinese car companies are in the dilemma of improving quality and controlling costs, lacking of technical improvement and polices of intellectual property protection. On the other hand, Chinese automotive manufacturing industry must figure out ways of making headway in the blue ocean of the industrial Internet and improving the comprehensive competitiveness of products through new technologies in new areas. For instance, the technology of industrial Internet identifier resolution can facilitate a fully interconnected infrastructure with people, machines, products, factories and customers and achieve the full interconnection of industrial elements

such as research and development, procurement, production, and sales, which improves collaboration efficiency and then promotes both horizontal and vertical integration of automotive industry data. With such technological support, Chinese automotive industry would jump to a new level through optimal integration of industrial resources and leading the technological innovation and product development of the automotive industry based on large-scale on-demand customization, open collaborative manufacturing, intelligent production, and targeted service.

2 Challenges in Automotive Industry Internet

In China, the automotive industry is the country's key industry. Its innovative research based on industrial Internet technologies is important but has been faced with many challenges and the efforts for constructing the automotive industrial Internet need more forward-looking and practicable research and application in the industrial Internet. Three major challenges are discussed as follows.

1) Connection of heterogeneous data.

There are a large number of heterogeneous data in the automotive industry, which lack unified standard and have insufficient identifiers and limited data collection. A standard system for multiple protocols is therefore needed to achieve interconnection and interoperability of industrial data. A resolution node in identifier resolution system is used as a link to obtain heterogeneous industry data and translate multi-format identifier data to gain complete data in the industry [6].

2) Optimal allocation of identifier resources.

There are lots of identifier resources in automotive resource information, from product development design to purchase, assembling and after-sales service. In order to connect the whole industry chain, identifier resources need to be processed, analyzed and fed back to industrial manufacturing enterprises. However, it is very difficult to integrate and manage these fragment resources, and the application costs will increase as well. An identifier resolution system for automotive industry which can optimize the allocation of resources by creating the query entry and allocation entry of the automotive Industry Internet.

3) Coordinated development of industrial ecosystem.

The development of the industrial Internet will trigger major reforms in the automotive manufacturing industry and related industries, and as a result, new requirements for the development of the automotive industry will be raised as well. However, as the development of the automotive industry's industrial Internet has just begun, uncertainties and lack of motivation make the industrial ecological development imperfect. The construction of the identifier resolution system will effectively link Chinese next-generation industrial Internet development plan with the scientific and technological innovation plan. It will find the suitable scenarios for industrial Internet operations and services and explore the appropriate development paths of industrial Internet technology for China to speed up future automotive manufacturing and regional economic development.

3 Overview of Identifier Resolution

Used to identify different objects, entities, and industrial Internet objects, the identifier, a character string, can be composed of numbers, letters, symbols and characters with certain rules. The identifier resolution in the traditional Internet translates the domain name identity into an IP address, while in the industrial Internet it translates the physical or virtual digital object identity into object address, and adds a process of querying the association information of item [5]. There are two changes in the industrial Internet identifier resolution technology: first, the granularity is refined from the host to resources such as goods, information and services; second, the function of supporting intelligent association of different hosts, different places and heterogeneous information is set [6].

Similar to the domain name in the Internet, which gives the target object an Identification Code (ID) that can recognize and manage the resources by switching identifier between the physical world and the network world freely, the industrial Internet identifier of the automotive industry is a key resource for identifying and managing complete vehicles, parts and equipment. The resolution of the identifier in automotive industrial Internet gives the ability of looking up the server address, which stores product information through the product's unique ID, or looking up the information and related services of product. Therefore, the resolution of the identifier in automotive industrial Internet is an important basis for realizing the revolution of connecting services and the automotive industrial Internet.

4 Identifier Resolution System in the Automotive Industrial Internet

The identifier resolution system is an important part of the architecture of automotive industrial Internet, as well as a neural hub that supports the interconnection in the industrial Internet. Foton Motor is constructing a secondary node for the identifier resolution system in the industrial Internet and divides the process of identifier resolution into eight steps: 1) identification of identifier objects, 2) formulation of identifier codes, 3) selection of identifier terminals, 4) maintenance of identifier data, 5) assurance of the identifier security, 6) construction of identifier resolution in the secondary node, 7) compilation of the standard identifier resolution system, and 8) development of identifier-based application software.

4.1 Identification of Identifier Objects

The automotive industrial Internet identifiers cover all aspects of the automotive industry value chain. Foton Motor

mainly uses vehicles, parts, organizations and equipment as the major ingredients to construct an identifier resolution system in combination with the condition of Chinese automotive industry management and related standards.

1) Vehicle identifiers.

Vehicle identifiers are mainly related to vehicle research and development, production, sales and maintenance. It includes vehicle model identifiers, vehicle announcement identifiers, Vehicle Identification Number (VIN) identifiers, vehicle configuration list identifiers, vehicle production order identifiers, sales order identifiers, vehicle maintenance order identifiers, and so on.

2) Parts identifiers.

The identifiers of parts are generated through production and maintenance, including parts classification identifiers, single/batch parts identifiers, parts purchase order identifiers, parts production order identifiers, parts logistics order identifiers, parts storage order identifiers, and parts maintenance order identifiers.

3) Equipment category identifiers.

The equipment category identifiers are mainly needed during production, transportation and sales in the automotive industry. They are equipment classification identifiers, equipment identifiers, equipment failure identifiers, equipment function identifiers, and equipment location identifiers.

4) Institution identifiers.

Institution identifiers refer to various types of objects in the ecological value chain of the automotive industry. Generally speaking, institution identifiers include company vehicle manufacturing identifiers, company component manufacturing identifiers, sales enterprise identifiers, and company aftermarket service identifiers. In enterprises, institution identifiers also denote factory identifiers, workshop identifiers, and internal management department identifiers.

5) Quality category identifiers.

Quality category identifiers express the standards and grades of products inspected by the automotive industry, including product inspection standard identifiers, quality grade identifiers, defect cause identifiers, and defect level identifiers.

