



ECU软件的AUTOSAR开发方法

浙江大学ESE工程中心



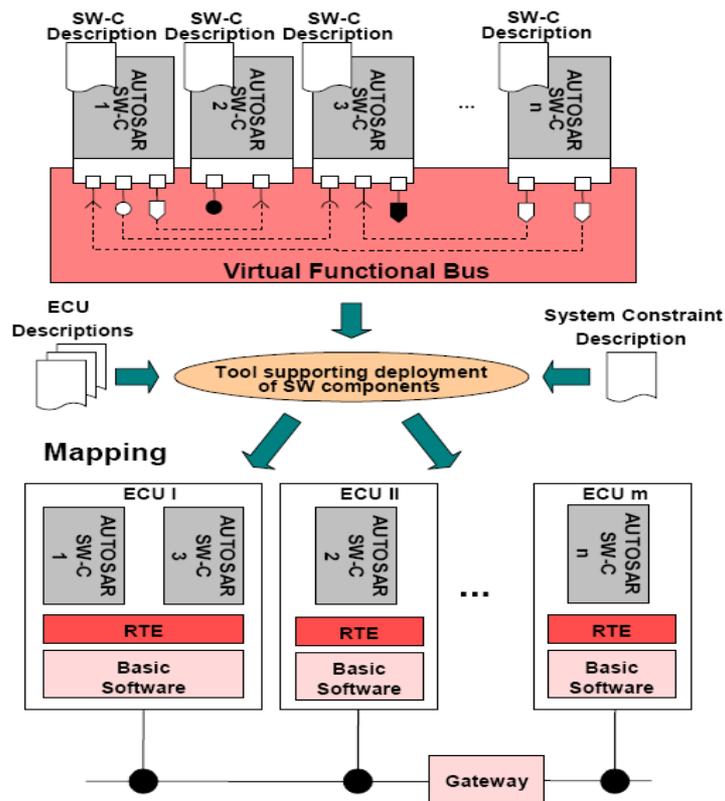
Outline

- [方法概述](#)
- 系统设计
- 系统配置
- ECU配置
- 执行文件生成

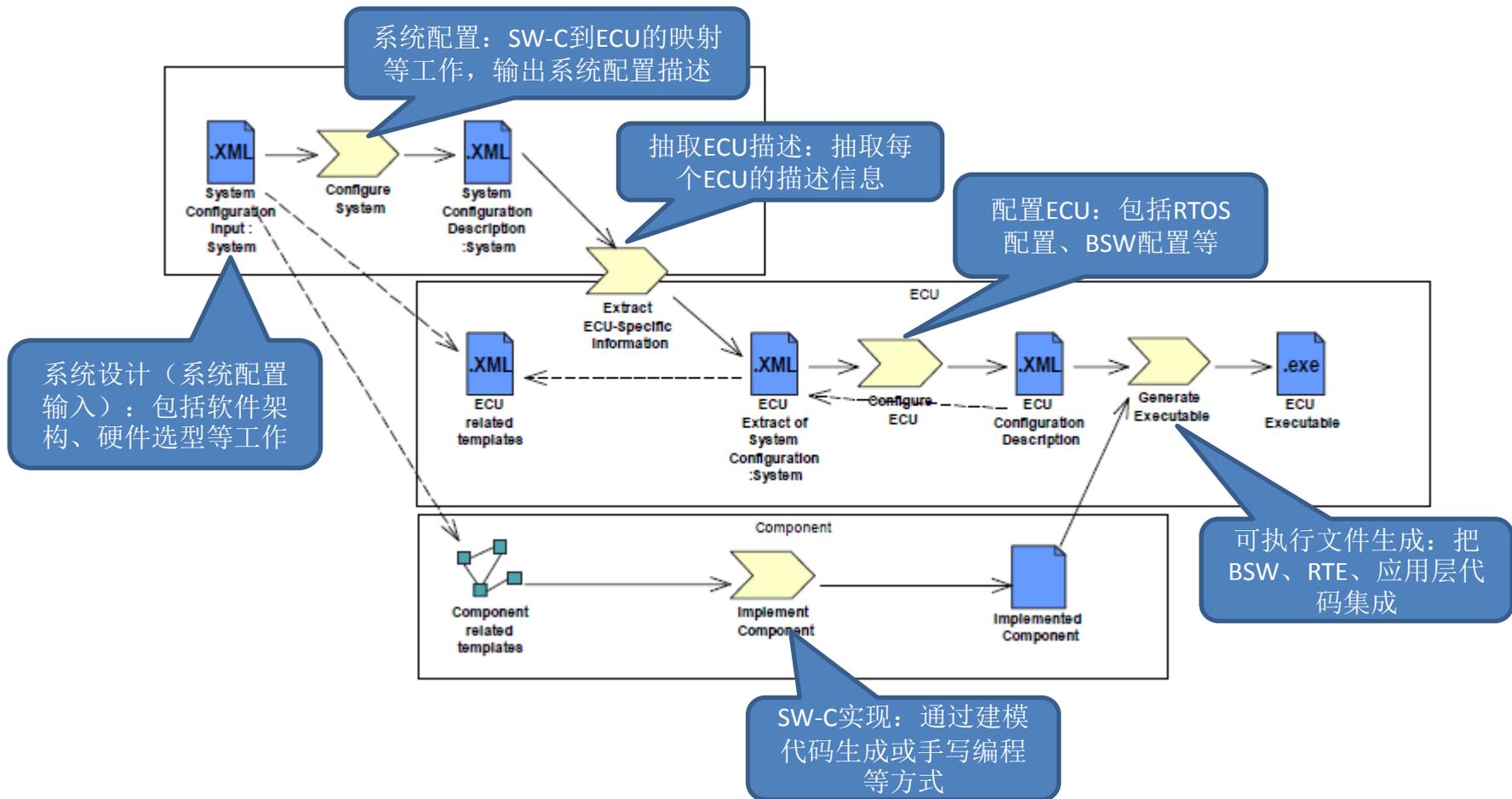


