基于 UDS 诊断协议的 ODX 标准研究与应用

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【摘要】 本文通过对 ODX 标准的研究，完成了从 UDS 诊断协议到 ODX 标准的完整而准确的映射，并在此基础上利用模块化开发理念设计了 ODX 标准解析软件。开发者仅需将 ODX 文件导入诊断设备即可完成诊断设备开发，大大缩减了开发时间。

【关键词】 ODX，UDS，车辆故障诊断，诊断设备，模块化开发

Research and Applcation of ODX Based on UDS Diagnostic Protocol

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Abstract: This paper accomplished a complete and accurate mapping from UDS diagnostic protocol to ODX standard based on the research of ODX standard. Then, ODX file analytical software was designed using the modularization development concept. Developer only need import an ODX file into the diagnostic equipment, thus the diagnostic equipment was accomplished. Using this method the development time was reduced a lot.

Key words: ODX, UDS, vehicle fault diagnosis, diagnostic equipment, modularization development

1 RESEARCH BACKGROUND AND VALUE

The current development mode of domestic after sale diagnostic equipment is that the OEMs release the diagnostic protocol documents to the diagnostic equipment developers in paper or electronic form. Diagnostic equipment developers need diagnostic protocol analysis engineers organize the diagnostic protocol into a specific documentation which can be used as an input file for coding. There are many bugs in the software because the coding process is completed by hand. So, after the completion of the program development, high-strength software testing is needed to ensure the consistency between the diagnostic protocols and software. Thus, the whole development process requires a lot of manpower, material and financial resources. This process needs a long time to develop which can not meet the requirement of after sales department. ODX standard is proposed by ASAM organization which can solve this problem, as shown in Figure 1, the standard data exchanging format can be used among the vehicle manufacturer, ECU supplier and diagnostic equipment supplier, using this standard can avoid technical barriers. Through in-depth study of the ODX standard, we completed the full and accurate mapping from the UDS diagnostic protocol to ODX standard, depends on it we developed a modular ODX analytical software. The diagnostic communicate function between the ODX data file and the vehicle ECU is realized by MVCI standard. By the way of this development, OEMs diagnostic protocol designers simply need import the ODX file into a diagnostic equipment, then diagnostic equipment can automatically parse and generate the corresponding ODX diagnostic software. Using this method not only improves the efficiency of the developing diagnostic procedures, but also greatly reduces error rate which is made by the traditional paper-based development mode of human understanding and human coding.

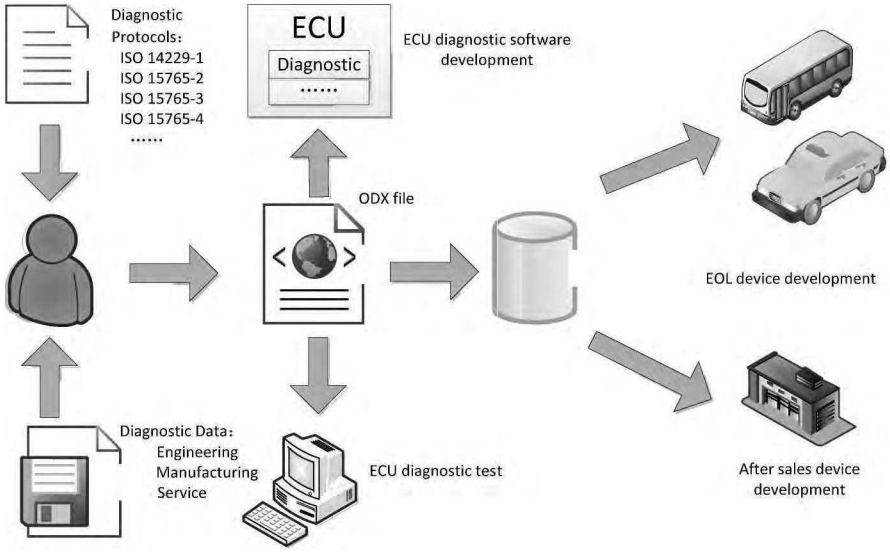

Figure 1 ODX applicable prospect

2 ODX ARCHITECTURE AND MAPPING DESIGN

ODX standard covers all diagnostic services of ECU, which can be applied in all device development processes, include the diagnostic protocol design, functional test and diagnostic equipment development. This standard is made of the description of diagnostic data and vehicle ECU communication interface. The standard contains the UML data model of ECU diagnostic data and programming data. We have accomplished this UML data by XML. ODX file consists of the following eight components, shown in Figure 2.