4.2 Encoding of Identifiers

Encoding is a basic technical means for people to unify their views and exchange information, which improves the efficiency of information processing. Identifier encoding is a technology for defining, assigning and managing the data structure of the encoding format of industrial Internet identity objects. At present, the mainstream encoding technologies include Globe Standard 1 (GS1), Electronic Product Code (EPC), Handle, Object Identifier (OID), Entity Code for Internet of Thing (Ecode), and more [6].

The encoded automotive industrial Internet identifier consists of a prefix and a suffix [4]. The primary and secondary nodes assign the prefix, and the suffix is mainly composed of an application identifier and a unique code. The application identifier is used to distinguish between different identification objects in the automotive industrial Internet. **Table 1** is an example of encoded identifiers from the identifiers resolution system of Foton Moter, where (V) represents the vehicle identifier and (91) denotes the identifier of automotive.

4.3 Selection of Identifier Terminals

The selection of identifier terminals includes the selection of carrying methods and carriers. Existing carriers generally include bar codes, Quick Response (QR) Codes, Radio Frequency Identification (RFID) tags and sensors [5]. The carrying methods generally include nameplates, tags, labels, laser etching and mechanical stamping.

Automotive industry prefers direct marking of identifiers at present. A label and list are used when direct marking is not suitable. If the methods mentioned before do not work well, external packing can come in handy. Thanks to the development of QR code, the automotive industrial Internet identifier terminals currently adopt engraving with QR code and bar code. Laser etching used on key components can be long-term identifiable. RFID is valued in the automotive industry with the development of the industrial Internet.

4.4 Management of Identifier Data

Identifier data is the key parameter information expressed by an identifier object. There are a large number of Original Equipment Manufacturers (OEMs), component manufacturers, distributors and service providers in the automotive industrial Internet, and all of them have their own identifier data based on their data standards. On the one hand, the owner of each identifier needs to register key information in the identifier resolution system that has the function of registration, review and update in order to enable other people to query data. On the other hand, the identifier data need to integrate with heterogeneous industrial Internet application system data due to the diversity of identifier data environment. It is necessary to map identifier data to various types and maintain them in order to strengthen the interoperability of industrial Internet resources in the automotive industry and facilitate the search and discovery of industrial Internet resources between different industrial Internet systems.

4.5 Security of Identifiers

The industrial Internet identifier resolution system is an important network infrastructure of the automotive industrial In-

▼**Table 1. An example of identifier encoding**

Prefix	Separator	Application Identifier	Unique Code
88.107.00001	/	(V)	LRDXXXXXXXXXXXXX
88.107.00001	/	(91)	XXXXXXXX

ternet. The identifier data are important information generated during the production and operation of an enterprise, which need to be protected carefully since it may involve the company's trade secrets and core assets. It is necessary to display different information according to the users' levels and support the secure channel function to prevent sensitive information from interception during the construction of the identifier resolution system.

The construction of the industrial Internet identifier resolution system in the automotive industry is separated into three fields at the security level;

· The software filed security. The rationality of the software architecture and the completeness of relevant protocols are all issues for overall consideration of identifier security;

· The data filed security. It includes security guarantees for the exchange storage of massive data, optimized aggregation management of multi-source heterogeneous data and countermeasures against illegal data use;

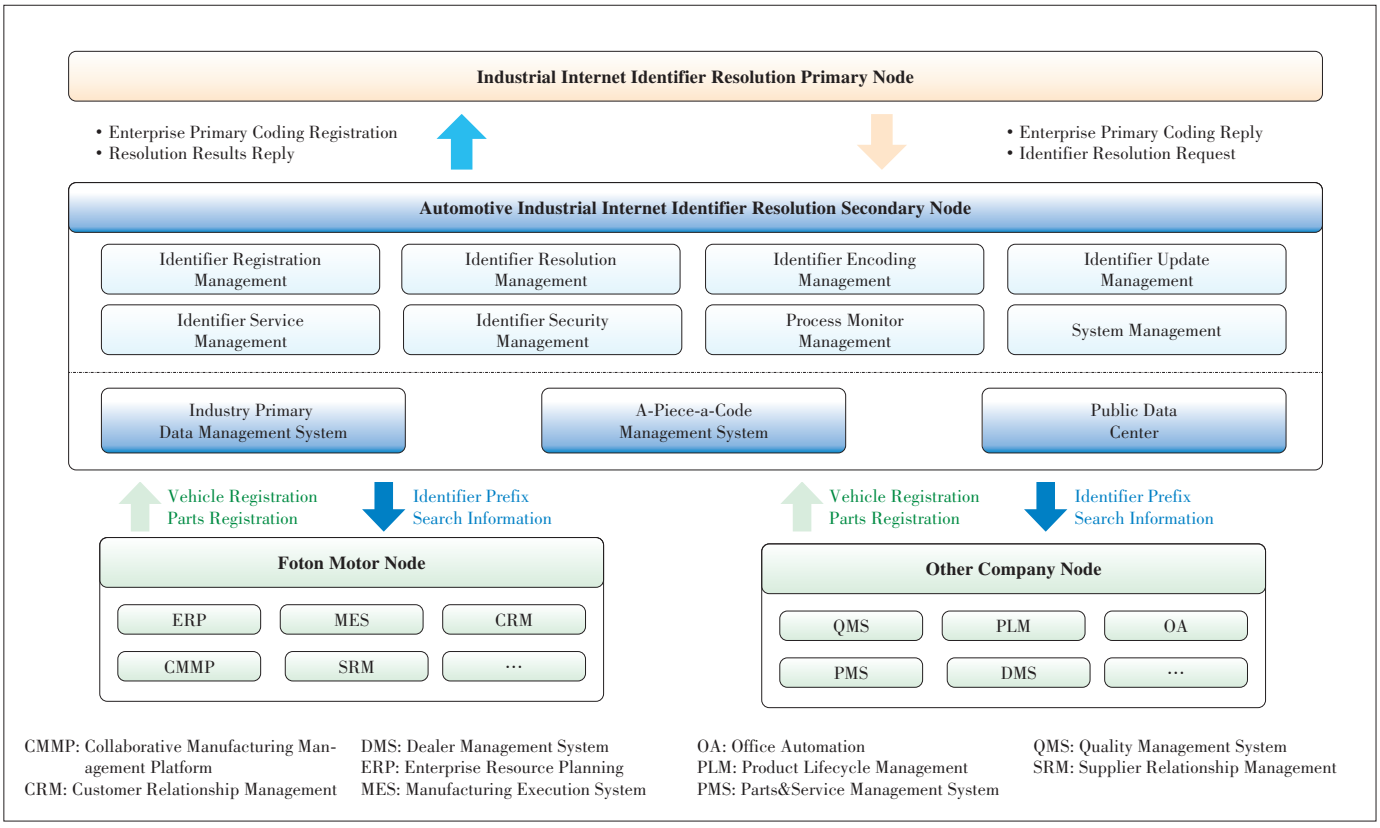
· The operation field security. It would avoid misuse of registration and illegal registration, allocate reasonable identification resources and improve the security of environment for identification management.

