HUAWEI HiCar

Ecosystem White Paper

Issue	**1.0**
Date	**2020-11-18**

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Contents

1 Overview

This document describes the industry background, user value, basic functions, framework, technical points, and capability openness plan of HUAWEI HiCar, providing reference for app developers and vehicle hardware developers.

2 Industry Background

In recent years, with the increasing demand for new energy vehicles and the emergence of technologies such as 5G, cloud computing, Internet of Things (IoT), and self-driving, the In-Vehicle Infotainment (IVI) system is becoming software-oriented, and the in-vehicle content, services, and experience are becoming digital, networked, and open. Diverse and closed vehicle operating systems are on the verge of break-up, and the vehicle cockpit industry is also facing unprecedented changes. Against this backdrop, the industry calls for collaborative efforts from automobile manufacturers, mobile communications operators, device manufacturers, academia, and hardware/software service providers.

In a cockpit environment, mobile devices (mobile phones) and vehicles (head units) are more connected than ever. Vehicles are now equipped with multiple displays (such as the center console, vehicle instrument panel, and head-up display (HUD)), better audio input and output devices (such as microphones and speakers), convenient reverse control input capabilities such as direction control buttons, and high-precision vehicle data. However, the computing capabilities of vehicle control hardware are updated relatively infrequently, and there are not enough car apps and services. On the contrary, mobile phones enjoy the latest hardware platform capabilities (chip-level AI capabilities), software platforms, and high-speed mobile data network connectivity, as well as various user-facing apps and services.

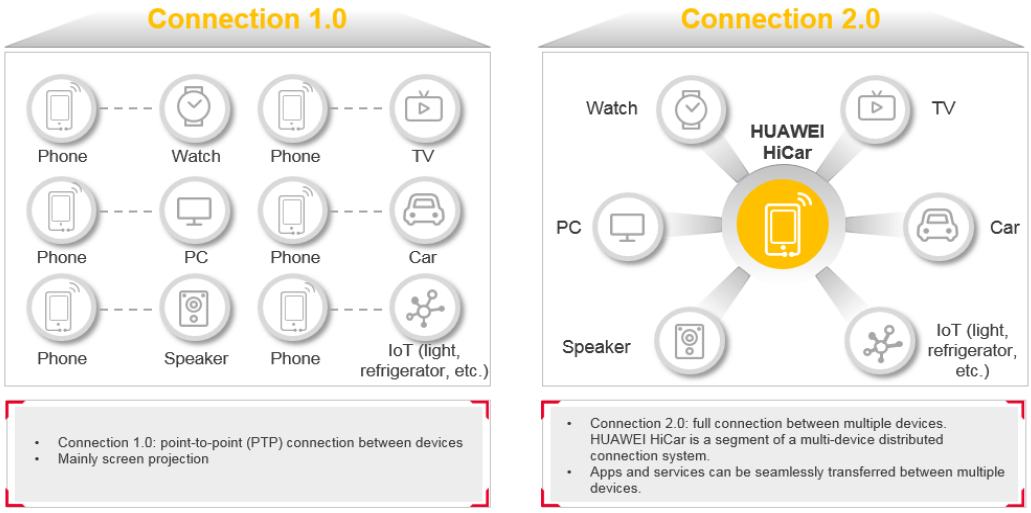
From consumers' point of view, vehicles should provide more smart mobile capabilities in addition to basic vehicular performance. Therefore, a brand new challenge is proposed, that is, how to gradually transform the vehicle cockpit into a smart space that integrates home, entertainment, work, and social activities, forming a new relationship between people and vehicles and bringing new experiences to consumers.

3 General Introduction

3.1 Solution Overview

Traditionally, the connection between mobile phones and head units mainly lies in the projection function, which is Connection 1.0. HUAWEI HiCar implements Connection 2.0, which not only establishes channels between mobile phones and head units but also extends mobile phone apps and services to cars, enabling full connections between cars and mobile phones as well as other IoT devices.

Figure 3-1 Smart connection 2.0 implemented by HUAWEI HiCar



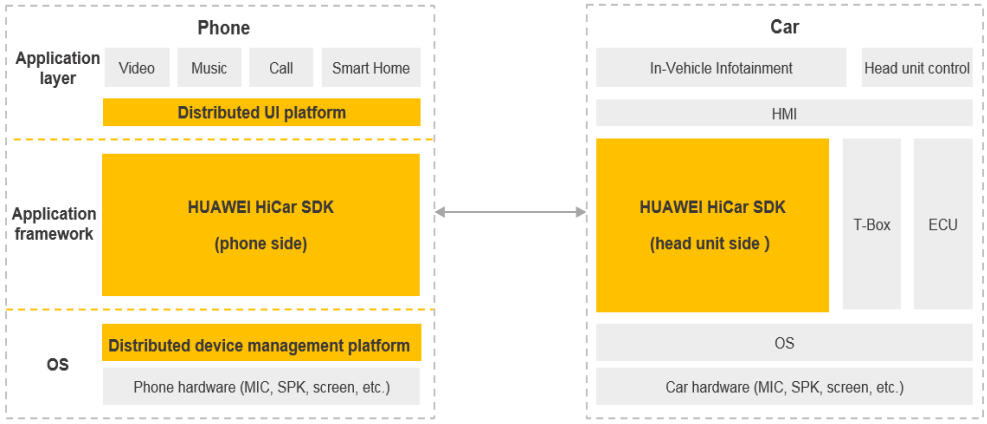
HUAWEI HiCar is a smart and all-scenario people-car-home connection solution provided by Huawei. It connects mobile devices to cars and builds channels between mobile phones and cars based on the strengths of cars and mobile devices and multi-device connection

capabilities to extend mobile phone apps and services to cars, realizing device-centered, all-scenario experience and creating the best smart traveling experience for consumers.

- With a mobile phone in hand, consumers are able to enjoy a consistent experience when moving between locations such as from home into a car.
- The hardware resources, system capabilities, and service ecosystems of mobile phones and cars are quickly integrated, making users feel that all devices function as one virtual super device.

