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System Architecture Optimization of the Internet of Vehicles

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ABSTRACT. *In recent years, the concept of the internet of things has been constantly promoted, the technology of the internet of things has been constantly improved, and its fields are more and more extensive. The internet of vehicles developed from telematics has been more and more regarded as a branch field of the internet of things. Although it is a new thing, it develops rapidly and has made great achievements. Relevant applications, services and products emerge one after another. However, through the analysis of existing applications, services and products, it is found that there is still some room for improvement. In particular, in the context of rapid development of communications technology, there is no overall architecture for how to make comprehensive use of existing communication networks to connect vehicles into a network. This paper attempts to propose solutions to the above problems.*

KEYWORDS: *System architecture optimization, Internet of vehicles*

1. Introduction

The current international research on Internet of vehicles in a sense grew out of what's commonly known as Telematics, which is the on-board computer system that USES wireless communications technology. New computer markets, called Telematics, are emerging as computers and networking technologies are applied to cars. Telematics is a comprehensive product of wireless communication technology, satellite navigation system, network communication technology and on-board computer, which is regarded as the future star of automobile technology.

Telematics is characterized by the use of wireless means of communication such as communication networks, satellites and broadcasting. And the terminal can download applications or update software at a lower cost. However, the main functions of Telematics system are still vehicle safety and vehicle preservation. Moreover, Telematics is at best a point-to-point connection, and most services rely on voice calls between drivers and passengers and the people sitting in the service center. There is no strict concept of networking, so it cannot be called a fully

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networked system of vehicles.

Based on the mobility characteristics of vehicles, the network of vehicles is a wireless communication technology based network. So this chapter firstly based on wireless communication technology selection of vehicles using the environment to do a summary, based on the above all the work, this paper presents an improved car networking system architecture, in order to realize the car and road, the car and the owner, the owner and the owner, the owner effective connection with the third party service provider, so as to constitute a real sense of the car networking (as shown in figure 1).

In general, the framework can be interpreted as a comprehensive use of multiple means of communication to connect vehicles and services in real time. Vehicle as terminal nodes, the use of on-board network terminal equipment, network access to the car, in order to get including voice communications services, location-based services, navigation services, vehicle service center connectivity (telematics service provider), mobile Internet access, the vehicle third party information management service, vehicle emergency rescue, vehicle data and management services, in-car entertainment, a variety of services.

2. Vehicle Ad-Hoc Network

To solve the problem of networking between vehicles, AD Hoc network naturally becomes the first choice for vehicles as a typical moving object. AD Hoc is a mobile network without the support of wired infrastructure. Nodes in the network are all composed of mobile hosts, and communication can be achieved through free networking between mobile hosts. The terminals in the network have equal status and can quickly build a mobile communication network at any time and anywhere without the support of existing information infrastructure network facilities. AD Hoc network was originally applied in the military field, and its research started from the packet wireless network data communication project in the battlefield environment.

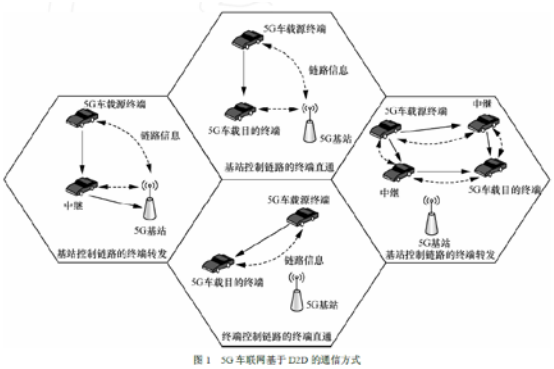

图 1 5G 车联网基于 D2D 的通信方式

3. The Vehicle is Connected to the Internet

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3.1 Architecture of 5g Car Networking

The application of 5G communication technology in the vehicle networking scene in the future will enable the vehicle networking to have more flexible architecture and new system elements (5G vehicle-mounted unit OBU, 5G base station, 5G mobile terminal, 5G cloud server, etc.). In addition to V2X (X: vehicle, road, pedestrian and Internet, etc.) information exchange in vehicle-based networks, inter-vehicular networks and vehicle-mounted mobile Internet, 5G vehicular networking will also achieve connectivity among OBU, base stations, mobile terminals and cloud servers, giving them special functions and communication modes respectively. The features of 5G VEHICular networking architecture are mainly reflected in OBU multi-network access and fusion, OBU multi-channel Internet access, and multi-identity 5G base station.