4.6 Construction of Secondary Node

The identifier resolution system in automotive industrial Internet secondary node is the core system that implements the registration, query and resolution of identifiers by various application subjects in the automotive industry. Foton Motor has taken the lead in constructing a secondary node for the resolution of the automotive industrial Internet in China. The resolution system supports the registration and resolution of physical resources such as vehicles, equipment and parts, as well as virtual resources such as algorithms and processes. As an industry public service platform, the identifier resolution secondary node in the industrial Internet is linked up to the national primary nodes, which can query the network location of secondary nodes and linked down to the local data or local resolution system of each company in the automotive industry value chain, which can query the enterprise data storage location from the secondary node [1].

The construction of identifier resolution in secondary nodes faces a large number of different hosts, different places and heterogeneous systems due to the complexity and diversity of the industrial Internet environment. The simple resolution of storage location can no longer meet the increasingly sophisticated requirements for industrial Internet data in automotive industry. Therefore, Foton Motor builds the identifier resolution system of secondary node based on the industry master data system, the a-piece-a-code system and a public data center, as shown in **Fig. 1**.

The industry master data system, as a data standard management system, will unify the classification and description



▲**Figure 1. Integration diagram of a secondary node in automotive Industrial Internet identifier resolution.**

of vehicles, parts and accessories in the automotive industry, or solve the problem of "same things with different names" among different enterprises through mapping of backend data. An a-piece-a-code system is used for the unique code management of single piece or single batch in the industry, providing the entire network with unique codes for the entire vehicle and parts. The public data center serves as a shared data storage center that stores the core data registered in secondary node by enterprises so that it can support association and mapping of identifiers. The secondary node built on this basis can analyze the network storage location and associated information of the same identity object. It can provide data support for the development of new business forms and new ecology in the automotive industry as well.

4.7 Standard of Identifier Resolution System

At present, the mainstream identification standard systems include Handle, OID , Ecode, EPC and so on. These systems are used to uniquely mark item objects and digital objects at the first time and provide information query for them. Now they have developed into a low-level information architecture, similar to Domain Name System (DNS) in the Internet [4].

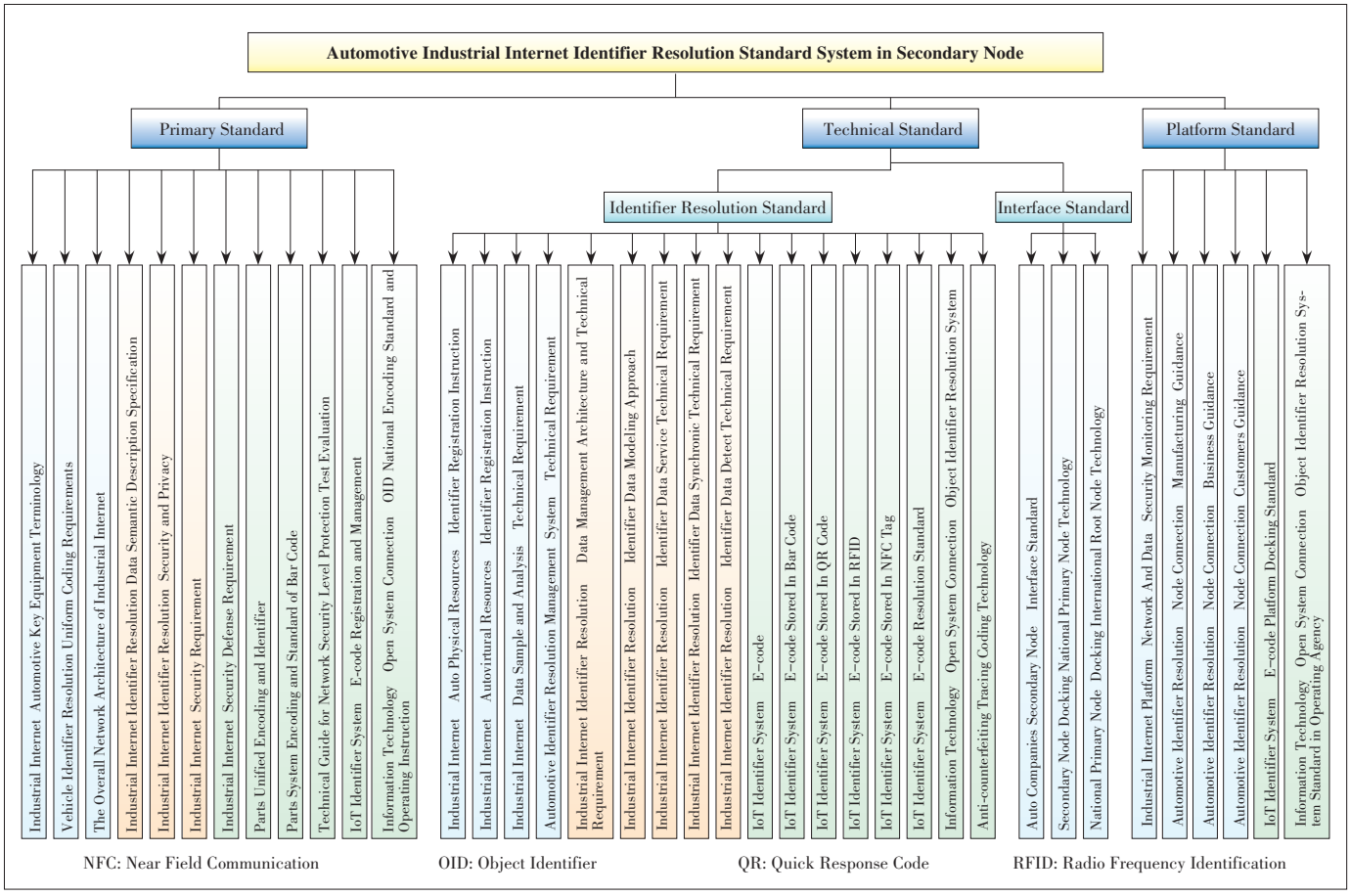
The demands in automotive industry have been fully considered and the research results in other industries have been drawn on while constructing the identifiers resolution standard system in automotive industrial Internet. The resolution system takes technology standards as the main line, identifiers and resolution the core. At present, it is initially composed of three parts: basic standards, technical standards and platform standards, as shown in **Fig. 2**.