3.2 Technical Architecture

Figure 3-2 Technical architecture of HUAWEI HiCar



4S: Safety; Smart Connection; Seamless Experience; Resource Sharing

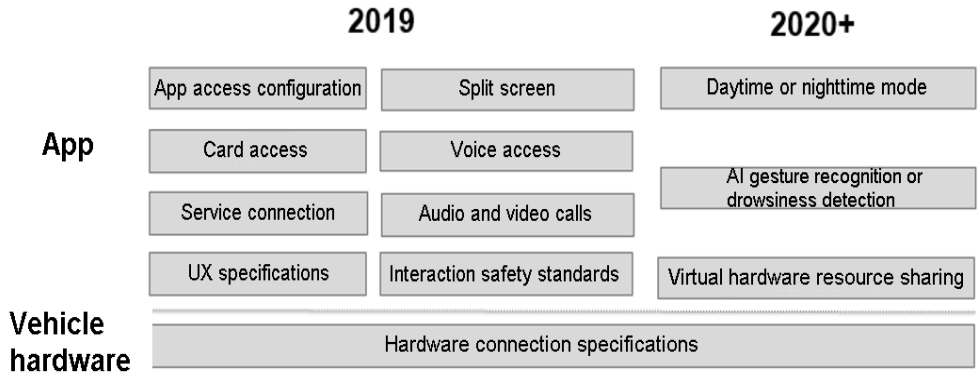
- **Safety:** Consider travel safety as the most basic need. Embed safety interaction genes into interaction design standards and technical implementation, and provide active safety capabilities such as abnormal driver behavior detection.
- **Smart Connection:** High-speed and simplified connections. Divert mobile phone users to cars.
- **Seamless Experience:** Consistent experience inside and outside cars based on the distributed core platform capabilities. Consumers can enjoy services and do not need to know the service providers. For example, the music played on a mobile phone can be seamlessly transferred into a head unit when a user moves into a car because the mobile phone is automatically connected to the car. Then, the music is output through the speaker in the car. This seamless experience is implemented by seamless switchover of apps and services among multiple devices in different scenarios.
- **Resource Sharing:** Hardware mutual-assistance, for example, sharing of AI computing capabilities on mobile phones. Antennas of cars are combined with communication capabilities of mobile phones. The GPS data of both head units and mobile phones is used to achieve more precise navigation. During voice interaction, mobile phones and head units can complement each other in voice wake-up and speech recognition capabilities, achieving better results beyond the capacity of a single device.

3.3 Open Capability Roadmap

Huawei focuses on building the HUAWEI HiCar open platform and opens capabilities to automobile manufacturers, tier 1 suppliers, and app developers to boost innovation and create an ecosystem that enables people-car-home smart life experience.

The following figure shows the HUAWEI HiCar open capability roadmap.

Figure 3-3 Open capability roadmap of HUAWEI HiCar



4 Benefits

The HUAWEI HiCar solution aims to provide efficient solutions for IVI upgrade, provide developers with value-added innovation spaces, and provide consumers with all-scenario experiences.

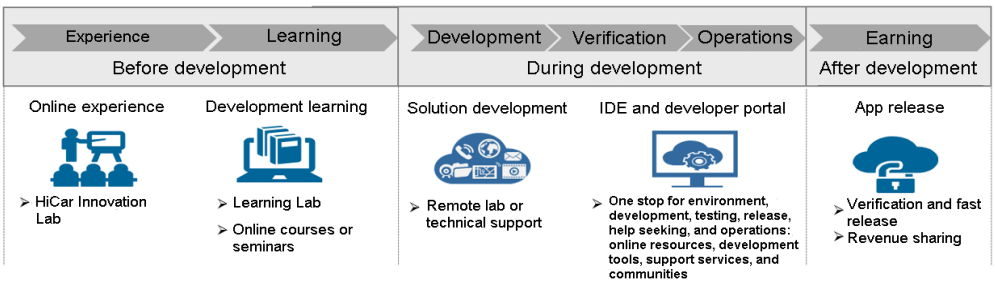
- **For consumers**: Based on Huawei's cross-device distributed capabilities, HUAWEI HiCar establishes a high-speed connection channel between mobile phones and head units, quickly integrates the hardware resources, system capabilities, and service ecosystems of mobile phones and cars, making users feel that all devices function as one virtual super device.

  In addition, Huawei's distributed platform capabilities closely link travel scenarios with other scenarios (such as office and home), achieve optimal experience through cross-device collaboration, and build a smart cockpit service system for all scenarios.

- **For automobile manufacturers and tier 1 suppliers**: Using HUAWEI HiCar, automobile manufacturers can obtain the computing power of peripherals such as mobile phones and mobile Internet ecosystem services at low costs. This helps them upgrade the intelligent cockpit experience in one step and achieve all-scenario smart living, accelerating the development of intelligent connected vehicles. In addition, HUAWEI HiCar enables automobile manufacturers and tier 1 suppliers to bulk replicate core platform capabilities, reducing their R&D costs and shortening the R&D cycle.

- **For app developers**: HUAWEI HiCar provides a broader platform, which not only enables quick and convenient access for apps, but also enables app developers to upgrade services and innovate quickly. In addition, Huawei provides developers with technical capabilities throughout the life cycle. User operations, channel-based promotion, product optimization, and other capabilities help developers implement positive interactions with users and other developers and reduce their development and operations costs.
  - Value capability kits are opened to build an ecosystem with app vendors.
  - The one-stop IDE platform supports one-time development and cross-device deployment, reducing development costs for app vendors and encouraging them to build an app service ecosystem.
  - The UX standards and vehicle hardware access specifications, with safety as the most basic need, can enable developers to achieve efficient development and innovation in compliance with driving safety requirements.

Figure 4-1 Overall app development process



By opening up greater computing power to devices, HUAWEI HiCar provides developers with a broader space for innovation.

- In-vehicle camera virtualization and AI are used to implement intelligent driving behavior monitoring and reminding. The AI computing power of mobile phones can be used to detect driver fatigue and remind drivers to stay focused.
- The head unit control system enables remote control of vehicles to realize people-car-home interconnectivity.
- Collaboration between cars and multiple devices such as head units, mobile phones, tablets, and TVs enables seamless switchover of video calls.

5 UX Open Capabilities

5.1 Design Overview

Design objectives: To ensure driving safety, enable convenient and comfortable operations, and provide smart and considerate services.

Design considerations:

- Secure and convenient: Information is easy to read and search. The UI layout and hot zone are easy to operate. Less distracting.
- Natural and comfortable: The UI is simple, consistent, easy to learn, and easy to use. Efficient, natural, and multimodal operations. Seamless device connection and sharing.
- Smart and considerate: Content and message notifications are intelligently managed. Functions and features are simplified.

Figure 5-1 Design considerations of HUAWEI HiCar

5.2 Human Factors Research and Visual Design

User observation and research and analysis of operation models show that people usually keep their mobile phones 30 cm away from their body when using them. To guarantee the safety

and usability of interactions in a cockpit environment with a distance of 70 cm, HUAWEI HiCar adapts in-vehicle human-computer interaction elements to meet the requirements for complex driving status.

UI Element Size

Based on user observation models and vehicle usage environments (including movement and bumps), the visual size of each UI element in the in-car system must be at least twice that of elements on a mobile phone to ensure readability and operability.

Text Content and Font Size

Font size, font size level, and contrast ratio are important factors that affect the readability and reading efficiency of in-car displays. To ensure readability and reading efficiency, the following requirements must be met:

- a.Minimum font size: 5.3 mm
- b.Font size level: There are primary and secondary text levels, and the font size difference is 4 to 6 levels.

