基于ODX数据的ADAS自动刷写平台研究

李阳春　翟庆

（华晨汽车工程研究院，中国沈阳 110141）

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【摘要】越来越多的OEM正在开发ADAS功能，以提高汽车产品的竞争力。ADAS系统更新是研发过程中通常的做法，特别是在开发阶段。因此，有效、及时和准确的更新系统，并在开发过程中降低成本对于OEM是非常重要的。ODX（Open Diagnostic eXhange）数据描述了ECU（Electronic Control Unit）诊断内容、刷写和功能配置，OEM也可以使用ODX诊断数据来验证和刷写ECU。本文描述了一个基于ODX数据的高效且自动的刷写平台，可以自动地检查ADAS系统中应该更新的ECU，然后将ECU刷写至正确的软件版本，以保证ADAS中ECU的更新效率。

主题词：ADAS　ODX　数据　更新平台　效率

Automatic Update Platform Research of ADAS Based on ODX Data

Li Yangchun, Zhai Qing

(Brilliance Automotive Research & Design Center, Shenyang, 110141, China)

【Abstract】More and more OEMs are developing ADAS functionalities to increase competitiveness of vehicle products. ADAS system is very common to be updated, especially in development phase. Therefore, effective and accurate updating system, which decreases costs of timing and money during development, is necessary and important for OEM sides. ODX (Open Diagnostic eXhange) data describes ECU (Electronic Control Unit) diagnostic content, including flashing and coding, ODX is useful for OEM to validate and update ECU via diagnostic functionality as well. The platform, which provides effective and automatic updating, is described in this paper based on ODX data. It can check which ECU in ADAS system shall be updated, then flash ECUs with accurate software version synchronously to guarantee efficiency of updating for ECUs in ADAS.

Key words: ADAS, ODX data, updating platform, Efficiency

Abbreviations

ODX	Open Diagnostic data eXchage
ECU	Electronic Control Unit
ADAS	Advanced Driving Assistant System

1 Background

ADAS is hot and popular configuration of vehicle all over the world, globe standard-setting organization defines different levels to clarify ADAS functionalities. Meanwhile, OEM is developing the ADAS system to increase the competiveness of products in vehicle market. However, even ADAS functionality catches a lot of eyes, the system is very complicated to implement and execute. The ECUs in system work together to realize the driver assistant function, communication between ECUs consists of messages. Therefore until SOP, a lot of validation on test bench and real vehicle shall be done in development phase for function realization. If error happens, updating ECUs is low-cost and easy way to fix bug instead of ECU exchange, furthermore all ECUs in ADAS shall be same version level in each functionality validation phase. Therefore, accurate and automatic ECUs updating platform for ADAS is very necessary and important to increase the efficiency of fixing bug and development. The automatic update platform described in this paper is to solve flashing the problem of low accuracy and efficiency for ECUs of ADAS. Regarding application of ODX data in system, it contributes to implementation of platform for different vehicle type.

2 Solutions

The main advantage of described updating platform is effective and accurate. Based on it, the core part of

platform is ODX data and checking system

2.1 ODX Data

ODX is the data format that the International Organization for Standardization (ISO) has established in order to define for transferring ECU diagnostic and programming data between system suppliers, vehicle manufacturers, service dealerships and diagnostic tools of different suppliers [1]. Today's situation in the automotive industry mostly utilizes an informal description of document for diagnostic data stream information of vehicle ECUs. Each user, who desires to use the ECU diagnostic data stream documentation to set up development tools or service diagnostic test equipment, needs a manual transformation of this documentation into a format readable by these tools. This effort will no longer be required if the diagnostic data stream information is provided in ODX format and if those tools support the ODX format.

ODX specifies the concept of utilizing a new industrial standard diagnostic format to make diagnostic data stream information available for application supplier of diagnostic tool to simplify the support of the aftermarket automotive service industry. The ODX modeled diagnostic data are compatible to the software requirements of the MVCI (Modular Vehicle Communication Interface). The ODX modeled diagnostic data will enable a MVCI device to communicate with the vehicle (ECU(s)) and interpret the diagnostic data which is contained in the messages between the external test equipment and the ECU(s). For an ODX compliant external test equipment, to be displayed by the tester, no software programming is necessary to convert diagnostic data into technician readable information [1].

The ODX specification contains the data model to describe all diagnostic data of a vehicle and physical ECU, e.g. diagnostic trouble codes, data parameters, identification data, input/output parameters, ECU configuration (variant coding) data, communication parameters. ODX is described in UML (Unified Modeling Language) diagrams and the data exchange format utilizes XML (extensible mark-up language) [1].