1) Primary standards.

The basic standards mainly define automotive production lines, electrical and safety equipment, coding principles, data structures and symbolic representation methods for vehicles, parts and accessories. The standards can achieve data integration across enterprises and regions and provide standard coding rules for OEMs, component manufacturers and distributors.

2) Technical standards.

The technical standards mainly cover three parts. The first is to standardize the registration and resolution principles of identifiers in physical resources including complete vehicles, equipment, parts and components, and in virtual resources including algorithms and processes. Secondly, the technical requirements of the sources of automotive industrial Internet identification data, resolution methods and storage specifica-



▲**Figure 2. Standards for automotive Industrial Internet identifier resolution system.**

tion are standardized. Thirdly, the interface technical requirements are standardized, including data transmission methods and interface methods, to ensure the intelligence, feasibility, advancement and reliability of multi-platform interconnection after the platform is connected.

3) Platform standards.

The platform standards mainly specify the technique for network data security monitoring and privacy protection of the industrial Internet in automotive industry. Operating guidelines are also standardized for OEMs, component manufacturers, dealers and other participants in the construction of the identifiers resolution in industrial Internet.

4.8 Applications Based on Identifiers

The development of the industrial Internet identifier resolution in the automotive industry cannot be separated from the application and promotion of the industry. In the process of constructing the secondary node, Foton Motor focuses on the development of application systems based on the characteristics of the automotive industry such as logo engraving, logo collection and logo query, which provides strong support for the industrial innovation of the automotive industrial Internet.

The development of identifier-based applications and its industrial ecology have gradually improved with the development of industrial Internet applications. In addition, software engineering can get more abundant application scenarios and promote the development of other related software with the development of software ecosystems such as dedicated encoding and decoding software, decoding query software with product information, general coding query software and social and e-commerce portal coding query software.

5 Exploration of Identifier Applications

The construction of the industrial Internet identifier resolution system in the automotive industry is an important basis for the application of the automotive industrial Internet. On the one hand, an identifier database for products, parts and accessories in the automotive industry is established based on the automotive industrial Internet identifier resolution standards, and used as the entrance to the Internet identification query of automotive industry. On the other hand, the entrance to the industrial Internet resource management of the automotive industry is established through the implementation of the new technologies and key equipment in industrial Internet and IT. The big data service platform in automotive industry is established based on the entrance that covers national automotive manufacturers, suppliers, service providers, dealers, customers and other industry agencies.

Foton Motor sets a goal of connecting the internal resources and external services of automotive companies to create higher value for OEMs, suppliers and customers while exploring the development of industrial Internet applications. Foton Motor uses the industrial Internet identifier resolution platform as the basis to open up all aspects of resources in the commercial vehicle industry chain and the value chain of OEMs, in order to build a complete industrial Internet service system for the automotive industry. Foton Motor actively carries out explorations and applications in supply chain coordination, quality traceability, accurate service and other aspects, as shown in **Fig. 3**.

5.1 Supply Chain Collaboration Based on Identifiers

Collaborative management of the supply chain is an interconnected ecosystem covering the entire value chain of planning, procurement, supply, logistics, warehousing, quality, transportation, sales and service. Network storage location codes are assigned to the entire vehicle, parts, suppliers, equipment and tooling equipment with the help of the identifier resolution platform in automotive industrial Internet. In order to build a good basic environment for supply chain collaboration, the location codes are combined with their own unique codes in their respective systems to ensure that each participating interconnected data has unique identification information.

Taking customer needs as the starting point and based on a unified identifier resolution service, companies link physical objects such as complete vehicles, production parts and spare parts in the supply chain in implementation. Companies also exam the weak points of supply chain management in order to build a collaborative and efficient supply chain collaborative management system.

In the supply chain collaborative application scenario in automotive industry, the specific application process of using identifier resolution are as follows (**Fig. 4**):

• Step 1: The identifier of a collaborative resource is encoded.

• Step 2: The above resource is registered in the identifier resolution system.

• Step 3: In the product design phase, the R&D department designs products based on the same identifier.

• Step 4: The procurement department's design requirements for R&D are communicated to the supplier in time.