Icon and Hot Zone

To ensure the readability and operability of icons, the minimum icon size is 6.6 mm.

Contrast Ratio

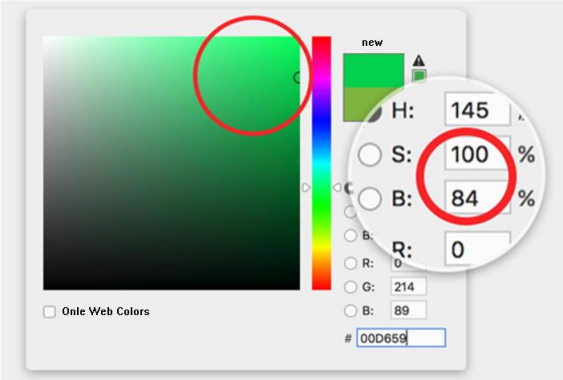
To guarantee the display effect and readability in complex luminance conditions such as at night, in low light, or glare, the following contrast ratio requirements must be met:

It is recommended that the contrast ratio be greater than 7:1 (4.5:1 is the absolute minimum), and a dark background be used. Do not make large areas of the UI pure white as this will distract users.

No matter whether a light or dark color style is selected, the contrast ratio must be within a reasonable range.

Color Matching

Figure 5-2 Matching between saturation and brightness



According to the Munsell color system, higher saturation and brightness result in brighter color.

The color in the upper right corner is brighter and is not recommended.

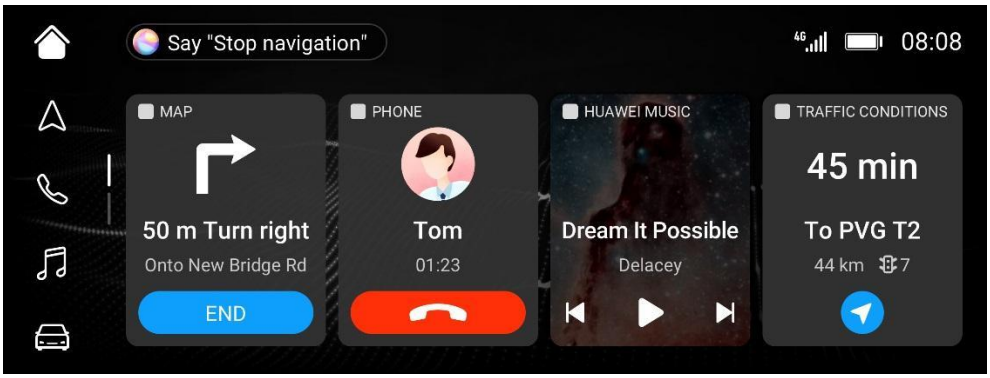
Both the saturation and brightness must be considered during color selection. The sum of the two values must be less than or equal to 180.

5.3 Desktop Cards

5.3.1 Card Overview

Desktop cards are important carriers of app content and functions. Users can operate desktop cards to quickly access core functions of apps, improving interaction convenience. Apps can access HUAWEI HiCar desktop cards to display their core functions and services and combine card elements to fit user needs in different scenarios.

Figure 5-3 Desktop cards



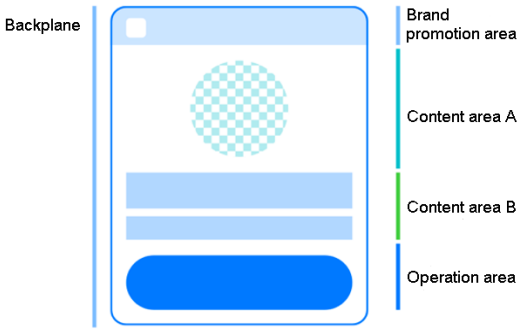
5.3.2 Card Composition

- Backplane: The backplane can be filled with colors or a background image can be set.

  The background color can be black, white, or color. Each app needs to provide three backplanes to adapt to card theme switching.

- Brand promotion area: The brand promotion area contains icons and text. Each app can display their brand icon and name in this area.
- Content area: Used to display information related to application scenarios. The content can be images, text, or graphics.
- Operation area: This area contains text or image buttons, with a maximum of three controls or one control group.

Figure 5-4 Card composition

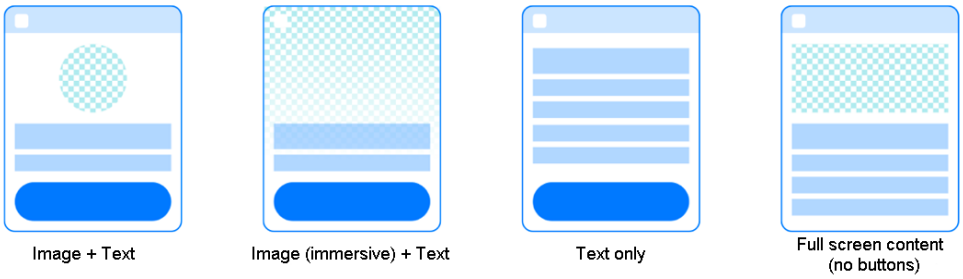


5.3.3 Card Content Area Combination

Card content areas can be combined flexibly. Developers can design cards for their apps in different combination modes based on business characteristics and needs.

A content area can contain images and text or contain only text. Its display area can extend to the operation area (buttons are optional).

Figure 5-5 Card content area

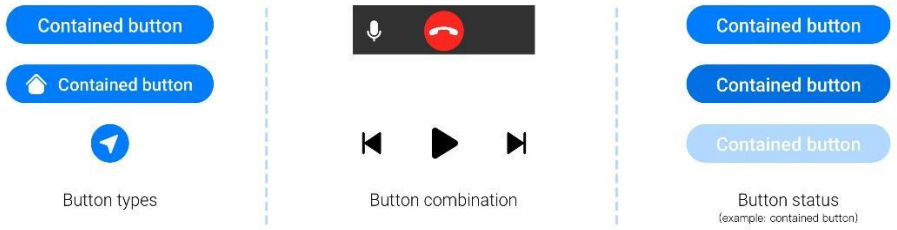


5.3.4 Card Operation Area

Buttons are functional carriers in the operation area. Each app developer can select button styles and combination modes to design cards based on business requirements. Buttons are optional elements in cards.

- Button style. A button can be an icon or text.
- Combination mode: Buttons can be used individually or combined into a control group (in the form of icons).
- Button status: A button can be in initial, touched, or unavailable state. The states are differentiated by different colors and transparency levels.

Figure 5-6 Card operation area



5.4 Automatic UI Adaptation

To ensure that the HUAWEI HiCar UI can be properly displayed on screens of different aspect ratios and sizes, the UI layout must be adaptive.