AUTOSAR开发方法概述

- 应用层由各个SW-C设计组成
- 在VFB上可以验证SW-C间的接口一致性
- 利用工具进行系统配置、ECU配置、代码生成
- 支持整车电控系统设计



AUTOSAR开发方法概述



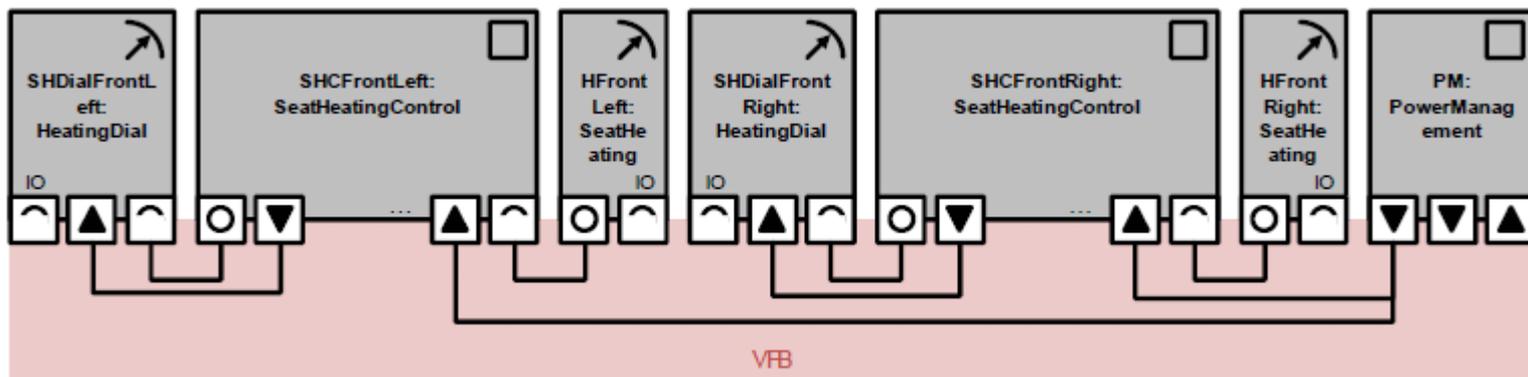
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