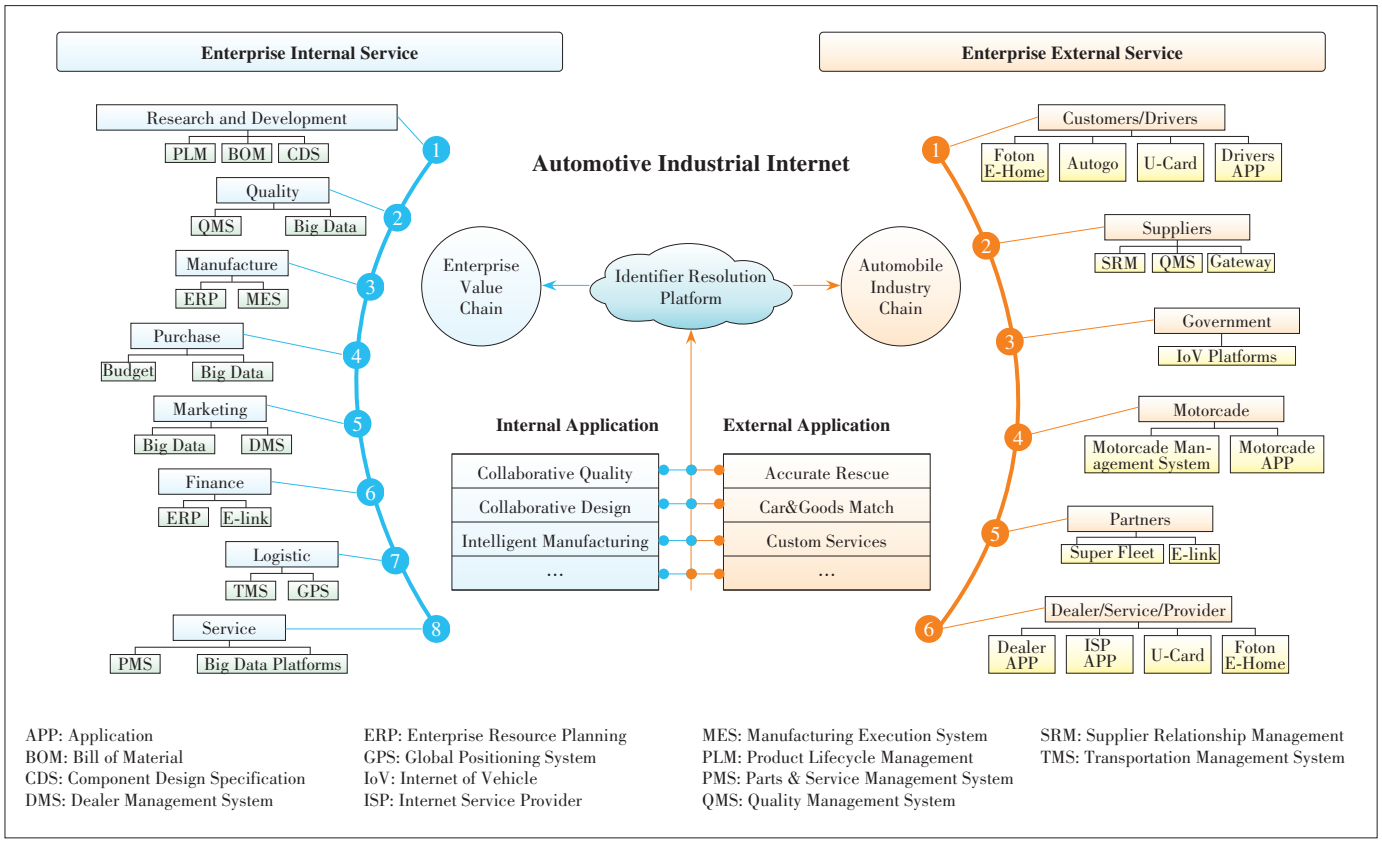
• Step 5: The supplier obtains the R&D requirements based on the unified identifiers and promptly gives feedback.

• Step 6: The logistics company gives timely feedback about the logistics status of the product based on the unified identifiers.

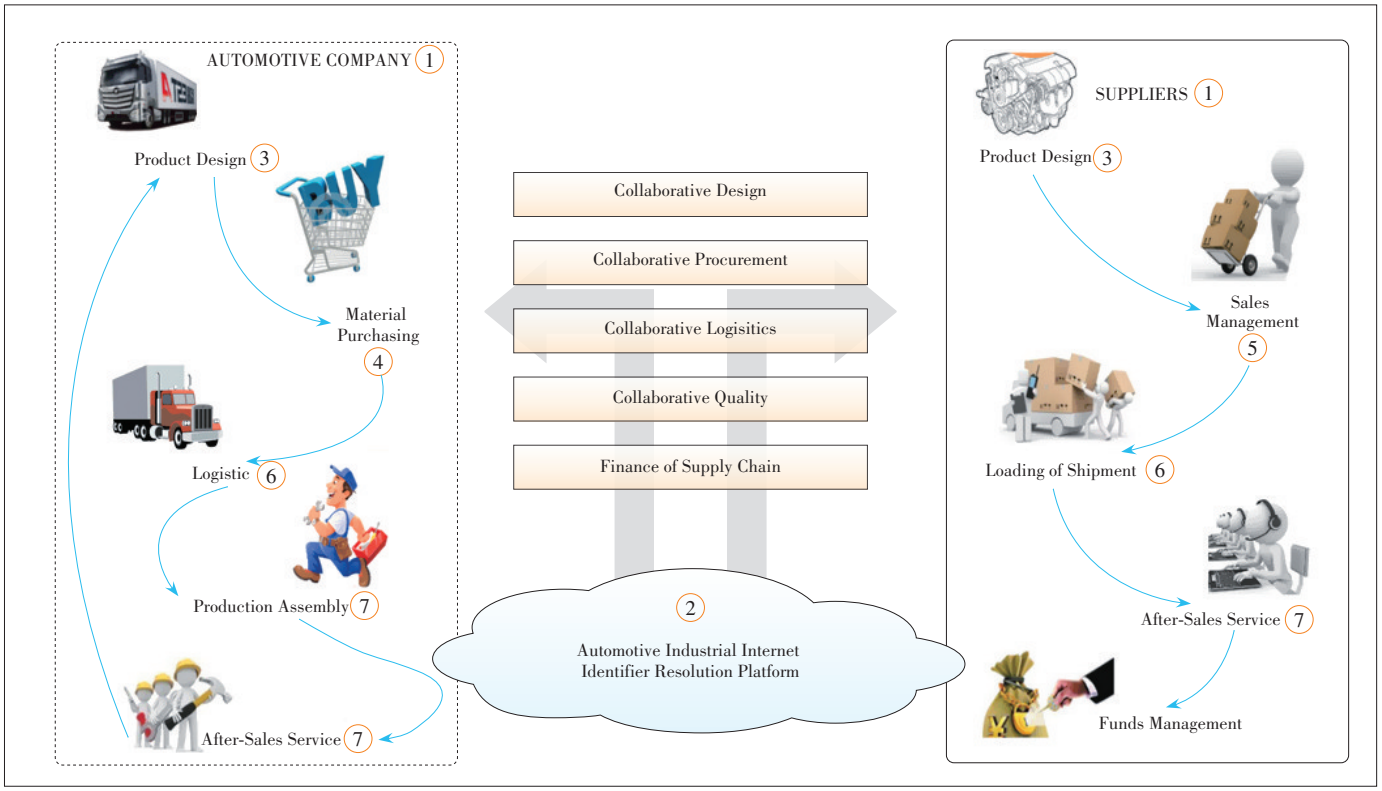
• Step 7: Based on the unified identifiers, the quality department reports the quality inspection information to the R&D department and suppliers.