The basic adaptation methods include stretch, zoom, hide, evenly space, proportion, line break, and extend. An app can use one or more of the methods to reorganize the UI.

Figure 5-7 Adaptation methods

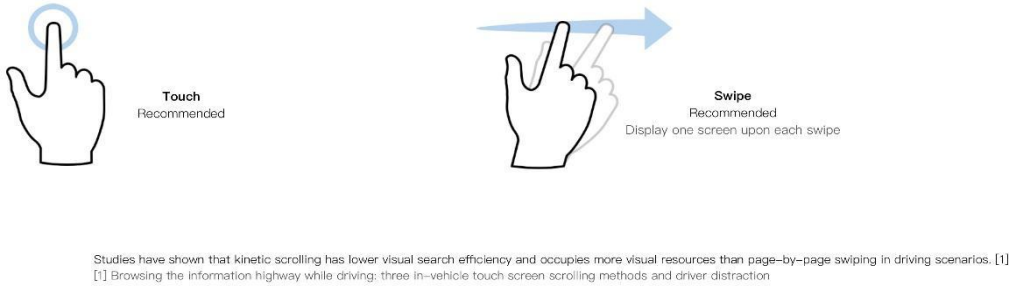
5.5 Interaction Modes

5.5.1 Hand Gesture Interaction

Interaction using hand gestures is limited due to the complexity of driving scenarios and the unique physical distance and visual angle between the driver and screen.

It is recommended that complex gestures be reduced and basic simple gestures be used to avoid complex and error-prone interactions. Voice commands are recommended to implement complex interactions.

Figure 5-8 Touchscreen gestures



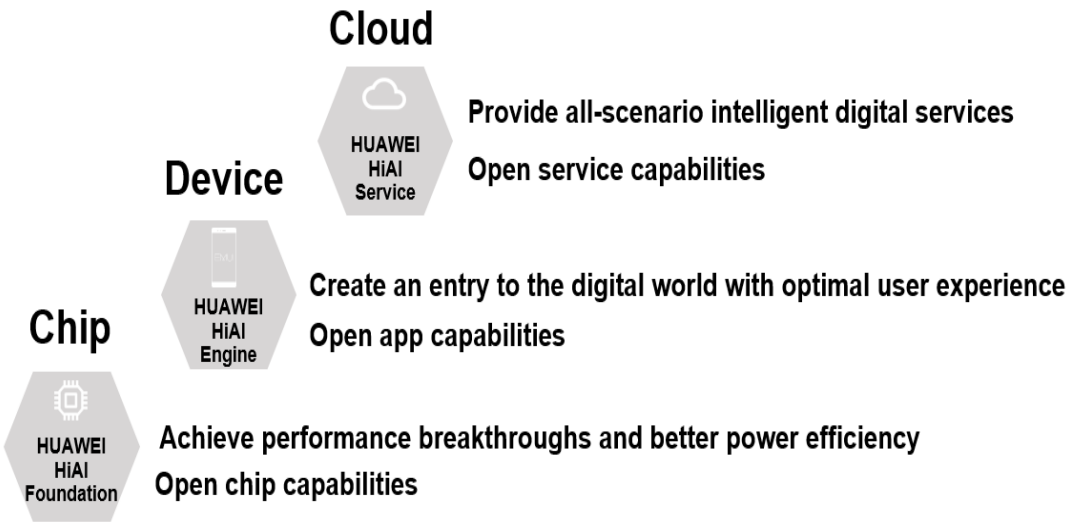
5.5.2 Voice Interaction

Compared with touchscreen- and button-assisted interactions, voice interaction requires less user attention and fewer operations. The design principle of reducing distractions and focusing on driving encourages app developers to add voice interaction experience. Users can use voice commands to wake up Huawei's voice assistant to perform navigation, play music, make calls, and perform other operations, making the driving experience safer and more convenient.

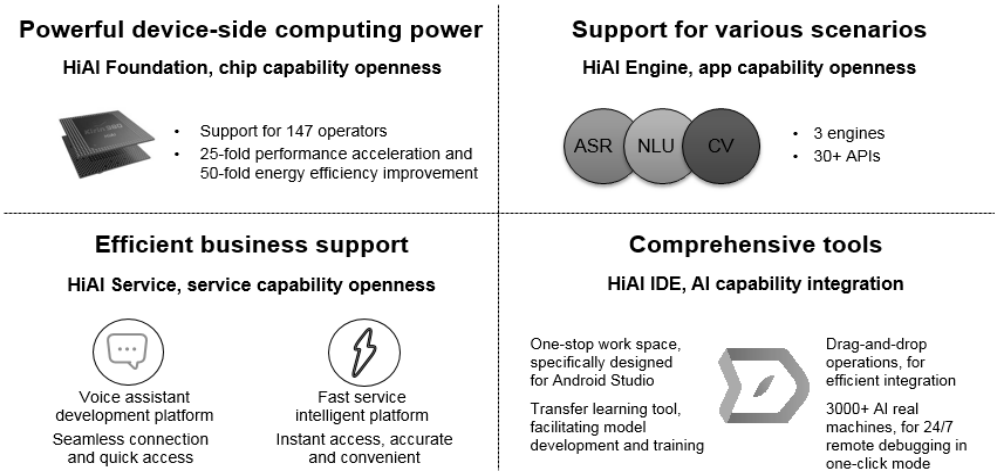
6 HUAWEI HiCar Open Capabilities

6.1 AI Open Capabilities

HUAWEI HiAI is an open AI capability platform for smart devices. It is based on the "chip, device, and cloud" architecture and opens chip capabilities, app capabilities, and service capabilities to build an open smart ecosystem.



With infinite possibilities brought about by AI connections, developers can quickly leverage Huawei's powerful AI processing capabilities to provide a better smart app experience for users.



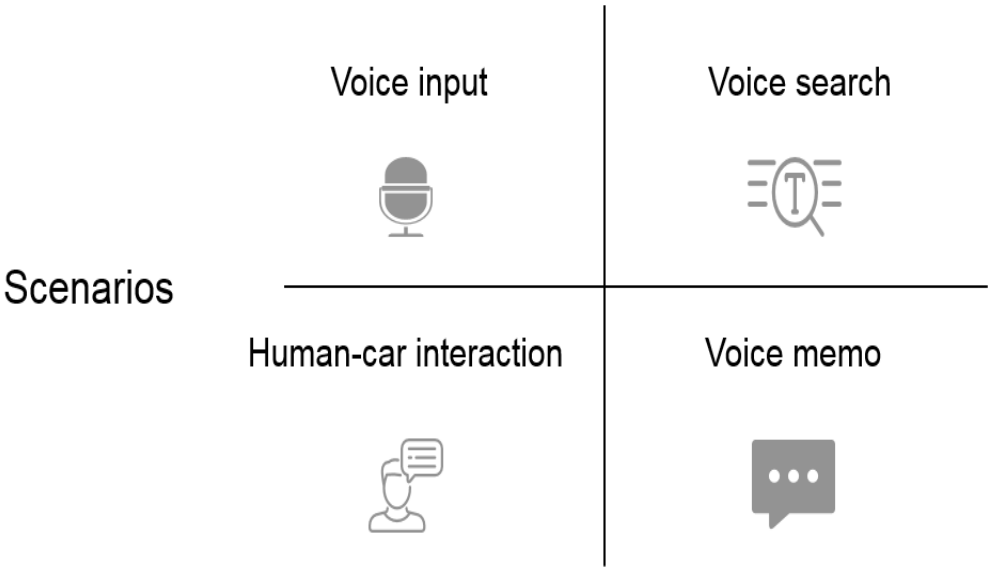
For details about the HiAI capabilities, visit the following website:

https://developer.huawei.com/consumer/en/hiai 。

6.1.1 AI Voice Capabilities

Huawei's speech recognition engine provides speech recognition capabilities oriented to mobile devices and opens APIs at the application layer for developers. Voice files and real-time voice data streams can be converted into Chinese character sequences with an accuracy rate of over 90% (local recognition: 95%; cloud recognition: 97%).

With AI voice capabilities, drivers can give voice commands to call a friend, play the previous or next song, or adjust the volume while holding the steering wheel, minimizing any possible distractions. The API for opening AI voice capabilities can be used to develop third-party apps that have speech recognition requirements, such as for voice input, voice search, using chat apps, and human-computer interaction in driving scenarios.



Huawei's speech recognition engine has the following features:

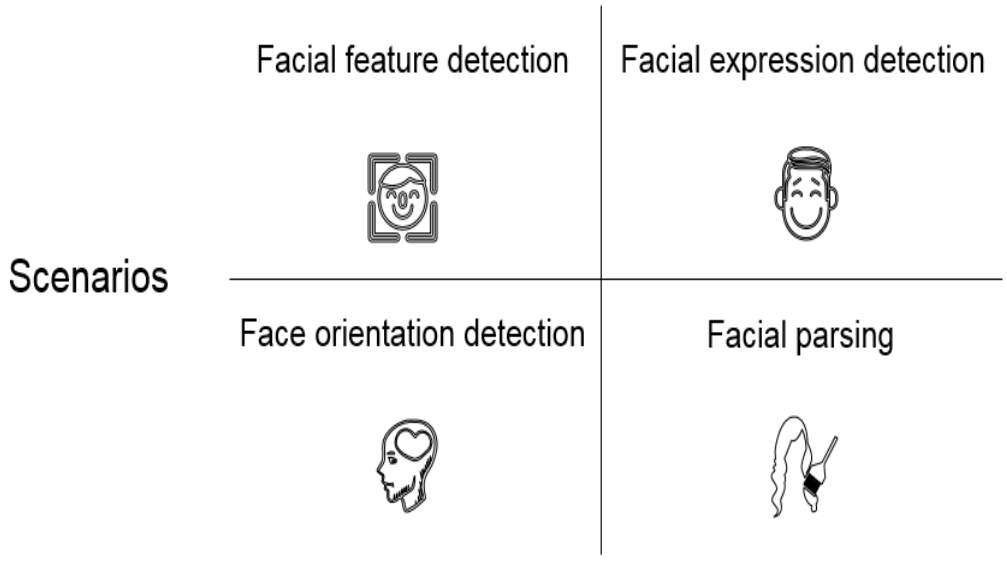
- Leading speech recognition technology in the world, with an accuracy rate of 95% for local speech recognition.
- Support for Mandarin in all regions of China.
- Recognition result response within 200 ms. Local running enables smoother input and faster responses.
- Intelligent sentence segmentation with punctuation marks.
- Continuously optimized models to support a large number of vertical industry proper nouns.
- Support for real-time voice input or file reading and real-time display of results.
- Support for endpoint detection and silence detection.

For more information about voice capabilities, see:https://developer.huawei.com/consumer/cn/devservice/doc/3142001

6.1.2 AI Computer Vision Capabilities

HUAWEI HiCar supports virtualized invoking of in-vehicle cameras and allows the development of computer vision-related recognition apps (for example, apps for driver drowsiness detection and gesture recognition) based on the HiAI computing power of mobile phones. These apps can use the HiAI open capabilities.

Huawei's API for opening AI computer vision capabilities supports facial comparison, face parsing, face attributes, face orientation recognition, facial feature detection, and face detection. The algorithm is developed based on the deep neural network and makes full use of the NPU chips in mobile phones to accelerate the neural network, and the acceleration ratio can be over 10 times higher than normal. This API can greatly reduce the algorithm development time, reduce the ROM space occupied by algorithm models, and make apps more lightweight.



- **Facial feature detection**: Coordinates of landmarks that represent the face outline locations (currently, there are 68 landmarks) can be returned. The data

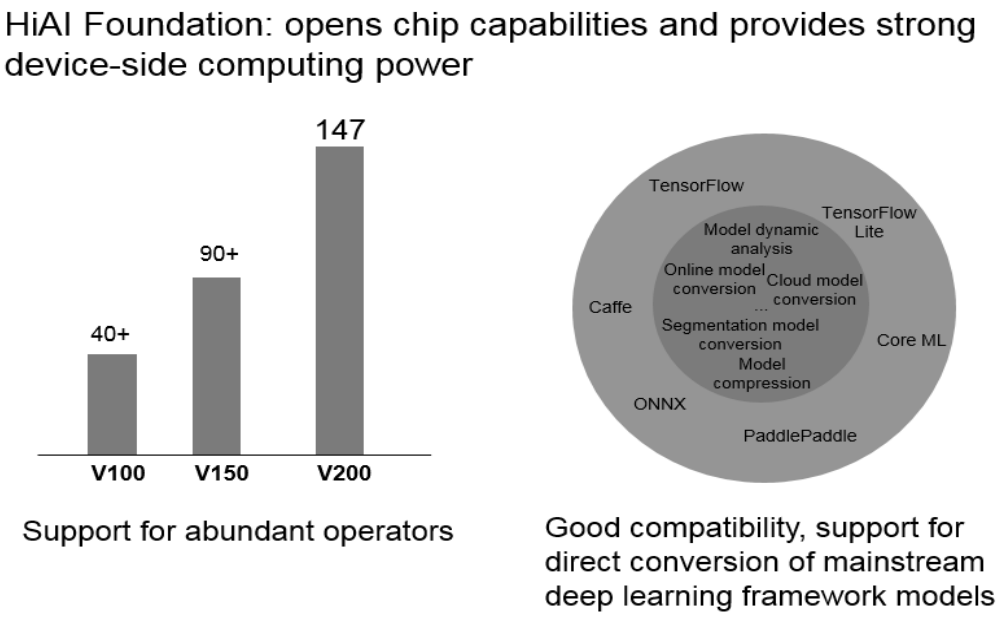
can be used for the following functions: facial comparison, face parsing, face attributes, face orientation detection, facial feature detection, and face detection.