3.1.1 Obu Multi-Network Access and Fusion

At present, in the Internet of vehicles, a variety of networks coexist, including WLAN, 2G/3G cellular communication, LTE and satellite communication based on IEEE 802.11 A/B/G/ N/P standard protocol. These networks use different standards and protocols in the Internet of vehicles communication, and the data processing and information interaction are not perfect. While 5G car networking will integrate multiple networks to achieve seamless information exchange and communication switching. 5G mobile communication network is a two-layer network including macro cellular layer and device layer [5], in which macro cellular layer is similar to traditional cellular network and involves direct communication between base station and terminal equipment. In device-layer communication, device-to-device (D2D, DEdevice-to-device) communication is an important part of 5G mobile communication technology, which is a communication mode of information interaction between terminals without any network infrastructure [6]. According to the base station's control over resource allocation and the starting, purpose and relay terminal nodes, D2D terminal communication modes can be divided into four categories [5].

1) Terminal forwarding of the base station control link. Under the circumstance of poor signal coverage, terminal equipment can communicate with base station through the information forwarding of adjacent terminal equipment, in which the communication link is controlled by base station and relay equipment. In this communication mode, terminal equipment can achieve higher QoS (Quality of service).

2) Direct communication between terminals of the base station control link. The information exchange and communication between terminals does not have the assistance of base station, but the base station control link is required.

3) Terminal control link terminal forwarding. The base station does not participate in the establishment of communication link and information interaction. The source terminal and the destination terminal coordinate and control the communication between each other through the relay equipment.

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4) Terminal control link terminal direct communication. Without the assistance of base station and terminal equipment, the communication between terminals can automatically control the establishment of links, which is conducive to reducing the interference between devices. Figure 1 shows the application of D2D communication mode of 5G mobile communication network in vehicle networking. In the future, THE D2D communication technology of 5G car networking will provide a new communication mode for car networking. Among them, OBU can directly access the Internet through 5G base station or relay (including adjacent OBU and user mobile terminal) in the on-board mobile Internet to realize information interaction between the vehicle and cloud server. In the vehicular Intranet, in order to fully realize the human-computer interaction between users and vehicles, the OBU is used as the medium to transmit vehicle data over a short distance through a self-control link with 5G mobile terminals of users without the assistance of base stations or other terminal devices. In the communication network based on D2D, 5G VEHICle-mounted units can establish AD Hoc network based on single-hop or multi-hop D2D in the network communication edge or signal congestion zone to implement vehicle-ad hoc network communication [5]. Through the above analysis of 5 g car networking communication mode, as shown in figure 2, 5 g car networking will change based on the IEEE 802.11 p standard car networking communication mode, the implementation of more between entities (and the OBU and owners between the OBU mobile terminals, pedestrians, 5 g base stations, Internet) between the information interaction, realize the OBU multi-network access [2] and car network, international network, vehicle-mounted mobile Internet “triple play”.