Compared with traditional supply chain management, the supply chain management based on identifier resolution is improved in the following five areas.

The collaborative design shortens the development cycle. Through the identifier resolution technology, the research and development resources are fully shared in the industrial Inter-



▲Figure 3. Explorations on the innovative applications of the automotive industrial Internet identifier.



▲Figure 4. Supply chain collaboration based on identifier resolution.

net field and it becomes possible for suppliers and dealers to participate in the design and evaluation of vehicle products. The synchronous and collaborative development situation are formed and the development cycle is shorter.

The collaborative procurement lowers the risk of material shortage. Through the industrial Internet identifier resolution technology, OEMs and suppliers can obtain real-time dynamic information of customer orders, inventory levels and purchase orders, which will reduce the risk of material shortage.

The logistics collaboration reduces logistics costs. OEMs and supplier can obtain the logistics information if the vehicle logistics information and cargo information are registered in the identifier resolution system in time. The vehicle efficiency will improve and transportation cost will reduce due to the collection of the cargo flow.

The quality collaboration improves supplier capabilities. Service providers and customers can register the collected quality problems in the identifier resolution system while using the vehicle, and then suppliers can obtain quality feedback in time and optimize the design and improve the quality of supplier parts.

The finance of the supply chain. The identifier resolution technology can obtain the real-time location and maintenance information of the vehicle combined with the Internet of Vehicle that provides financial guarantees for partners and expands the business of assistant partners.

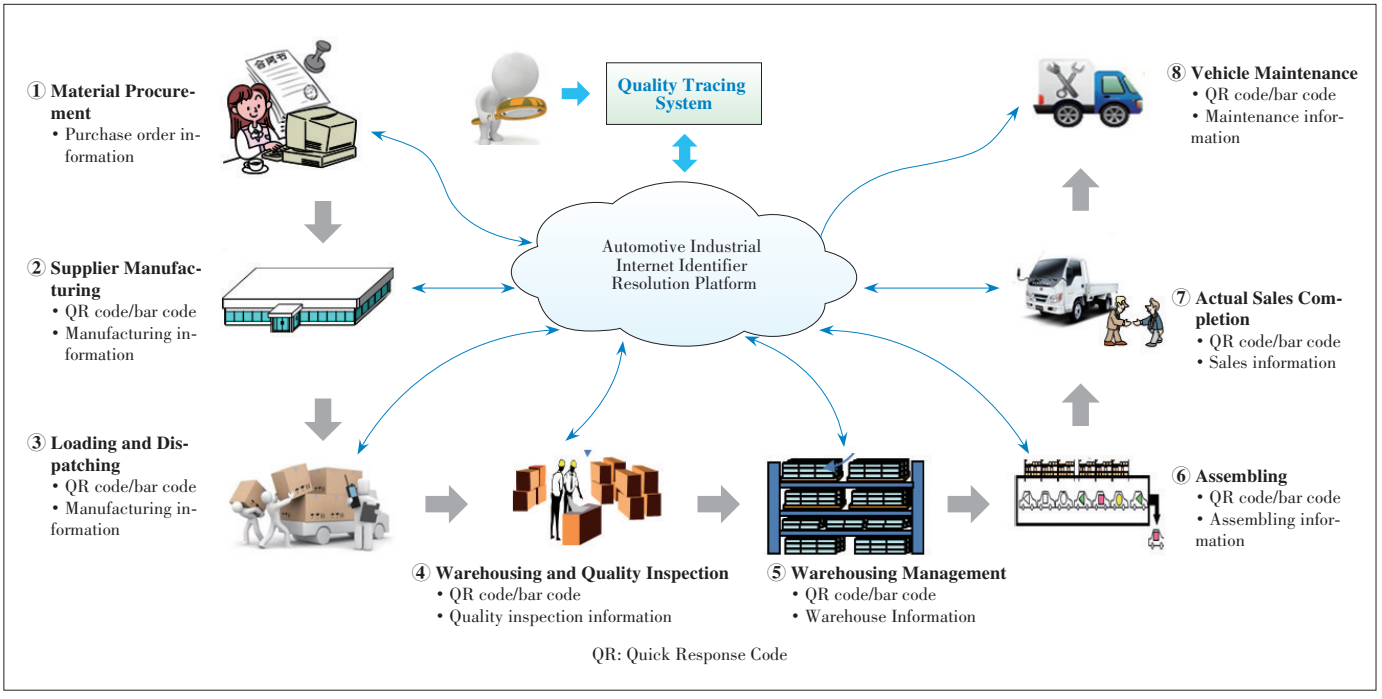
5.2 Quality Traceability Based on Identifier Resolution

With the help of the automotive industrial Internet identifier resolution standard and the application platform, a quality traceability coding standard that complies with the automotive industry standards is established. It makes coding rules of raw materials, semi-finished products and finished products traceable. On the one hand, automotive companies use the same traceability code rules to implement quality traceability management in order to improve the readability of the code and reduce the cost pressure of parts traceability on the automotive industry supply chain. On the other hand, the resolution system collects quality data for the entire life cycle of core components from manufacturing, transportation, quality inspection, storage, assembly of complete vehicles, terminal sales, maintenance services, replacement, and retirement to recycling, so that the product quality of companies can be optimized and improved [2].

The quality traceability of key components in the automotive industry needs to accurately record the correspondence between the vehicle and the components during the assembly process of vehicles. Besides, it should accurately record the information of vehicle dealers and customers during the vehicle sales process and the replacement of parts in the after-sales service. The vehicle manufacturer can quickly determine which vehicles the problematic parts are installed on, which areas these vehicles are sent to and which end users are sold to through this way. If end users need to repair or replace parts, they can know where the nearest service outlet is.

In the application scenario of quality tracing of automotive key components, the specific application process of using identifier resolution is as follows (**Fig. 5**):

• Step 1: Suppliers encode the key components of the car with QR code, bar code or RFID and register them in the iden-



▲**Figure 5. Quality tracing based on identifier resolution.**

tifier resolution system.