- **Facial expression detection**: The following facial expressions can be detected: happy, sad, surprised, angry, pout, grimace, and neutral. The following character attributes can be detected: gender, age, and wearing (glasses, hats, and beards). The expressions and character attributes of multiple faces can be detected at the same time.
- **Face orientation detection**: The following face orientation categories can be detected based on visible light images by using the image recognition technology: the face looking upward, the face looking to the right, the face looking downward, the face looking to the left, and no human face on the plane. This function can be used by apps to determine whether there is a person present and determine the face orientation of the person.
- **Facial parsing**: A face can be parsed into multiple areas in the following 16 categories: background, facial skin, left eyebrow, right eyebrow, left eye, right eye, nose, upper lip, inside of the mouth, lower lip, left ear, right ear, neck, glasses, and sunglasses.

For more information about the vision capabilities, visit the following website:https://developer.huawei.com/consumer/en/devservice/doc/2020901

6.1.3 AI Foundation Capabilities

HiAI Foundation APIs constitute an AI computing library of the mobile computing platform, enabling developers to efficiently compile AI-enabled apps to run on mobile devices. These APIs accelerate the computing of a neural network by using the HiAI heterogeneous computing platform. Developers can focus on developing new AI-enabled apps instead of focusing on performance tuning.



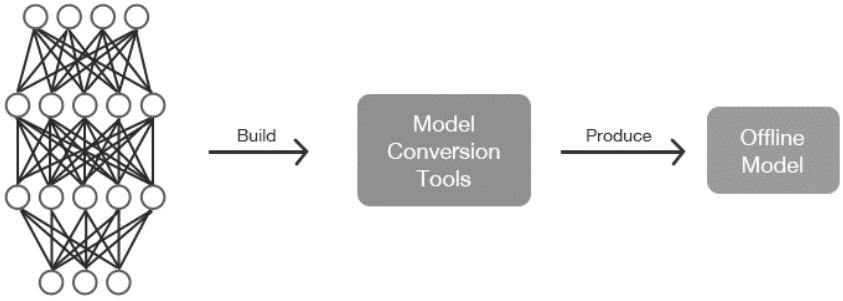
- The HiAI Foundation supports a dedicated set of AI instructions for neural network model operations that allow more efficient parallel execution of more neural network operators within minimal clock cycles.

- The HiAI Foundation can compile a variety of neural network operators, such as convolution, pooling, activation, and full link, into dedicated AI instruction sequences for the NPU in an offline setting, with data and weight rearrangement for an optimized performance. The instructions and the data are then combined together to generate an offline execution model. Furthermore, during offline compilation, cross-layer operators (convolution, ReLU, and pooling) can be fused together to reduce the read-write bandwidth of the DDR and improve the performance.
- The HiAI Foundation can rearrange relevant data (Batch, Channel, Height, and Width) in the neural network model in the most efficient manner, especially in terms of the channel data of Feature Maps. During convolution, the channel-related computing efficiency can be greatly improved.
- The HiAI Foundation supports sparse model acceleration. The NPU can skip the multiply-add algorithms with a coefficient of zero, which can greatly improve the computing efficiency and reduce the bandwidth while maintaining computing precision.

Execution procedure:

Step 1 The following figure shows that a trained neural network model, by using compilation tools, is converted into an offline model that can be efficiently executed on the HiAI Foundation and saved as a binary file.

The main purpose of compiling a standard neural network model (such as Caffe) into an offline model is to optimize the network configuration. After compilation, an optimized target file, called the offline model, is generated. The offline model is stored on disks in serialized mode. As a result, when the inference is performed, the optimized target file is used, which is faster.



Step 2 The following figure shows the offline model computing process, in which the offline model is loaded from the file and the user input data (such as an image) is copied to HiAI's NPU for computing. The user data only needs to be imported from the DDR to the NPU once for each inference during computing.

----End

The HiAI Foundation supports a variety of AI frameworks, including Caffe and TensorFlow. Developers need to specify the framework being used without modifying other APIs or parameters.

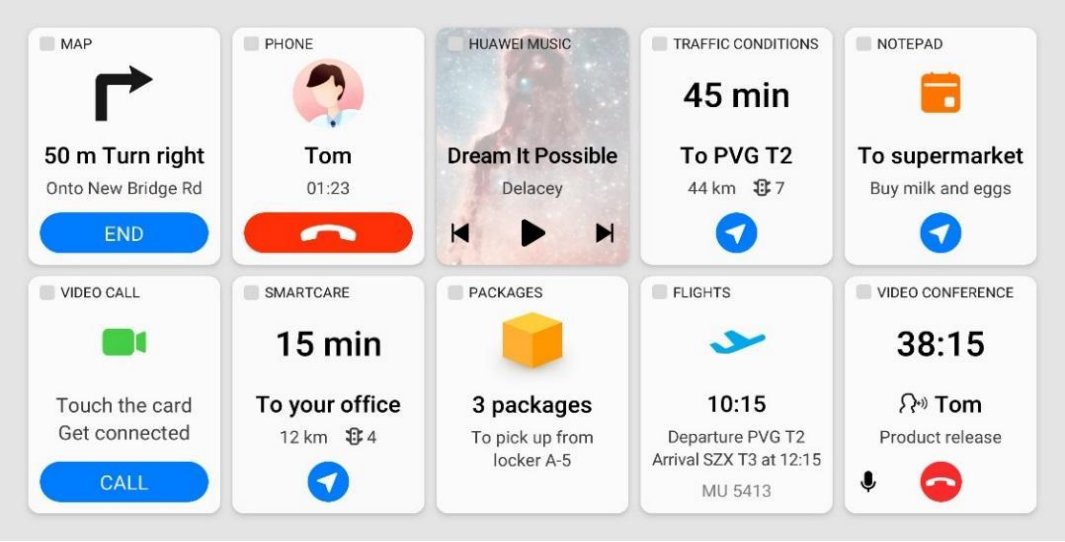
The HiAI Foundation supports most models and neural network operators and supports continuous optimization.

For more information about the Foundation capabilities, visit the following website:https://developer.huawei.com/consumer/cn/devservice/doc/3140201

6.2 HiCar Card Access Capabilities

Cards are important service information presentation and interaction entries in HUAWEI HiCar. HUAWEI HiCar has opened the HiCar card access capabilities to allow third-party apps to access cards.

Figure 6-1 Example of the white card style



Cards are classified into ongoing cards and common cards.