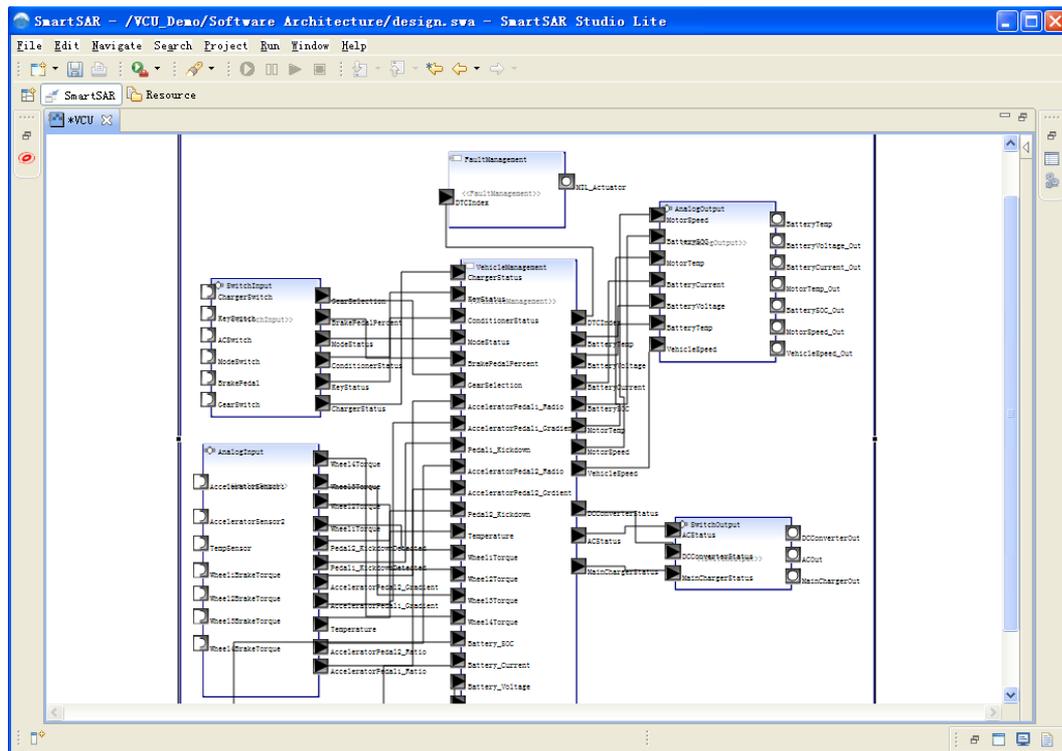
系统设计（系统配置输入）

- 软件架构设计：设计软件组件SW-C，包括data types、ports、interfaces等
- 收集ECU资源：处理器、内存、外设、执行器、传感器等规格
- 指定系统约束：总线速率、总线拓扑等约束



