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# Analysis of the Status Quo of China's Vehicle Operating System

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## Abstract

**With the continuous development of in-vehicle communication technology, as the terminal of the intelligent transportation system, the in-vehicle operating system is developing in the direction of multi-function, intelligence and networking, and has been widely used in automobiles. However, the current vehicle operating system in my country still has problems such as shortcomings in basic software, low system intelligence, and fragmentation of system layout. In response to these problems, targeted suggestions are put forward to help the healthy development of vehicle operating systems.**

## Keywords

**Vehicle Operating System; Problems; Countermeasure.**

## 1. Introduction

At present, the in-vehicle operating system is widely popularized, and the Internet + ecology is gradually maturing. Therefore, multi-functional IoV applications and services are continuously catalyzed and derived to meet the increasing driving needs of users. The initial version of the in-vehicle operating system was a traditional old-fashioned in-vehicle tape drive. Later, the WinCE in-vehicle system integrated with map navigation was launched. Today, it is an intelligent system integrating safety, convenience and entertainment. Users have already felt the convenience and beauty brought by the in-vehicle operating system, and today's in-vehicle operating system has become the standard configuration of automotive systems.

In October 2020, the "New Energy Vehicle Industry Development Plan (2021-2035)" clarified the technical direction related to intelligence, mainly including key technological breakthroughs such as automotive-grade chips, automotive operating systems, and new electronic and electrical architectures. Under the development trend of software-defined vehicles, the status of automotive operating systems will be particularly important.

## 2. Development Status of In-vehicle Operating System

### 2.1 Development Status of Foreign In-vehicle Operating Systems

As we all know, foreign countries have started research on computer technology, automotive electronics technology and communication technology very early, and the development of vehicle operating systems is also relatively advanced. The research on in-vehicle operating system originated in Japan and European and American countries, and has achieved excellent development results with its basic advantages in automotive technology and strong R&D investment.

At the beginning of the 20th century, the founder of Ericsson invented the first car phone, which opened the milestone of in-vehicle operating system. In the 1920s, the first Chevrolet car radio was born in the United States, which was an important step in the history of the development of car operating terminals. Since then, the in-vehicle operating system is no longer just a steering wheel and

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pedals. The control panel began to have more and more rich functions. In the 1990s, the application of GPS technology began to shift from the military field to the civilian field. At the same time, the navigation technology was continuously promoted. The US government launched the world's first autonomous navigation system, TravTek, in 1994. After the 21st century, with the vigorous development of the mobile Internet industry, the vehicle operating system has undergone earth-shaking changes. In 2014, Google released Android Auto and Apple released CarPlay, bringing the development of in-car operating systems to a new stage. On the one hand, in-vehicle applications are more abundant, the network is online, and personalized applications can be downloaded at will; on the other hand, the interaction mode is simplified, multi-touch screen and voice recognition replace buttons and dials, and the interaction between people and vehicles becomes intelligent. In 2016, Chevrolet announced that its new car will be fully adapted to the in-vehicle systems of two different platforms, Android Auto and Apple CarPlay.

At present, the foreign vehicle operating systems include instrument display system, car navigation and global positioning system (GPS), car wireless communication technology (GSM), voice prompt and alarm system, car geographic information system (GIS), car entertainment audio-visual system, etc. It is a multifunctional system. However, its various systems belong to independent control units and are not integrated into a whole. In the development and interaction of in-vehicle operating systems, major auto companies and Internet companies are also gradually participating in the wave of the Internet of Vehicles industry.

### 2.2 The Development Layout of In-vehicle Operating System is Gradually Carried Out in China

After entering the domestic market, the automotive operating system has been quickly recognized and sought after by consumers. The huge market prospect has stimulated a large number of developers to invest, and the automotive operating system has embarked on a road of rapid development.