Ongoing cards: The HiCar Launcher displays brief information about running tasks in ongoing cards for third-party apps of a specific type. A user can touch an ongoing card to

switch to the corresponding third-party app. When a task is finished, the corresponding card is cleared.

- Ongoing card for navigation: When a navigation task is running in the background, the desktop displays the real-time status of the navigation task and supports reverse control operations, such as stopping the navigation.
- Ongoing card for music: When an audio file is played in the background, the desktop displays brief information about the played content and supports reverse control operations, such as switching songs, playing, and pausing.
- Ongoing card for calling: When there is a call in the background, the desktop displays brief information about the call and supports reverse control operations, such as hanging up or muting the call.

Common cards: Third-party apps can push, update, and delete cards based on service scenarios. Users can also delete cards. Reverse control can be set on the cards.

- SmartCare cards: These cards display intelligent recommendation information for things such as traffic conditions, flights, express delivery packages, and films. The information is obtained from the HUAWEI HiBoard app. A user can touch a button on a SmartCare card to initiate a task, such as starting navigation. The user can also delete SmartCare cards.
- SmartCare cards must adapt to HUAWEI Ability Gallery (HAG) and are currently not fully opened by the HiCar. For details about the HAG, visit https://developer.huawei.com/consumer/en/huawei-hag.
- Smart Home cards: These cards push smart home information such as the air conditioner switch obtained from the HUAWEI Smart Home app. A user can use a Smart Home card to perform reverse control or delete a Smart Home card.(*Smart Home cards are currently unavailable.*)
- Other app cards: Third-party apps recommend content in specific scenarios, such as navigation and intelligent parking. A user can delete these types of cards.

6.3 Camera Open Capabilities

Once connected, the HiCar can detect the camera capabilities equipped in a car. With its underlying device virtualization capability, the HiCar enables third-party apps to detect or access cameras in cars or other devices. Third-party apps can obtain and access cameras through the standard Android APIs and HiCar custom attributes.

The HiCar can provide more services for users based on the in-vehicle camera capabilities. The following are examples of the services:

- **In-vehicle video call**: Users can use their in-vehicle camera and large screen to make a video call while ensuring driving safety (for example, in parking mode).
- **In-vehicle video conference**: The rear seat mode allows passengers to have a video conference while sitting in a car. To provide this service, a video conference app on mobile phones is required.
- **Driver monitoring**: The HiAI computing power of mobile phones and real-time data reported by driver seat cameras can be used to monitor drivers in real time and intelligently alert drivers when necessary.

- **Hand gesture recognition**: The HiAI computing power of mobile phones and real-time data reported by driver seat cameras can be used to recognize drivers' hand gestures to control HiCar-enabled apps and services.
- **Driving safety assistance**: The HiAI computing power of mobile phones and real-time data reported by dashcams can be used to perform auxiliary detection on driving safety and intelligently alert users.

6.4 CarService Open Capabilities

The HUAWEI HiCar app open platform opens the following vehicle-related capabilities: sensor data access, vehicle body electronic control, and vehicle services. When accessing the CarService capabilities, HiCar-enabled apps need to display a statement to obtain users' consent for using their vehicle data.

6.4.1 Vehicle Body Data Access Capability

With this CarService open capability, HiCar-enabled apps can register and subscribe to vehicle-related sensor data.

Vehicle body data includes the vehicle speed, steering wheel angle, gear mode, and vehicle ambient light sensor (during the daytime or nighttime).

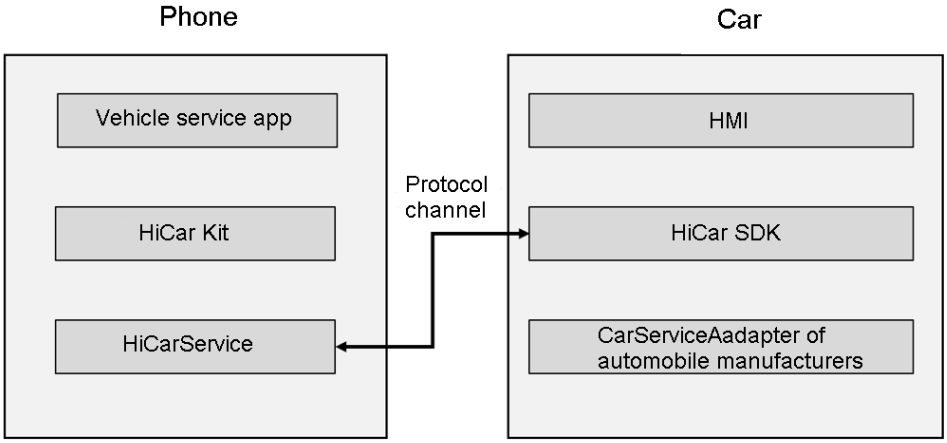
6.4.2 Vehicle Body Electronic Control Capability

With this CarService open capability, HiCar-enabled apps can query and control the air conditioners, windows, and speaker volumes in cars.

- Air conditioner control: Controls the air conditioner switch, air conditioner mode, and temperature, and queries the air conditioner status.
- Window control: Opens or closes the front, rear, left, and right windows, and queries the window status.
- Speaker volume control: Controls the speaker volume and mutes the speakers.

6.4.3 Vehicle Service Channel Capability

The HUAWEI HiCar platform provides the capability for vehicle service apps to use a vehicle service channel (this requires automobile manufacturers to adapt to these services on the vehicle side). The HiCar vehicle service channel can forward vehicle service data.



For example, a vehicle service channel can be used to:

- Transfer vehicle body data to a vehicle service app running on mobile phones and display the data on a vehicle screen to users.
- Collect service data from vehicles, send the data to a vehicle service app running on mobile phones, and upload the data to the cloud of automobile manufacturers.

7 HUAWEI HiCar-Enabled App Connection Guide

Apps connected to the HiCar are installed and run on HiCar-enabled mobile phones. Based on HUAWEI HiCar open platform capabilities, the apps can seamlessly use the resources and capabilities of in-vehicle hardware devices, and the apps and services can be applied to vehicles.

The apps to be connected to the HiCar must comply with the standards for release on HUAWEI AppGallery. HUAWEI AppGallery provides the HUAWEI HiCar zone. Users can access the HiCar zone from the HiCar entry on their mobile phones to query, download, and install apps that support the HiCar.

7.1 Connection of Common Apps

If a third-party app is connected to the HiCar as a common app, the app icon is displayed on the HiCar icon page. The app developer needs to submit a connection application to the HiCar and configure the following activity start information in the androidManifest.xml file:

API 1: Activity start configuration in the androidManifest.xml file for a common app.

```
<intent-filter>
<action android:name="huawei.intent.action.HICAR" />
<category android:name="huawei.intent.category.HICAR" />
</intent-filter>
```

Description: After the preceding information is configured, a common app can connect to the HiCar.