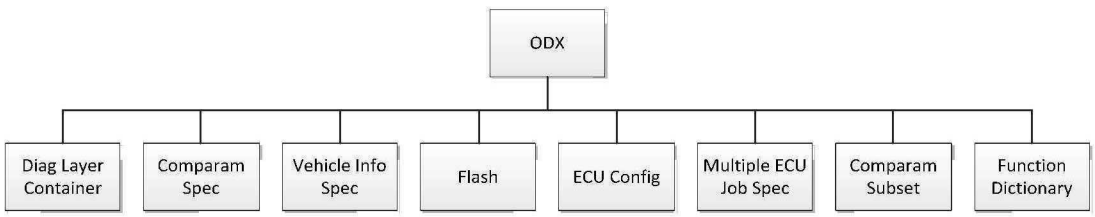

Figure 2 ODX Structure

Since ODX file needs to contain all information based on ECU UDS diagnostic services. We research and analyze the DIAG LAYER CONTAINER modules of ODX standard. We find a correspondence between the UDS diagnostic protocol and ODX standard, and ensure that all information in the diagnostic protocol can be accurately mapped to the ODX standard.

DIAG LAYER CONTAINER model shown in Figure 3, including PROTOCOL, FUNCTIONAL-GROUP, BASE-VARIANT, ECU-VARIANT[1] and the ECU Shared Data. Each part of UDS diagnostic protocol is mapped to the PROTOCOL, FUNCTIONAL-GROUP, BASE-VARIANT, ECU-VARIANT. ISO 14229 protocol requesting and reposing format are mapped with PROTOCOL and FUNCTIONAL-GROUP[2], supported diagnostic services is mapped with the BASE-VARIANT, data flow definitions, fault code definitions etc are mapped with ECU-VARIANT, ECU Shared Data provided ODX standard parameters storage pool for the mapping mechanism. With this mapping method we perfect changed the standard diagnostic protocol into ODX file which can be analyzed by the mainstream ODX editing software.

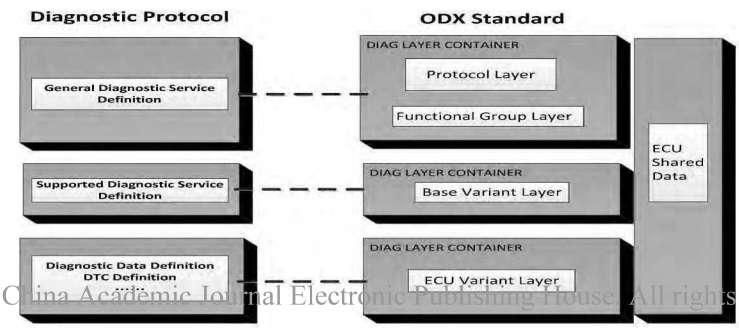

Figure 3 Diagnostic layer mapping relationship

3 ODX ANALYSIS SOFTWARE DESIGN AND DEVELOPMENT

Modularization developed method is used in the overall architecture design of analysis software. Similarity functions are abstracted and encapsulated. Modules are connected through interface in order to achieve the goal of tight cohesion and loose coupling. Each diagnostic function is consisted by several serialized diagnostic command. In order to edit the diagnostic sequence, JavaScript and Com packaging are used in the structure form. Adding Com components or modifying the JavaScript file can be used for the new diagnostic demand.