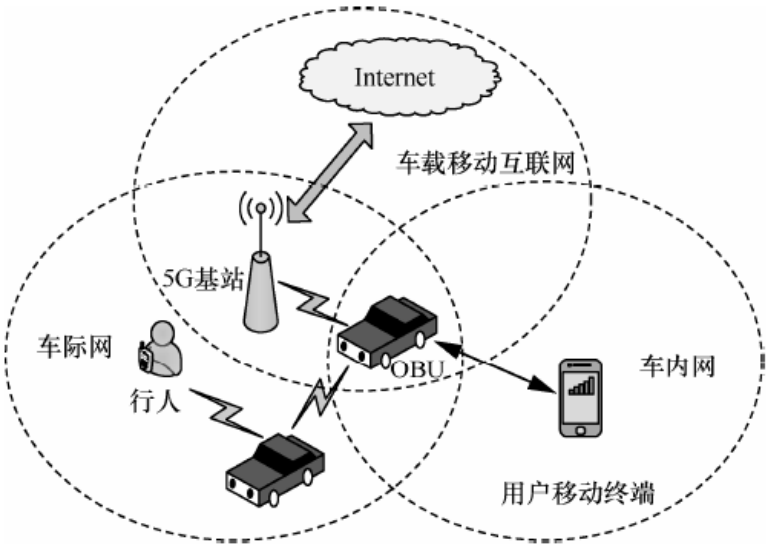

图 2　5G 车联网“三网融合”结构

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3.1.2 Multi-Identity 5g Base Station

As the relay of terminal communication, the traditional base station plays an important role in data forwarding and link control. The massive deployment of 5G base stations will realize ultra-dense networks, thus giving users functions such as accurate positioning and assisting terminal communication. In the communication network based on 5G MMW, D2D technology involves direct communication between terminals and base stations (D2B) and base stations and base stations (B2B) [7]. Among them, self-organizing communication between D2B and B2B will be an important breakthrough, which determines that 5G base stations will play a crucial role in different roles. In the application scenario of car networking, 5G base station will have the following functions.

1) Collaborative relay. 5G base stations have the relaying and forwarding functions of traditional base stations, serving as wireless access points to assist cars to communicate with the Internet.

2) Act as an RSU. In high-speed operating environments, 5G base stations in vAD will replace Rsus, communicate with OBU in real time, broadcast traffic information to vehicles in VAD, and assist vehicle-to-vehicle communication and multiple vAD communication. This not only saves the construction cost of the Internet of Vehicles system, but also solves various problems faced by the fusion of V2I collaborative communication system [8] [9].

3) Precise positioning. GPS as the current OBU positioning system is very fragile, vulnerable to spoofing, blocking and other types of attacks. Moreover, GPS signals are vulnerable to weather influences, which makes precise positioning impossible [2]. The massive deployment of 5G base stations in the future USES higher frequency and signal bandwidth, the implementation of dense network and large-scale antenna array, so that the OBU can reduce positioning errors in the complex NLOS environment. Secondly, D2D communication makes full use of the advantages of high-density terminal device connection to improve positioning performance from the following two aspects [10]. On the one hand, can also be used to determine the D2D link between vehicles of pseudorange observation signal, as shown in the D2D communication not only makes the OBU can receive messages from nearby vehicles and mobile terminals, the synchronization and channel estimation unit entities such as signal processing can also be used for signal transmission time delay estimation. In Internet of vehicles, D2D communication mode provides a mesh network, and the maximum number of links formed by N OBU is N (n-1). On the other hand, OBU's D2D communication link is directly intersected for positioning

By changing the required data, the local decision can be further accelerated and the convergence time of location estimation process can be improved.

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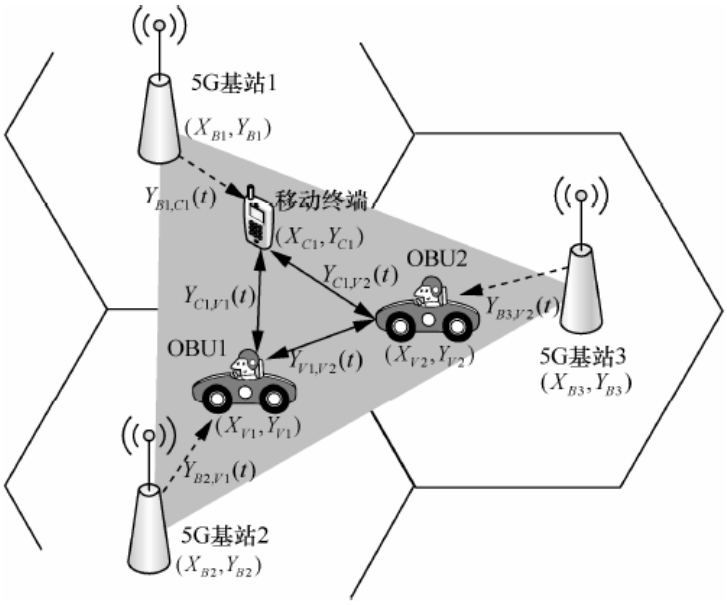