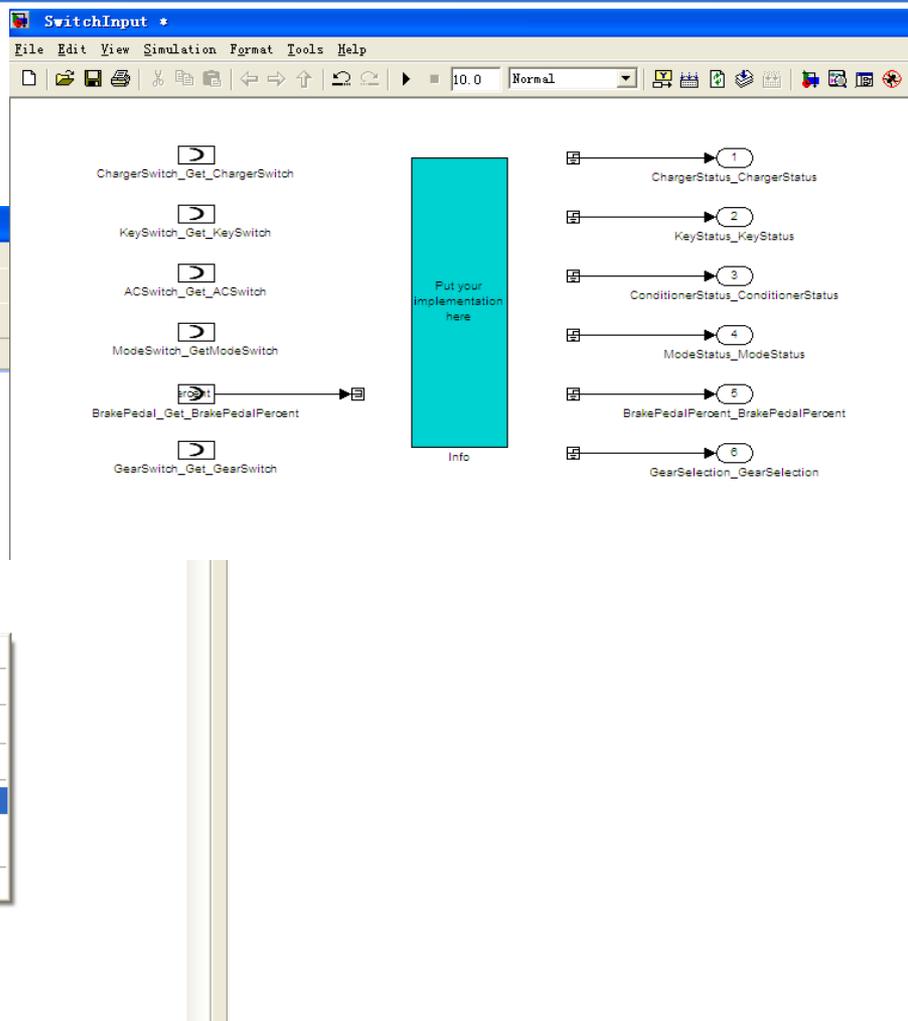
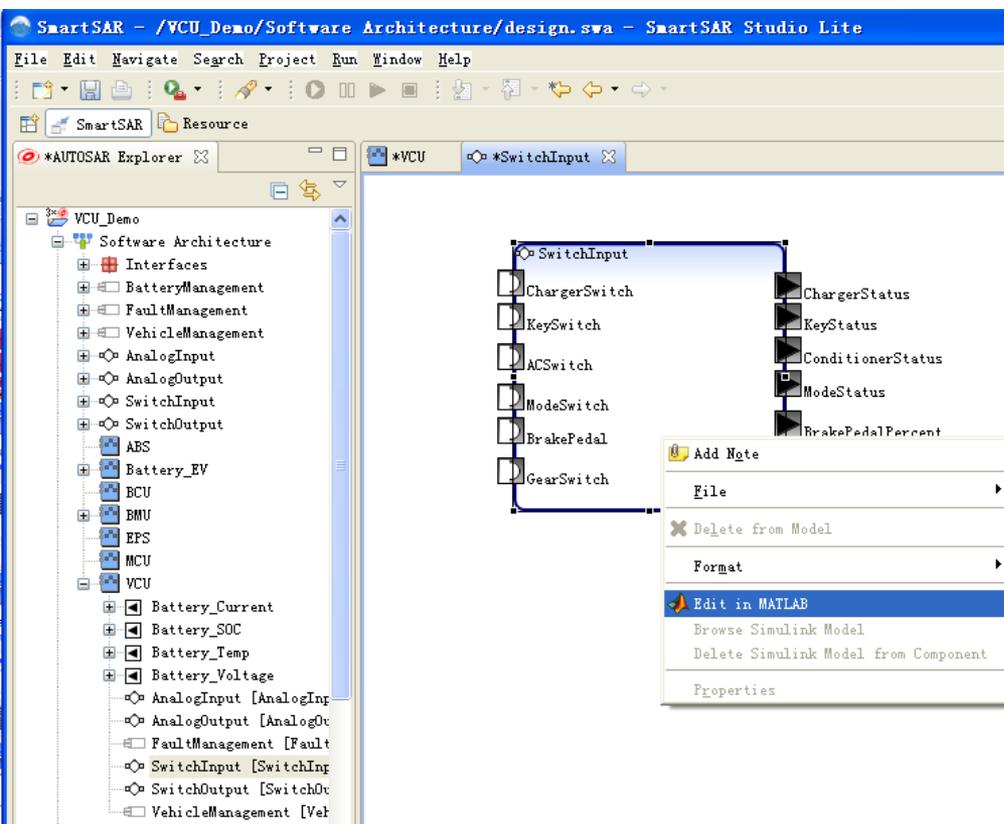
系统设计之软件架构

- SW-C的设计和新建
- SW-C的输入输出的定义
(Port、Interface)
- SW-C之间的关系绑定
(Connector)