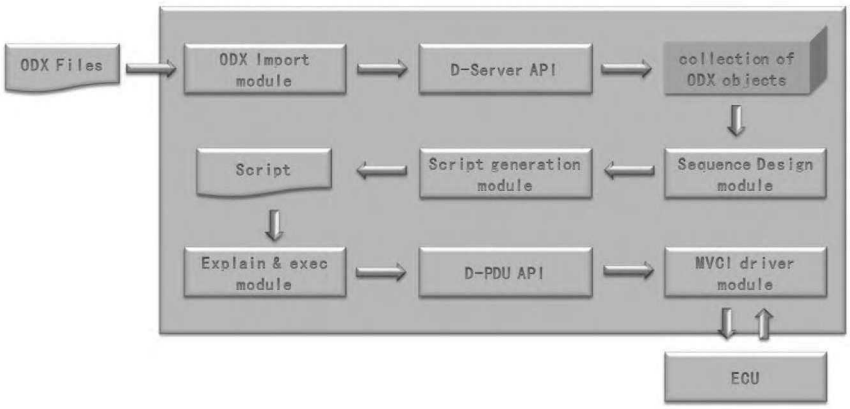

Figure 4 ODX analysis software processing flow

ODX analysis software is designed based on ISO 22900/ISO 22901. The core technology is the development of D-Server API and D-PDU API. D-Server API class structure contains more than 260 class structures, more than 3, 000 external interfaces, ODX infrastructure involves more than 420 class structures, over 2700 external interfaces, and the software needs about 2940 functions to achieve its editing function. D-PDU API includes over 30 primitive functions and more than 200 parameter structures. As the basic resource repository, D-Server API and D-PDU API need lots of design and reconstruction in order to be compliance with the international standards. During development, we still use the well-design of ASAM. All the ODX nodes are defined in the object-oriented manner. ODX file can be read, analyzed and instantiated according to ISO 22900, the software can be called by editing module and script generation module to accomplish the conversion from edit mode to operation mode.

When the software is in the running mode, the scripts are executed by interpreted and executed module. The service of ODX file can be achieved by calling D-Server API. Via the drive interaction between D-PDU API and MVCI, the communication between diagnostic equipment and vehicle controller is build up.

4 RESEARCH RESULTS APPLICATION

Based on results of this study, ODX analysis software has been designed. Shown in Figure 5, at least four people and at least 1 month time are required to develop the diagnostic equipment by using the traditional develop method. But if the development is based on the ODX standard, only 1 person and half a month are required. Manpower, financial and efficiency are all improved significantly.

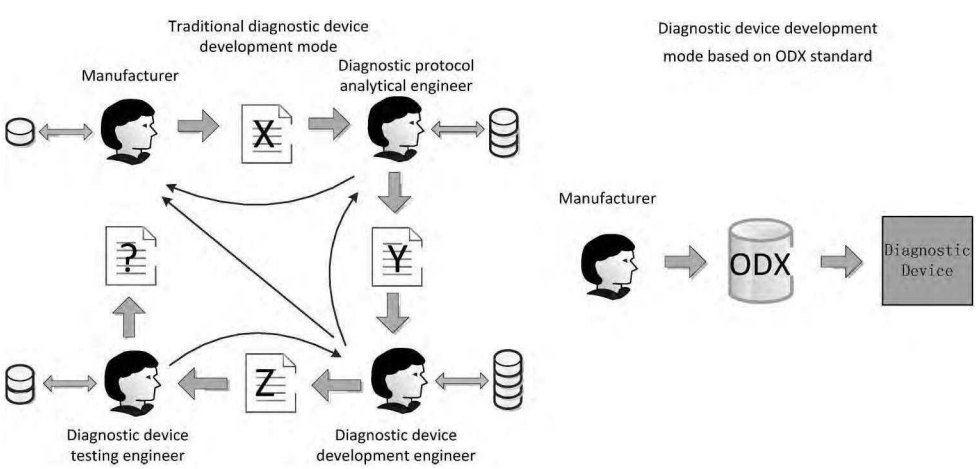

Figure 5 Development mode comparison

5 CONCLUSION AND PROSPECT

If the study results are applied in the diagnostic protocol design, testing and so on, the data versatility will be enhanced and diagnostic software development efficiency will be improved. The results of the present study are only applied in the after sale area right now. In the future, at the supplier ECU development area we will also use the ODX standard to generate the software. Finally, the study results could be used in each process of the whole diagnostic development, which will create a new era in the domestic diagnostic developing area.