Analysis of Can Bus Frame Loss Compensation Method in 5g Environment

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Abstract: with the Continuous Development of 5g Technology, Its High Data Rates, Reduced Latency, Energy Savings, Reduced Costs, Increased System Capacity and Large-Scale Device Connection Performance Goals, the Development of Connected Vehicle Technology and Automated Driving Will Rely on Higher Transmission Rates, 5g Networks with Lower Latency. the Can Bus is Widely Used in Automobiles. in North America and Western Europe, the Can Bus Protocol Has Become the Standard Bus for Automotive Computer Control Systems and Embedded Industrial Control Local Area Networks. Can Communications Have Random Delays. When the Can Bus Has a Communication Failure Due to Electromagnetic Interference, Cable Aging, and Loose Connectors, Its Communication Delay Will Increase and Cause Communication to Drop Frames. Since Many Key Components of the Device Are Controlled Based on the Can Bus, Communication Delays and Frame Loss Will Reduce the Performance of the Control System and May Also Damage the Device in Severe Cases. This Article Discusses the Can Bus Frame Loss Compensation Method in the 5g Environment.

1. Introduction

The Internet of Vehicles Technology Has Gone through the Stage of Using Cable-Based Roadside Units (Road Signboards) and 2g / 3g / 4g Networks to Carry in-Vehicle Information Services. It is Relying on High-Speed Mobile Communication Technology and Gradually Entering the Era of Autonomous Driving. According to the Automobile Development Plans of China, the United States, Japan and Other Countries, Relying on 5g Networks with Higher Transmission Rates and Lower Delays, Mass Production of Autonomous Vehicles Will Be Fully Realized in 2025, and the Market Size Will Reach $ 1 Trillion [1-3].

CAN bus is more sensitive to communication load due to its unique communication mechanism. Increasing the communication load will reduce the communication performance [4]. Therefore, communication delay and frame loss compensation methods should try to avoid increasing the communication load. In addition, due to the random nature of communication failure, the range of communication delay and the number of consecutive dropped frames is large, and the probability distribution is difficult to know in advance [5-7].

Technologies such as artificial intelligence, machine learning, and big data mining analysis can make wireless networks more convenient and intelligent. Focusing on 5G context awareness enhancement, it supports the following types of perception services: location-related perception to achieve high-precision positioning and trajectory in wireless networks. Predict and consider mobility management and optimization, such as parameter optimization under network switching; service-related perception, DPI service identification, high-definition video QoE / QoS evaluation model, and adjustment of network parameters; etc .; perception of user behaviors, enabling individual users Portrait; intelligent operation and maintenance perception, such as intelligent performance detection, fault cause monitoring and prediction. In MWC2016, Japan ’s KDDI Labs, in conjunction with HP and Brocade, launched a prototype of a 5G network intelligent operation and maintenance system based on AI. For the SDN / NFV network architecture, the AI monitoring module embedded in the NFV platform can automatically monitor network abnormalities and perform automatic recovery. The accuracy rate is expected to exceed 90%, and the efficiency is 5 times that of the traditional monitoring method.

In order to maximize the performance of the control system, the compensation method should be

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able to accurately compensate according to the specific communication delay and frame loss. However, it is difficult for the existing compensation methods to accurately compensate for the communication delay and loss detection without increasing the communication load. Therefore, it is necessary to study a new communication delay and loss detection compensation method to ensure that the CAN bus control system is available. Can still have good control performance in the event of communication failure.

2. Can Bus Structure and Principle Introduction

2016 is the 60th anniversary of the birth of artificial intelligence. At present, the discussion on artificial intelligence in the industry is very hot, and it is generally believed that it will cause profound changes in the industrial structure. It has been widely used, leading to new formats and business models. As for the network structure and various 5G services in the 5G era, the industry has basically reached consensus. Artificial intelligencemachine learning will become a basic supporting technology in the 5G era. In particular, it will provide a self-organizing network (SON), Fault repair, network management, network planning, network optimization and more.

The controller area network bus (CAN, Controller Area Network) is a serial communication protocol bus for real-time applications. It can use twisted pair wires to transmit signals. It is one of the most widely used field buses in the world. The CAN protocol is used to communicate between various components in a car, thereby replacing expensive and bulky distribution harnesses. Figure 1showsthe CAN system composition diagram.

The robustness of the protocol extends its use to other automation and industrial applications. CAN protocol features include complete serial data communication, providing real-time support, transmission rates up to 1Mb / s, and 11-bit addressing and error detection capabilities. The following is a diagram of the CAN system (Figure 1).