系统设计之SW-C实现

- 通过Simulink等工具建模

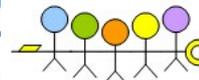


系统设计之SW-C描述导出 (arxml)

The screenshot displays the AUTOSAR Explorer interface. On the left, a tree view shows the project structure under 'VCU_Demo', with 'Software Architecture' expanded. A context menu is open over the 'SwitchInput' component, with 'Export Software Component Description' selected. The main workspace shows a diagram with components like 'ChargerStatus', 'KeyStatus', and 'ConditionerStatus' connected to 'SwitchInput'. A '另存为' (Save As) dialog box is open, showing the file is being saved as 'BatteryEV.arxml' in the 'Software Architecture' folder. The dialog also shows a list of recent files, including 'InternalBehavior' and 'BatteryEV.arxml'. The file name field contains 'BatteryEV.arxml' and the file type is set to 'AUTOSAR description file (*.arxml)'.

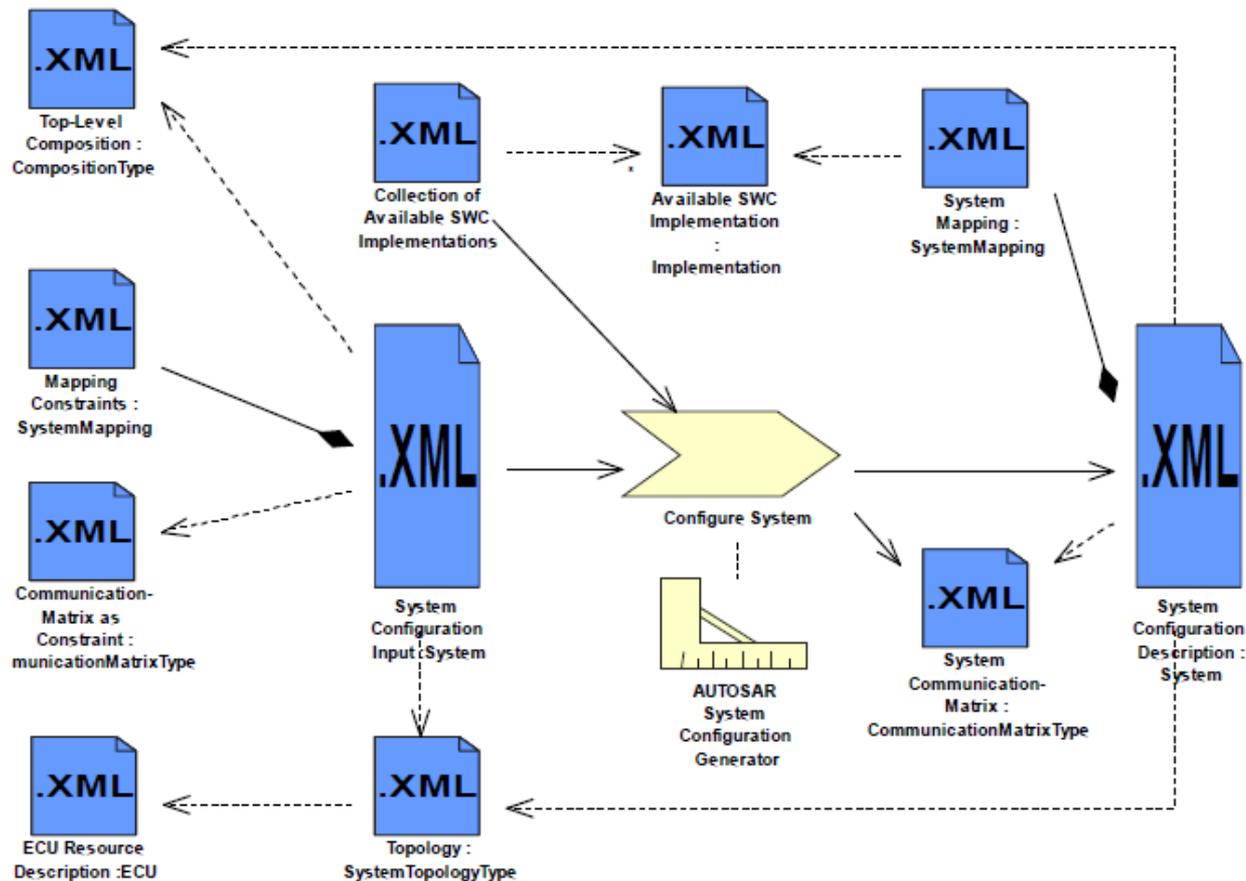
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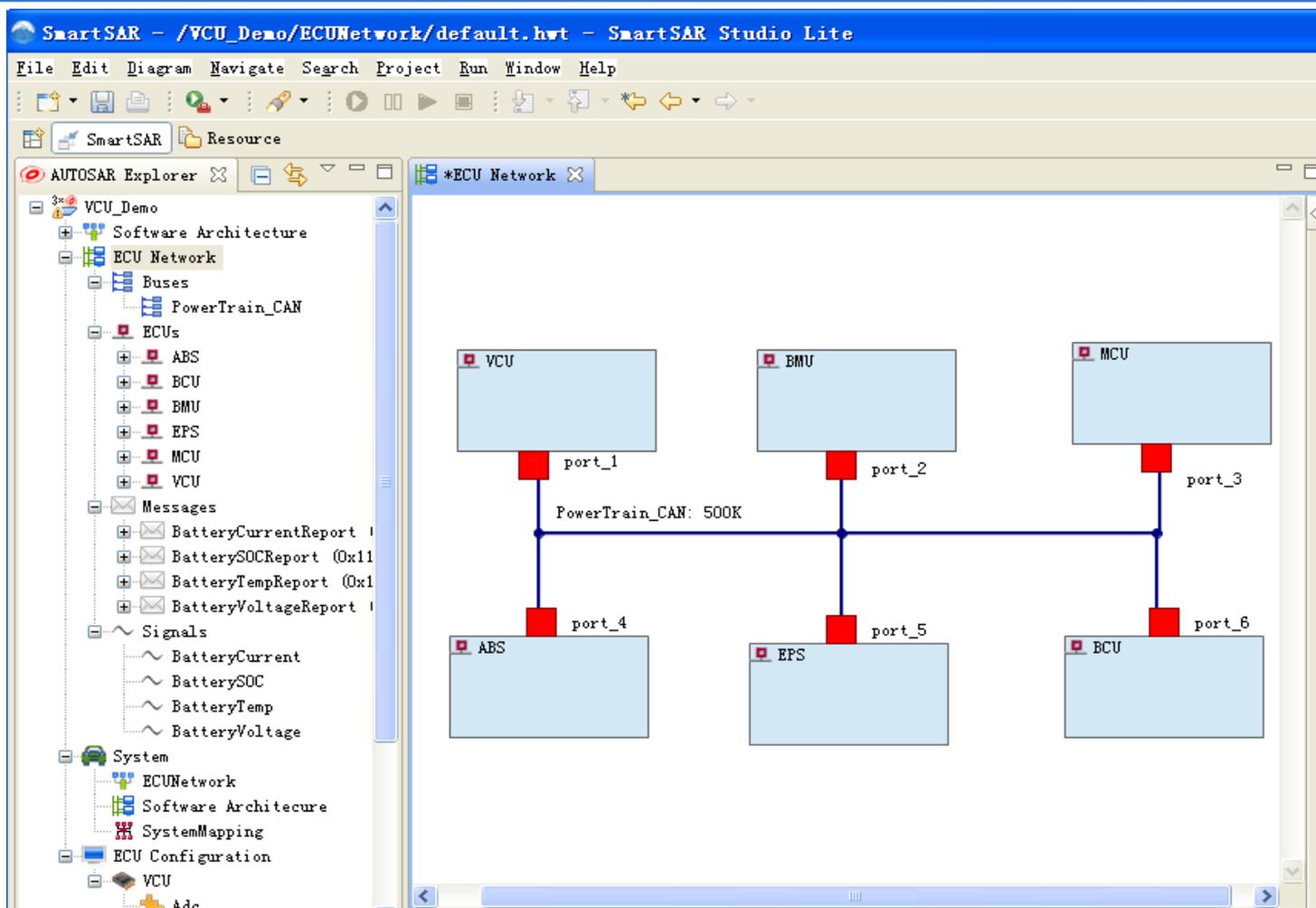