In the early stage of development, the WinCE operating system accounted for 80% of the domestic vehicle market, and the vehicle operating system with GPS navigation and multimedia functions was popular.However, due to the limitations of the WinCE system itself, and the lack of innovation in the later development, different on-board operation products have roughly the same functions, so the development speed is hindered.With the launch of the Android operating system, its code is open source and highly scalable, which has driven a large number of developers to invest in research, domestic Internet giants have begun to deploy vehicle networking strategies, and a large number of foreign in-vehicle operating devices have penetrated into China.Represented by CarLife launched by Baidu, on the one hand, it can obtain the driving status of the car, such as the fuel level of the car, the status of the taillights, the condition of the wipers, and the running status of the tires. On the other hand, it can be combined with intelligent voice recognition, Baidu search, map LBS, etc. , and the combination of online and offline to meet the needs of users for mobile office, shopping and so on in the car. More new technologies and new products have emerged in the field of in-vehicle operating systems, and more interactive forms have emerged as the times require, and in-vehicle operating systems have become comprehensively intelligent.

A large number of applications can be downloaded and installed at will, realizing highly intelligent human-vehicle interaction combined with voice, images, etc., integrating safety, intelligence, convenience and entertainment.

## 3. Problems Existing in China's In-vehicle Operating System

### 3.1 There are Shortcomings in the Basic Software Layer

For a long time, China's software industry has developed slowly. From mobile phone systems to vehicle operating systems, open source software developed in the United States has been used, and a virtuous circle of basic software development ecology has not been formed. At present, QNX accounts for the largest share of the global in-vehicle operating system, followed by Linux and

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WinCE. However, WinCE has stopped updating and has gradually withdrawn from the vehicle operating system market. The market share of Linux, Android and other systems has further increased, becoming the mainstream operating system in China. However, the central server of the Apache Software Foundation is located in the United States and is subject to the jurisdiction of US export laws and regulations. The Linux kernel distribution server and the git repository server are also located in the United States. Therefore, there are certain political and economic risks. When the world fluctuates violently or major political events occur, there may be immeasurable losses.

### 3.2 The Degree of System Intelligence is Not High Enough

The domestic software industry started late, most of the key software technologies are in the hands of foreign multinational companies, and there are certain technical barriers. At present, most domestic vehicle operating systems can realize functions such as audio-visual entertainment, Bluetooth phone, mobile phone interconnection, etc. However, due to the lack of support for large-capacity ultra-high-speed communication networks, it is difficult to realize real-time information exchange between vehicles and vehicles and between vehicles and roads. It is difficult to participate in the construction of the Internet of Vehicles and the Internet of Roads, that is, it does not have the characteristics of "networking". Without real-time interconnection with the outside world, it is impossible to judge the surrounding driving environment, and it is impossible to talk about unmanned and automated driving functions.

### 3.3 The System Layout is Fragmented

At present, the domestic automotive electronics industry has made great progress. The operation and interaction environment of the car cockpit is mainly composed of functional partitions such as LCD instrumentation, central control display system, HUD, and driving recorder. Drivers obtain driving information through these systems. However, these domestic systems are relatively independent at present. They are responsible for different functions and present a fragmented layout. This complex fragmented layout can easily distract car users, which may lead to driving accidents. Since many functions of traditional in-vehicle systems require special dedicated chips to implement, and automotive-grade chips have higher requirements for computing power, processing power and security, this requires large-scale R&D investment by vehicle companies.

At the same time, it is not easy for users and car companies to add new functions to the existing in-vehicle system, and it is difficult to ensure its smooth operation for a long time.