• Step 2: According to the coding identifier, the OEM records product information such as storage, quality inspection, warehousing and assembling and registers related information in the identifier resolution system.

• Step 3: The OEM marks the entire vehicle with an identifier, then records the correspondence between the vehicle and the components, and finally registers the vehicle identifier in the identifier resolution system.

• Step 4: When the vehicle is sold to the customer, the dealer binds the customer's information (name, age, occupation, purpose, etc.) with the vehicle information and registers the information in the identifier resolution system.

• Step 5: The service provider obtains the production, logistics, quality inspection and other information of the parts and records the replacement information of the old and new parts by scanning the QR code of the parts during the maintenance.

5.3 Intelligent Production Based on Identifier Resolution

Customer needs, product resources, production materials, logistics transportation and other information related to production are registered for the identifier resolution system in the manufacturing process in the industrial Internet ecology of the automotive industry in order to lay the foundation of intelligent production. The process mainly includes the following steps (**Fig. 6**):

• Step 1: Registration of customer identifier order. Customers complete product customization in the Dealer Management System (DMS) and get an order number, then the system automatically registers the order information in the identifier resolution system.

• Step 2: The product design department obtains the information about the specific model and configuration involved in the order according to the order identifier and registers the designed product Bill of Material (BOM), parts and other identifier to the identifier resolution system.

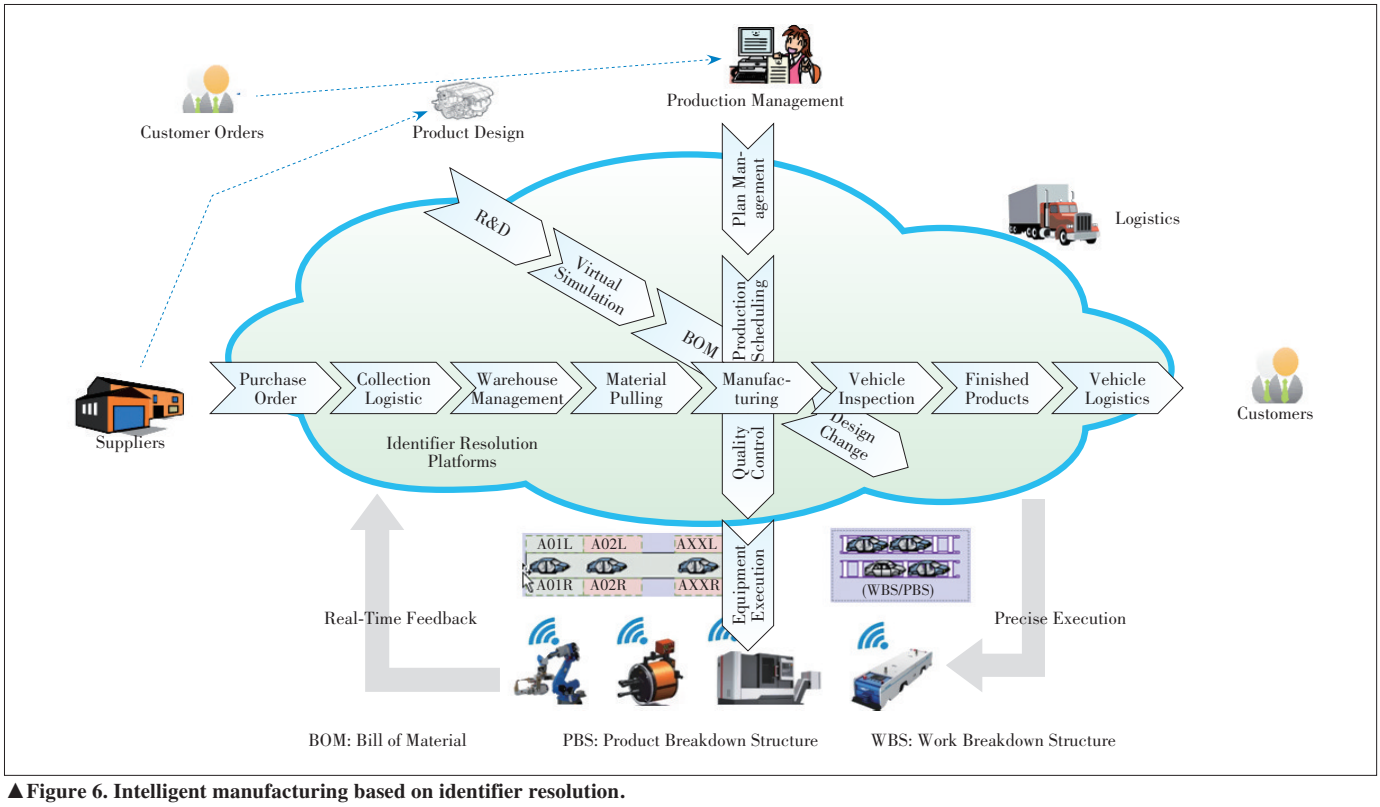
• Step 3: Purchasing and production management departments formulate purchase requisitions, production orders and production plans and register the purchase order and production plan information in the identifier resolution system.

• Step 4: The supplier obtains the material specific information and order date required by the purchase order through the identifier resolution system and then starts the production order.

• Step 5: The logistics company obtains information such as the specific delivery date and quantity of parts according to the production order identifier and purchase order identifier and transports the materials to the warehouse where the production is located.

• Step 6: According to the order identifier, material identifier and equipment identifier, the production department obtains the resource information required by customers and production and translates it into job instructions to guide the equipment to execute accurately. At the same time, the equipment reports the processing results in time, and the execution result is registered in the identifier resolution system.

• Step 7: Through the identifier resolution system, custom-



▲**Figure 6. Intelligent manufacturing based on identifier resolution.**

ers can get the specific production process of their customized products in time.

5.4 Service Innovation Based on Identifier Resolution

An intelligent service system based on the industrial Internet identifier resolution system is established by creating an intelligent and differentiated customer service system. It can promote information interconnection between the product end and the client and upgrade the traditional after-sales service to active services, remote online services and intelligent services [3].