The ODX modeled diagnostic data describe [1]:

- Protocol specification for diagnostic communication of ECUs
- Communication parameters for different protocols and data link layers and for ECU software
- ECU programming data (Flash)
- Related vehicle interface description (connectors and pin out)
- Functional description of diagnostic capabilities of a network of ECUs
- ECU configuration data (Variant coding)

Usage of ODX data in the ECU life cycle shows the usage of ODX in the ECU life cycle (Figure 1). Engineering, manufacturing and aftersales service specify communication protocol and data to be implemented in the ECU. This information will be documented in a structured format which is utilized as the XML standard the ODX is created by an appropriate authoring tool. There is potential to generate ECU software from the ODX file. Furthermore, the same ODX file is used to set up the diagnostic engineering tools to verify proper communication with the ECU, and to perform functional verification and compliance testing. Once all quality goals are met, the ODX file will be set as diagnostic database. Generally, the characters and described content of ODX are suitable for updating platform.

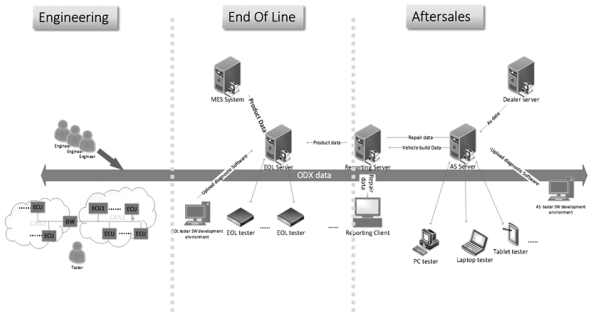

Figure 1. Usage of ODX data in the ECU life cycle

2.2 Checking Server

During functionality release and validation phase, the software of ECUs in ADAS system shall stay same version level, and once fixing bug in ECU, Software shall be updated as well as software version number, which is informed to test engineer. From testing point of view, the management of ECU version and corresponding flashing file consumes too much time and manpower, sometimes even manual error happens, the manipulation decreases the efficiency of testing. No matter the beginning of testing and the pilot process of testing, ECUs shall be updated to target software version. Checking server is responsible to read all ECU software version numbers, then compares the target version number of each ECU, which is imported into the system. Next then, the system identifies and marks the ECU to be updated and prepares the matched flashing file to be imported into system as well (Figure 2).

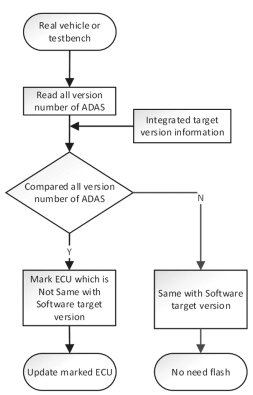

Figure 2. Implementation process of automatic update system

3 Realization

From application point of view, it is described that how automatic updating system works in detail.

3.1 Preparation

During the development phase, ADAS validation is necessary for vehicle functionality implementation and safety. Of course, ADAS functionality validation will be done on test bench or real vehicle. No matter which way, the software of ECUs related ADAS shall achieve the same level of functionality compared to last validation phase. Except physical side, testing team shall organize the list of target version numbers of ECUs. For sure, there are different kinds of software in ECUs, which have different functions, such as application, boot loader or calibration. If ECU does not have related software type, ECU cannot report relative software number which is marked as "N/A" (Table 1).

Table 1. Target versions of ADAS ECUs

Validation Phase	Component/System	Variant	Change description	Boot Loader Version Number	Application software part Number	Calibration software part Number	Delivery date
FRS_DO_M	IPC	Elite	SW Application; SW Data	BTLD-00005763-001.003.002	6075002200A001	6075002100A001	2017-10-09
	RAR	Elite;	SW Application; SW Bootloader;SW	BTLD-00005763-001.003.002	6075001200A001	6075001100A001	2017-10-09
	EPS	Grandeur;	SW Data	N/A	N/A	6078751100V91.00	2017-10-09
	ESC	Elite	SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	FCW	Elite	SW Application; SW Bootloader; SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	ADA	Elite	SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	EMS	Grandeur	SW bugfix	04.05	6078506200VA0.00	6078506100VA0.00	2017-10-09
	GW	Luxury	SW bugfix	V03.00	N.A	6078033100/VA0.00	2017-10-09
	BDC	Elite;	SW Application	N/A	N/A	6078559100VA0.00	2017-10-09
	HU	Grandeur	SW Application	N/A	N/A	6074071100/VA0.00	2017-10-09

The list will be imported into the automatic updating system as the answer of version comparison.

After importing, the system will read the all version numbers, for current software of ECU related ADAS then the system will compare version numbers based on target list. The result can report automatically, the result marks which software of which ECU shall be updated in red, the ECU with green mark means no need of updating (Table 2).

Table 2 Comparison result

Validation Phase	Component/System	Variant	Change description	Boot Loader Version Number	Application software part Number	Calibration software part Number	Delivery date
FRS_DO_M	IPC	Elite	SW Application; SW Data	BTLD-00005763-001.003.002	6075002200A001	6075002100A001	2017-10-09
	RAR	Elite;	SW Application; SW Bootloader;SW	BTLD-00005763-001.003.002	6075001200A001	6075001100A001	2017-10-09
	EPS	Grandeur;	SW Data	N/A	N/A	6078751100V91.00	2017-10-09
	ESC	Elite	SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	FCW	Elite	SW Application; SW Bootloader; SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	ADA	Elite	SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	EMS	Grandeur	SW bugfix	04.05	6078506200VA0.00	6078506100VA0.00	2017-10-09
	GW	Luxury	SW bugfix	V03.00	N.A	6078033100/VA0.00	2017-10-09
	BDC	Elite;	SW Application	N/A	N/A	6078559100VA0.00	2017-10-09
	HU	Grandeur	SW Application	N/A	N/A	6074071100/VA0.00	2017-10-09

Behind the system, the ODX data of ECUs have been created, which describe ECU flashing functionality via diagnostic communication [1]. The general concept of ODX structure is displayed in Figure 3.