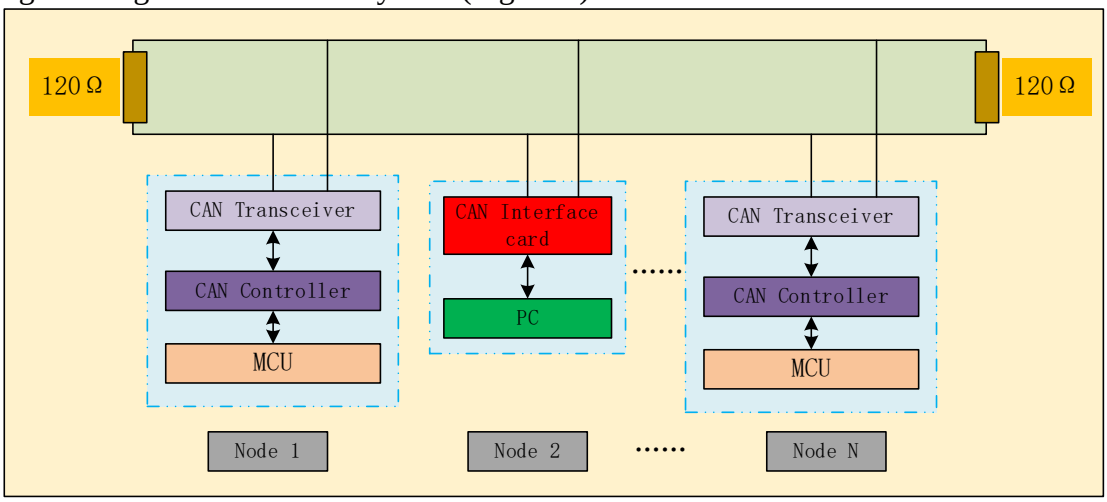

Fig.1 Can System Composition Diagram

CAN bus has the following characteristics:

a) It has the advantages of strong real-time performance, long transmission distance, strong electromagnetic interference resistance, and low cost;

b) Adopting two-wire serial communication mode, strong error detection ability, can work in high noise interference environment;

c) With priority and arbitration functions, multiple control modules are connected to CAN-bus through the CAN controller, forming a multi-master local network

d) Can decide to receive or block the message according to the message ID;

e) Reliable error handling and error detection mechanism;

f) After the sent information is damaged, it can be automatically resent;

g) The node has the function of automatically exiting the bus in the case of serious errors;

h) The message does not contain the source address or destination address, and only the identifier

is used to indicate the function information and priority information.

3. Frame Loss Mechanism of Can Bus Communication in 5g Environment

The CAN bus system is essentially a distributed network based on serial communication. It consists of multiple CAN nodes sharing a CAN bus, as shown in Figure 2. Among them, the clocks of the nodes are asynchronous and the timing of sending messages is independent of each other. When multiple messages apply for occupying the bus at the same time, a bus conflict will occur. At this time, each node uses the bus for time-sharing transmission of the control message according to the priority of the message. High-priority messages are transmitted preferentially. Low-priority messages need to wait for transmission of high-priority messages before transmission.

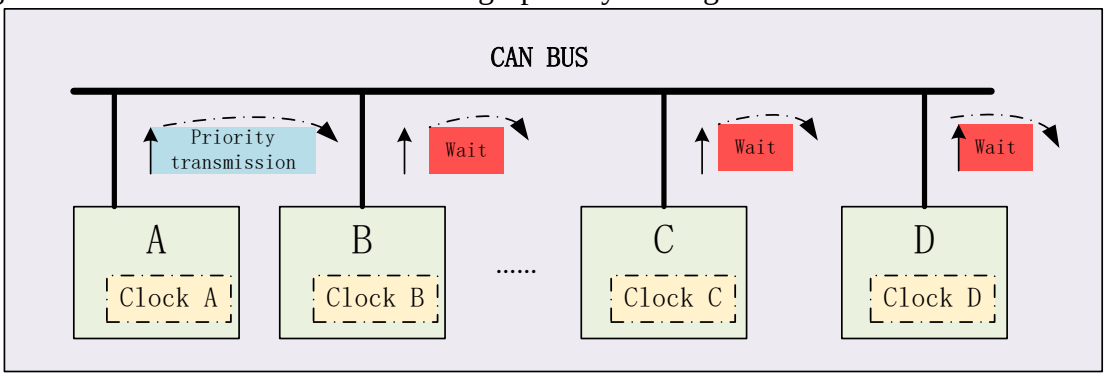

Fig.2 Can Bus System Topology

When a communication failure occurs on the bus, the message being transmitted is interrupted. When the communication fault disappears, the message is transmitted again through the bus contention. If the communication failure is serious, the CAN message will not be successfully transmitted within the current message period, which will cause communication to drop frames.

The CAN bus communication delay is inherently excellent. It is determined by the transmission of messages on the bus, and its size will be affected by communication failures. Communication frame loss is mainly caused by communication failures, and the number of consecutive frame drops varies depending on the severity of the communication failure.

4. Frame Loss Compensation Method for Can Bus Communication under 5g Environment

The high-speed transmission and low-latency features brought by 5G mobile communication technology bring qualitative changes to the business form and user experience of the connected car business. In this environment, frame loss compensation for CAN bus communication is necessary. In a specific network environment, a frame loss compensation method has been developed to meet the 5G environment.