In the traditional vehicle after-sales service, the vehicle's operating status data cannot be grasped immediately. The service engineer cannot get the fault information at the first time when the vehicle has a problem, and can only diagnose and maintain on the spot. This situation makes the vehicle service passive. The vehicle production data, product data and customer data are registered in the industrial Internet identifier resolution system based on the industrial Internet big data platform, which can grasp the running status of the vehicle at any time, predict the possible faults of the vehicle and timely detect the damaged parts of the vehicle for customers. Fault reminders, maintenance reminders and driving behavior guidance can be provided through this, as shown in **Fig. 7**.

1) Fault reminder.

We can connect vehicle production and assembly data, customer sales data and real-time data during product operation through the industrial Internet identifier resolution system and then establish a big data analysis model to monitor the performance indicators and damage levels of key vehicle components effectively. Besides, we can use short messaging service (SMS), applications (APP) and cars to push message reminders automatically and communicate with customers on the phone in time according to the fault level. If a customer raises a problem, we should ask him if there is a problem with the vehicle on the phone and immediately send related staff to solve the problem so that the expansion of the fault will avoid and it makes the vehicle operation economic and safety.

2) Maintenance reminder.

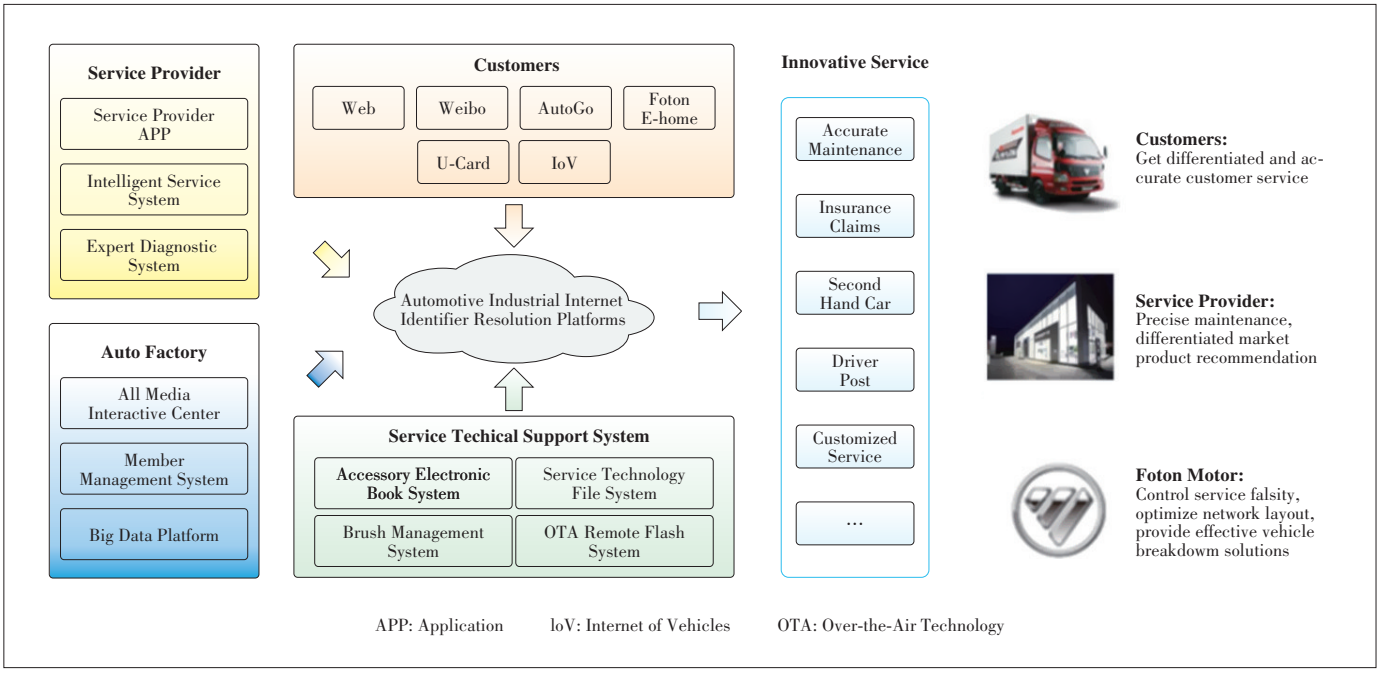
The travelled distance and vehicle operating condition information are registered in the identifier resolution system through the combination with the Internet of Vehicles. When the vehicle needs upkeep, the maintenance invitation will be sent through APP and SMS so as not to affect the service life of the vehicle due to improper maintenance. This will save maintenance costs, improve driving safety for customers, bring profits to service stations, reduce the failure rate, and increase the company's brand reputation at the same time.

3) Driving behavior guidance.

Big data generated in the operation of the vehicle in back end like vehicle's gear, speed, fuel consumption and other operating data, is used to analyzing the customer's driving behavior in order to provide driving behavior guidance to customers. Good driving habits to a certain extent will prolong the service life of the vehicle and reduce the failure rate of the vehicle.

6 Conclusions

The identifier resolution system is set up to standardize the



▲**Figure 7. Service innovation based on identifier resolution.**

registration and application process of the automotive industrial Internet identifier through the implementation of new technologies and key equipment of the industrial Internet and IT. Foton Motor is operating a secondary node of the industrial Internet in China, led by the Ministry of Industry and Information Technology of People's Republic of China. It has applied the identifier resolution system to the automotive industry on manufacturing, marketing and after-sales services.

In order to provide a large number of accurate identifier resolution data to support the development of the automotive industry, we should greatly improve the quantity of equipment identifiers, product identifiers and resource identifiers in the automotive industry. The industry ecology of automotive industrial Internet based on the identifier resolution system should be built at the same time. The ecology may achieve continuous innovation from the three aspects of the enterprise, the car ecology and the car life. Besides, customers should be provided with ecological services; in this way, customer loyalty is expected to be enhanced, influence of products and companies to be expanded, and industry upgrading to be promoted.

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LIU Xinwei received her B. Sc. from Huazhong University of Science and Technology, China in 2017. Now she is a graduate student in School of Electronics and Computer Engineering, Peking University, China. Her research interests include computer network architecture and named data networking.