系统配置概述

- 硬件约束输入
- 总线约束输入
- SW-C映射



系统配置之总线的硬件拓扑



系统配置之通信矩阵设计

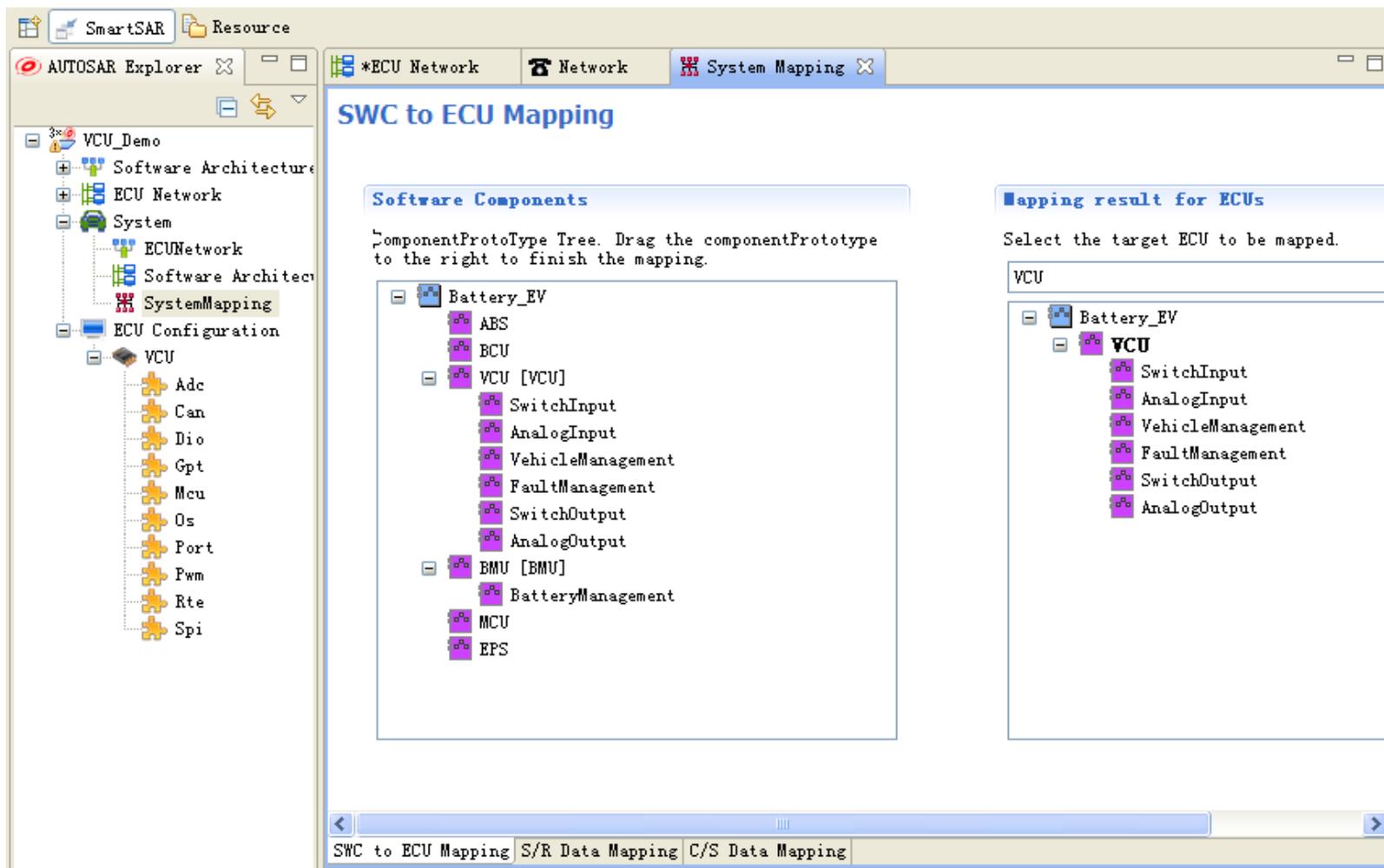
The screenshot displays the AUTOSAR Explorer interface. On the left, the project tree shows the configuration for 'VCU_Demo', including 'Software Architecture', 'ECU Network', 'Buses', 'ECUs', 'Messages', and 'Signals'. The 'ECU Network' section is expanded to show the 'PowerTrain_CAN' bus and its associated ECUs (ABS, BCU, BMU, EPS, MCU, VCU) and messages (BatteryCurrentReport, BatterySOCReport, BatteryTempReport, BatteryVoltageReport). The 'Messages' section is further expanded to show the internal structure of these messages, including 'BatteryCurrent', 'BatterySOC', 'BatteryTemp', and 'BatteryVoltage'.