### 3.4 Frequent Occurrence of Vehicle Application Problems

At present, many domestic vehicle companies have experienced problems with in-vehicle applications, and the frequency of problems is very high, which affects the user experience very intuitively. In the whole process of vehicle application from research and development to vehicle application, the application developer first develops the application, the component manufacturer conducts the integration test of the application and IVI, and then the vehicle manufacturer conducts the acceptance test. If the test is qualified, it can be assembled and put into mass production. In this process, for application developers, since many application software is now developed for mobile phones, the IVI system itself is more complicated than the mobile phone system, so problems are prone to occur during the use of the application software. For component manufacturers, most component manufacturers currently use manual testing. There are many defects in manual testing, such as low accuracy, high testing cost, long iterative testing cycle, and low efficiency associated with testing and R&D. Finally, for OEMs, some automakers are unable to conduct acceptance tests and rely heavily on the test reports provided by IVI manufacturers, and the test results are not notarized by a third party.

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# 4. Countermeasures and Suggestions

## 4.1 Break Through Key Technologies and Avoid Being Controlled by Others

Domestic in-vehicle operating systems should continue to attach importance to innovation, increase investment in research and development, strive to achieve breakthroughs in core technologies, and avoid being controlled by others, thus posing a threat to my country's information security. Specifically, at the government level, the Chinese government should continue to support the R&D and innovation of automobile companies in the form of industrial funds, and drive local governments to continue to pay attention to the field of in-vehicle operating systems to attract private capital investment. At the same time, in-depth exchanges with automobile powerhouses should be strengthened, and advanced technologies should be learned and fully digested and re-innovated. At the enterprise level, domestic leading auto companies have strong financial support and scientific research capabilities. They should give full play to their own advantages, attach importance to R&D innovation, strengthen technical exchanges with other small and medium-sized enterprises, improve the development speed of the industry, and further promote the healthy development of the field of in-vehicle operating systems.

## 4.2 Realize Overtaking on Curves Through 5G Applications

The 5G network has obvious advantages in terms of transmission speed, bandwidth capacity, and network delay. Domestic 5G commercialization is at the world's leading level, Chinese manufacturers lead developed countries such as Europe and the United States in the number of necessary standard patents for 5G. Huawei has performed well and is an important promoter of the current 5G technology development. 5G technology can realize massive data exchange, which will provide strong basic support for the construction of intelligent transportation system. The new generation of in-vehicle operating systems must actively ride on the express train of 5G technology, be compatible with a variety of intelligent sensors, and use multi-core and multi-threaded in-vehicle chips to realize functions including intelligent decision-making, automatic driving, automatic risk avoidance, and automatic addressing optimization. At the same time, it is necessary to combine emerging ICT technologies such as big data and artificial intelligence to become digital, modular and intelligent.

## 4.3 Improve System Layout and Promote Diverse Integration

Actively explore the multi-integrated development of the car cockpit, and realize multiple systems and applications driven by one chip. With the improvement of embedded processor performance and the demand for multi-screen interaction, the solution of one processor with multiple displays will become a new development direction of the vehicle operating system. The simple and fast interactive form and efficient and obvious information display will improve the good driving experience and ensure the driving safety. From the technical level, due to the promotion of artificial intelligence (AI), virtual reality, assisted driving (ADAS) and other technologies in the new technology era, as well as the improvement of innovation in emerging industries. In the future, the smart cockpit may realize multi-screen integration of instrument screen, central control screen, rearview mirror, driving recorder, etc. It can truly achieve real-time data interaction and sharing, and such an in-vehicle system will bring great convenience to consumers.

## 4.4 Deploy Automated Testing of In-vehicle Applications and Promote the Issuance of Standards

To solve the problems existing in traditional manual testing, the industry needs to actively deploy automated testing of in-vehicle applications, and improve the automation of in-vehicle application software functional testing, performance testing, iterative testing, and compatibility testing. The industry can jointly build a platform to conduct research on in-vehicle application test evaluation procedures, in-vehicle application test tests, and research on key technologies of in-vehicle application testing, so as to improve test efficiency, reduce test costs, and improve the efficiency of R&D personnel and testers. At the same time, the industry level should also actively promote the

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issuance of relevant standards to promote the healthy and sound development of in-vehicle application systems.

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