图 3　5G 车联网协作定位系统

3.2 Access to the Internet through Wireless Lan

In cities, with the increasing maturity of wireless LAN technology and the increase of coverage, through the integration of relevant communication modules on the on-board vehicle networking terminal equipment, vehicles can also use iEEE802.11 based short-range wireless communication technology to access the Internet in a specific use environment. Such as IEEE 802.11b, IEEE 802.11a and Hiperlan2, etc. In the future, the relevant technical parameters of the vehicle can be sent to the relevant service providers through the vehicle network terminal, and the real-time management of the vehicle state can be realized after the professional reads the information. In addition, passengers' personal computers, Pdas and other devices can be used as Internet access points to effectively realize mobile office.

It should be noted that there are some new technical problems objectively in ieee802.11, for which the protocol provides some crucial technical mechanisms as follows.

(1) CSMA/CA protocol

We know that the standard protocol for bus LAN at the MAC layer is CSMA/CD (Carrier Sense Multiple Access with Collision Detection). However, because the adapter of wireless product is not easy to detect whether there is a collision channel, 802.11 defines a new protocol, that is, carrier listening multi-access/collision avoidance CSMA/CA (with collision Avoidance). On the one hand, the carrier listens -- to see if the medium is idle; Conflict avoidance, on the other hand,

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minimizes the probability of signal collisions by randomly waiting for time, giving priority to sending when the medium is listening to idle. Moreover, to make the system more robust, IEEE802.11 also provides a CSMA/CA with a confirmer frame ACK. This MAC LAYER ACK provides fast recovery in the event of a signal collision that might occur if other noise is involved, or if interception fails.

(2) RTS/CTS protocol

The RTS/CTS protocol, the request send/allow send protocol, is a kind of handshake protocol, mainly used to solve the “hidden terminal” problem. “Hidden Terminals” means that Base Station A sends messages to Base Station B, and Base Station C does not detect that A also sends signals to B. Therefore, both A and C send signals to B at the same time, causing signal conflicts and ultimately resulting in the loss of signals sent to B. “Hidden terminals” tend to occur in large units (typically outdoors), which results in a loss of efficiency and requires error recovery mechanisms. It is especially important to avoid “hidden terminals” when large files need to be transferred. After injury, injury 802.11 provided the following solution. In the parameter configuration, if use the RTS/CTS protocol, at the same time set a maximum number of bytes -- once to teleport is greater than the upper limit of data on the RTS/CTS handshake protocol: first, send the RTS signal a to b, send some data show that a to b, b, after receipt of the RTS, to all the base station signal CTS, suggests that is ready, can send a, the rest of the base station temporarily “on hold”, then, a to b to send data, finally, b after receiving the data, which confirm the frame to all stations broadcast an ack, in this way, all the base station can be equal to listen again, competitive channel.

(3) Channel reforming

When the transmission frame is heavily interfered, it must be retransmitted. Therefore, the larger a packet is, the greater the cost (time, control signal, recovery mechanism) of retransmission is. In this case, if the frame size is reduced -- the large packet is divided into several small packets, even if retransmission, it is only a small packet retransmission, the cost is relatively small. This will greatly improve the anti-interference capability of Wirelesslan products in the area of noise interference. Of course, as an option, users in a “clean” area can also turn this feature off.