This method: determine whether the i-th frame is a lost frame by using the missing frame flag bit, and when the i-th frame is a lost frame, according to at least one of the inter-frame relationship of the first N frames of the i-th frame and the intra-frame relationship of the previous N frames , Estimate the spectral frequency parameters, pitch period, and gain of the i-th frame. The inter-frame relationship of the first N frames includes at least one of the correlation and energy stability of the first N frames. The intra-frame relationship of the first N frames includes the first N frames. At least one of correlation between sub-frames and energy stability. The parameters of the i-th frame are determined by the signal correlation and energy stability of the first N frames, and the correlation and energy stability of the signals within each frame. Taking into account the relationship between the signals, the estimated parameters of the i-th frame are obtained. More accurate, thereby improving the quality of decoded speech signals. Figure 3 shows the processing flow.

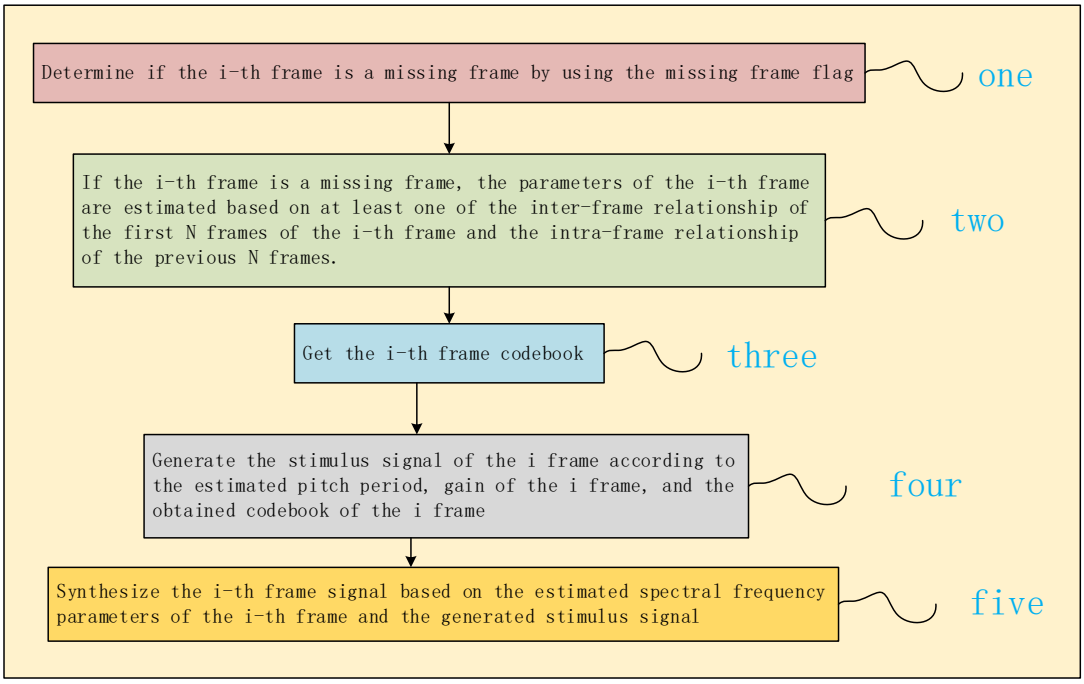

Fig.3 Can Bus Frame Loss Compensation Method

5. Conclusion

In the future, the combination of 5G networks with cloud computing and artificial intelligence technologies will bring new technical features such as cloud wireless access networks and mobile edge computing, changing the original business processes and delivery forms, and providing users with intelligent and ultimate experience Business and applications. In the future explosive mobile data traffic growth, massive device connections, and various emerging new business and application scenarios, 5G mobile communication technology provides support for building a user-centric information ecosystem.

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References

[1] Nasrallah A, Thyagaturu A S, Alharbi Z, et al. Ultra-low latency (ULL) networks: The IEEE TSN and IETF DetNet standards and related 5G ULL research[J]. IEEE Communications Surveys & Tutorials, 2018, 21(1): 88-145.

[2] Medbo J, Kyosti P, Kusume K, et al. Radio propagation modeling for 5G mobile and wireless communications[J]. IEEE Communications Magazine, 2016, 54(6): 144-151.

[3] Pateromichelakis E, Moggio F, Mannweiler C, et al. End-to-End Data Analytics Framework for 5G Architecture[J]. IEEE Access, 2019, 7: 40295-40312.

[4] Alnoman A, Anpalagan A. Towards the fulfillment of 5G network requirements: technologies and challenges[J]. Telecommunication Systems, 2017, 65(1): 101-116.

[5] Sim G H, Klos S, Asadi A, et al. An online context-aware machine learning algorithm for 5G mmWave vehicular communications[J]. IEEE/ACM Transactions on Networking, 2018, 26(6): 2487-2500.

[6] Heo J, Kang B, Yang J M, et al. Performance-Cost Tradeoff of Using Mobile Roadside Units for V2X Communication[J]. IEEE Transactions on Vehicular Technology, 2019, 68(9): 9049-9059.

[7] Qi Y, Yang G, Liu L, et al. 5G over-the-air measurement challenges: Overview[J]. IEEE Transactions on Electromagnetic Compatibility, 2017, 59(6): 1661-1670.