7.2 Connection of Audio Apps

If a third-party app is connected to the HiCar as an audio app, the app icon is displayed in the audio button position of the HiCar Dock area and on the icon page. The app developer needs to submit a connection application to the HiCar and configure the following activity start information in the androidManifest.xml file:

API 1: Activity start configuration in the androidManifest.xml file for an audio app.

<intent-filter>

<action android:name="huawei.intent.action.hicar.MEDIA"/>

<category android:name=huawei.intent.category.hicar.MEDIA">

</intent-filter>

Description: After the preceding information is configured, an audio app can connect to the HiCar.

7.3 Connection of Map Apps

If a third-party app is connected to the HiCar as a map app, the app icon is displayed in the navigation button position of the HiCar Dock area and on the icon page. The app developer needs to submit a connection application to the HiCar and configure the following activity start information in the androidManifest.xml file:

API 1: Activity start configuration in the androidManifest.xml file for a map app.

```
<intent-filter>

   <action android:name="huawei.intent.action.hicar.MAP"/>

   <category android:name="huawei.intent.category.hicar. MAP">

</intent-filter>
```

Description: After the preceding information is configured, a map app can connect to the HiCar.

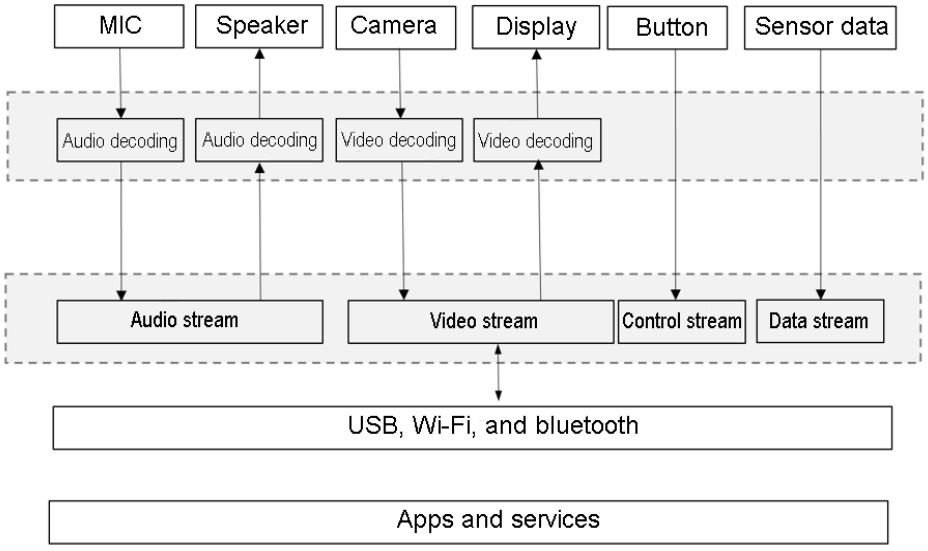
For details about how to access more applications, see:

HUAWEI HiCar zone in https://deveco.huawei.com.

8 HUAWEI HiCar Vehicle Hardware Integration Guide

The Cockpit Domain Controllers (CDC) include the traditional head unit, IVI, instrument panel, HUD, and headrest screen. After the HiCar is connected to the CDCs, the HiCar can use the CDC distributed I/O resources, including vehicle display resources (such as the center console, instrument panel, HUD, and headrest screen), vehicle audio input and output resources (such as the microphone and speaker), vehicle buttons, and vehicle body sensor data. Besides, the HiCar can use the HiAI hardware computing power of mobile phones.

Huawei provides the HiCar SDK for vehicle device suppliers to integrate so that the vehicle devices can easily support the HiCar. The suppliers need to implement Human Machine Interface (HMI) specifications based on the HiCar SDK and adapt to the hardware interfaces on which the HiCar SDK depends. The following figure shows the hardware resource topology.



- **HiCar Application layer interfaces for HiCar integration**:HiCar client interfaces at the application layer. For example, an HMI app can call this type of interfaces to implement HiCar-related human-computer interaction.

- **HiCar HiCar-defined hardware and OS HiCar-defined** : hardware and OS adaptation layer interfaces (Adapter Interfaces) defined by the HiCar. Integrators are responsible for the adaptation. The HiCar distributed protocol component needs to call these interfaces.

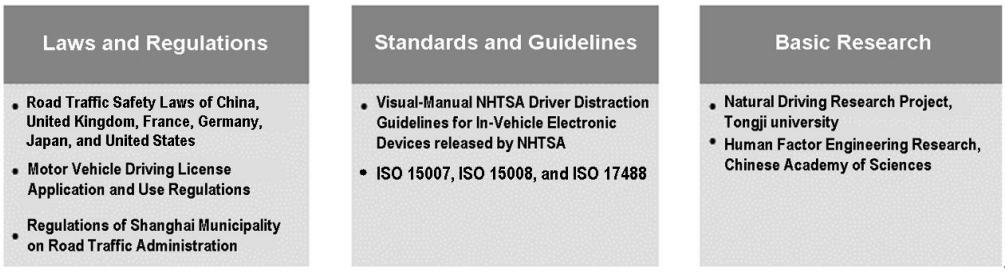
For details about how to connect vehicle hardware, see: HUAWEI HiCar zone in https://deveco.huawei.com.

9 HUAWEI HiCar User Interaction Safety Reference System

In recent years, the development and popularization of smart phones have reportedly had a negative impact on driving safety and reliability. Guaranteeing driving safety in the phone-vehicle connection process is the key to rapid development and wide-spread use of phone-vehicle connections.

Traffic accidents caused by mobile phone use while driving occur from time to time around the world. According to the Motor Vehicle Traffic Accident Liability Dispute Case Report released by the China Justice Big Data Institute (CJBDI), more than 4,491,000 cases of motor vehicle traffic accident liability disputes have been settled in the trial of first instance of the people's courts at all levels from January 1, 2012 to June 30, 2017. Among the causes of traffic accidents, mobile phone use while driving ranked No. 3, accounting for 10.56%. According to data released by the National Highway Traffic Safety Administration (NHTSA), an agency within the United States Department of Transportation, driver distraction contributed to 10% of all crashes in 2010 to 2016, and mobile phone use accounted for 13% among all accidents caused by distracted driving.

The HUAWEI HiCar solution puts "effectively controlling visual distractions and body movement distractions and keeping drivers focused" as a key part of the overall design and refers to a comprehensive system of regulations and standards in the user interaction safety design process.



As an active participant in the industry ecosystem, Huawei has participated in the smart cockpit safety experience innovation team of the Software Green Alliance (formerly known as the Android Green Alliance), and summarized the practices in user interaction security with industry partners in the *Smart Cockpit Safety Experience White Paper*. (For details, visit the website of Software Green Alliance.)