(4) Multi-channel roaming

With the increasing popularity of mobile computing devices, we hope to have a truly unfettered access to the Internet. Injury after injury is one such device in p 1 n802.11. The transmission frequency band is set on ap (Access Point) of the access device. The base station does not need to set fixed frequency band, and the base station has automatic identification function. The base station dynamically FM to the frequency band set by AP, which is called scan. Ieee802.11 defines two modes: passive scanning and active scanning. Passive scanning is when the base station listens for an indication from an AP and switches to a given band. Active scanning is when a base station makes a visitation request, an access point AP sends back a response containing band information, and the base station switches to a given band. After injury in p 1 wave with wavelet transform, p 1 wave adopts active scanning

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and wavelet transform with antenna receiving sensitivity, and the wavelet transform with wavelet transform is wavelet transform after injury. In this way, when the base station located in the coverage area of roams to the access point AP (b), the base station can adapt and take AP (b) as the current access point again.

4. Conclusion

The Internet of vehicles is changing the way of human traffic and communication, and promoting the development of vehicles to network and intelligence. This paper analyzes the problems faced by the front vehicle networking, applies 5G communication technology to the vehicle networking scene, and proposes a new 5G vehicle networking architecture. The system introduces the unique characteristics of 5G car networking, objectively analyzes the problems that still need to be solved in 5G car networking, tries to demonstrate the future trend of 5G car networking, and provides the direction for the research on 5G car networking. It is believed that the research of 5G car networking can promote the great evolution of society and make human society more convenient, safe, fast and efficient.

References

[1] Zhang Dengyin et al (2011). A qos model of Space-based integrated Information Network based on Differentiated Services [J]. Journal of Jiangsu University, no.2, pp.108-109

[2] Zhang Dengyin et al (2009). Research on new Network Simulator NS-3 [J]. Computer Technology and Development, no.11, pp.75-76.

[3] Chul-Su Kim et al (2006). Development of Open Telematics Service Based on Gateway and Framework [J]. Icact, no.2, pp.78-79.

[4] Communications industry standard of the People's Republic of China YD/T1292 -Technical Requirements for Media Gateway Control Protocol based on H. 248.

[5] JiBaoFeng, Diana wang, ice ice, xing yu-qi li, Gao Hongfeng, Korea ðª Cheng (2019). Throughput Enhancement method for ultra-dense Network Based on Layered Multi-hop Physical Layer Network Coding [J]. Computer science, pp. 158-159.

[6] Dynamic Channel Allocation method of Emergency Communication Network in Vehicle Networking [J]. Journal of Xi 'an University of Technology. 2019, no.3, pp.102-103.

[7] ZHANG Ning, Feng Cheng, Teng Fei, SUN Mingyang, Kang Chongqing (2019). Convergence of 5G Communication and Ubiquitous Power Internet of Things: Application Analysis and Research Prospect [J]. Wang Yi, Chen Qixin,. Power grid Technology, no.5, pp.78-79.

[8] Tian Qing, Yuan Fangzhou, Zheng Xuanping, Wang Yanping (2019). Research on multi-stage WIFI Bridge Emergency Multimedia Communication System [J].. Signal Processing, no.4, pp.75-76.

[9] Zhang Wenjing, Liu Tingting, Yang Chenyang, WANG Juncai (2019). Resource Planning based on Trajectory Prediction in ultra-dense Networks [J]. Signal

ISSN 2616-5775 Vol. 3, Issue 4: 57-65, DOI: 10.25236/AJCIS.030407

Processing, no.4, pp.12-16.
[10] Hu Zhihao, TONG Ning, LIU Qi, ZHENG Yuchao, Lin Xiangning, LI Zhengtian (2019). Distribution terminal site selection and networking strategy in stages, taking into account the influence of communication reliability [J]. Automation of power systems, no.13, pp.89-90.
[11] Zhang Haibo, LI Hu, Chen Shanxue, Zou Jian (2018). Grouping based resource allocation in hybrid Access Mode in ultra-dense Networks [J]. Journal of Beijing University of Posts and Telecommunications, no.3, pp.12-13.