If more ECUs are added in ODX data, these are described in BV and EV layer. The parents' layers are the same.

3.2 Implementation

After finishing preparation which means that the result is available, next step is the implementation, which is to update the necessary ECU in ADAS. The depiction in Figure 4 shows the system implementation structure from physical communication point of view. The system has stored all relevant flashing files for each ECU in ADAS, and it is responsible to identify which ECU shall be updated with right version. Finally, flashing order is set. ODX data implement to flash ECUs automatically based on order from system. Actually, the system communicates with each ECU via standard vehicle communication interface. After flashing, system will provide the final report of updating result, the user can save as it for readable format for traceability in future [2].

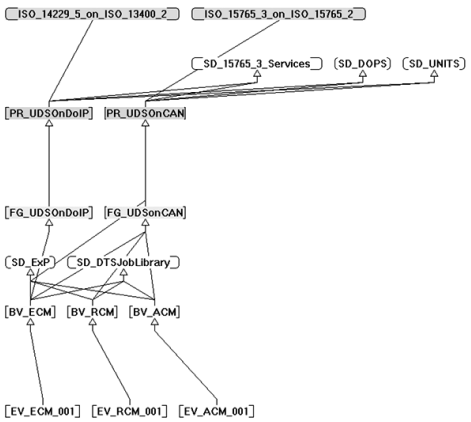

Figure 3. General ODX data structure.

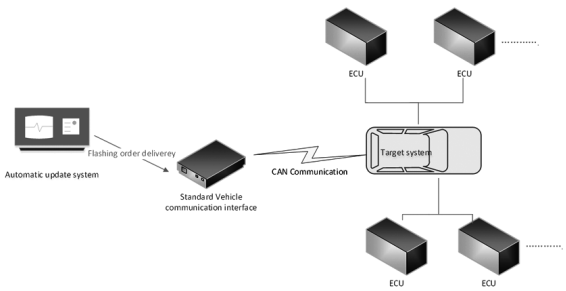

Figure 4. System architecture

3.3 Result

The final step is to check whether system can update ECUs accurately, even the system display for the updating is successful. The system will read different software version numbers of all ECU and compare these again. The final result is displayed in Table 3.

Table 3. Result of comparison again

Validation Phase	Component/System	Variant	Change description	Boot Loader Version Number	Application software part Number	Calibration software part Number	Delivery date
FRS_DO_M	IPC	Elite	SW Application; SW Data	BTLD-00005763-001.003.002	6075002200A001	6075002100A001	2017-10-09
	RAR	Elite;	SW Application; SW Bootloader,SW	BTLD-00005763-001.003.002	6075001200A001	6075001100A001	2017-10-09
	EPS	Grandeur;	SW Data	N/A	N/A	6078751100V91.00	2017-10-09
	ESC	Elite	SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	FCW	Elite	SW Application; SW Bootloader; SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	ADA	Elite	SW Data	BTLD-00005763-001.003.002	N/A	6085003100/V90.00	2017-10-09
	EMS	Grandeur	SW bugfix	04.05	6078506200VA0.00	6078506100VA0.00	2017-10-09
	GW	Luxury	SW bugfix	V03.00	N.A	6078033100/VA0.00	2017-10-09
	BDC	Elite;	SW Application	N/A	N/A	6078559100VA0.00	2017-10-09
	HU	Grandeur	SW Application	N/A	N/A	6074071100/VA0.00	2017-10-09

Based on final report, all existing software is marked as "Green", which means updating is successful and accurate. The system is necessary and essential. From ECU software reading to comparison, from attach flashing file to updating execution, all processes are automatic and accurate, which ensure the efficiency increases more than

before. Previously, the user shall read ECU software version and compare these with target version number one by one manually, and the process is more likely to produce errors. This platform finishes it automatically, from reading, comparing and flashing. Basically, the efficiency increases 3 times. With this platform the more ECUs are used, the more effective the platform will show, not only in effectiveness, but also more accuracy will be shown.

4 Conclusions

Based on theoretical analysis and real implementation, the conclusion can be drawn. Based on the research of the system, the software version of ECUs in ADAS can be updated to target one accurately and synchronously, which is very helpful to test and validate ADAS system on test bench or in real vehicle during development phase. The whole process is automatic, and the report is clearly to record the updating result of each ECU. It can help OEM save ECU development and management costs during platform vehicle development. From application point of view, this platform can be extended to the whole vehicle for ECU software update no matter which communication medium, like CAN or Ethernet, is used.

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