On the right, the '*ECU Network' window is open, showing a 'Communication Matrix: PowerTrain_CAN'. The matrix is a table with the following structure:

Name	Message	StartPosition	Length[Bit]	
Communication Matrix: PowerTrain_CAN				
Signals	port_1 (VCU)	port_4 (ABS)	port_2 (BMU)	port_3 (M
BatteryCurrent	BatteryCurrentReport (0x112)		<Tx>BatteryCurrentRe...	
BatterySOC	BatterySOCReport (0x111)		<Tx>BatterySOCReport...	
BatteryTemp	BatteryTempReport (0x114)		<Tx>BatteryTempRepor...	
BatteryVoltage	BatteryVoltageReport (0x113)		<Tx>BatteryVoltageRe...	

At the bottom of the interface, there are tabs for 'Validation', 'Console', and 'Description'.

系统配置之SW-C与硬件映射



系统配置之数据映射

The screenshot displays the SmartSAR AUTOSAR Explorer software interface. The left sidebar shows a project tree for 'VCU_Demo' with various components like 'Software Architecture', 'ECU Network', 'System', 'ECUNetwork', 'Software Architecture', 'SystemMapping', 'ECU Configuration', and 'VCU'. The 'VCU' component is expanded to show sub-components: 'Adc', 'Can', 'Dio', 'Gpt', 'Mcu', 'Os', 'Port', 'Pwm', 'Rte', and 'Spi'. The main workspace is titled 'S/R Data Mapping' and contains two panels: 'Data Elements' and 'SystemSignals'. The 'Data Elements' panel shows a tree structure for 'Battery_EV' under the 'BMU' context, listing elements like 'BatteryManagement', 'Battery_SOC', 'Battery_Current', 'Battery_Voltage', 'Battery_Temp', and 'BatteryTemp' with their respective data types (UInt16, UInt32). The 'SystemSignals' panel lists signals such as 'BatteryCurrentReport', 'BatterySOCReport', 'BatteryVoltageReport', and 'BatteryTempReport' with their corresponding data elements. A status bar at the bottom indicates the current view is 'S/R Data Mapping'.

系统配置描述的导出与抽取 (arxml)

The screenshot displays the AUTOSAR ARXML editor interface. The main window is divided into several panes:

- Left Pane:** Shows the project structure under 'AUTOSAR'. It includes a table of schema files:

xm...	http://www.w3.org/2001/XMLSchema-instance
xmlns	http://autosar.org/3.1.5
rsf:s	http://autosar.org/3.1.5 autosar_3-1-5.xsd

Below this is the 'TOP-LEVEL-PACKAGES' section, which contains an 'AR-PACKAGE (16)' with a list of elements:

SHORT-NAME	ELEMENTS
1 Units	ELEMENTS
2 ISignals	ELEMENTS
3 Frames	ELEMENTS
4 IPdus	ELEMENTS
5 SystemMapping	ELEMENTS
- Right Pane:** Shows the 'SYSTEM' configuration. It includes a 'MAPPING' section with 'DATA-MAPPINGS' and 'SW-MAPPINGS'.
 - DATA-MAPPINGS:** Contains a 'SENDER-RECEIVER-TO-SIGNAL-MAPPING' table:

DATA-EL...	SIGNAL
1 DATA-EL...	SIGNAL
2 DATA-EL...	SIGNAL
3 DATA-EL...	SIGNAL
4 DATA-EL...	SIGNAL
 - SW-MAPPINGS:** Contains a 'SWC-TO-ECU-MAPPING (2)' table:

SHORT-NAME	COMPO
1 VCU_mapping	COMPO
2 BMU_mapping	COMPO
- Bottom Pane:** Shows 'SOFTWARE-COMPOSITION' with a 'topLevel' element and a 'SOFTWARE-COMPOSITION-TREE' section.

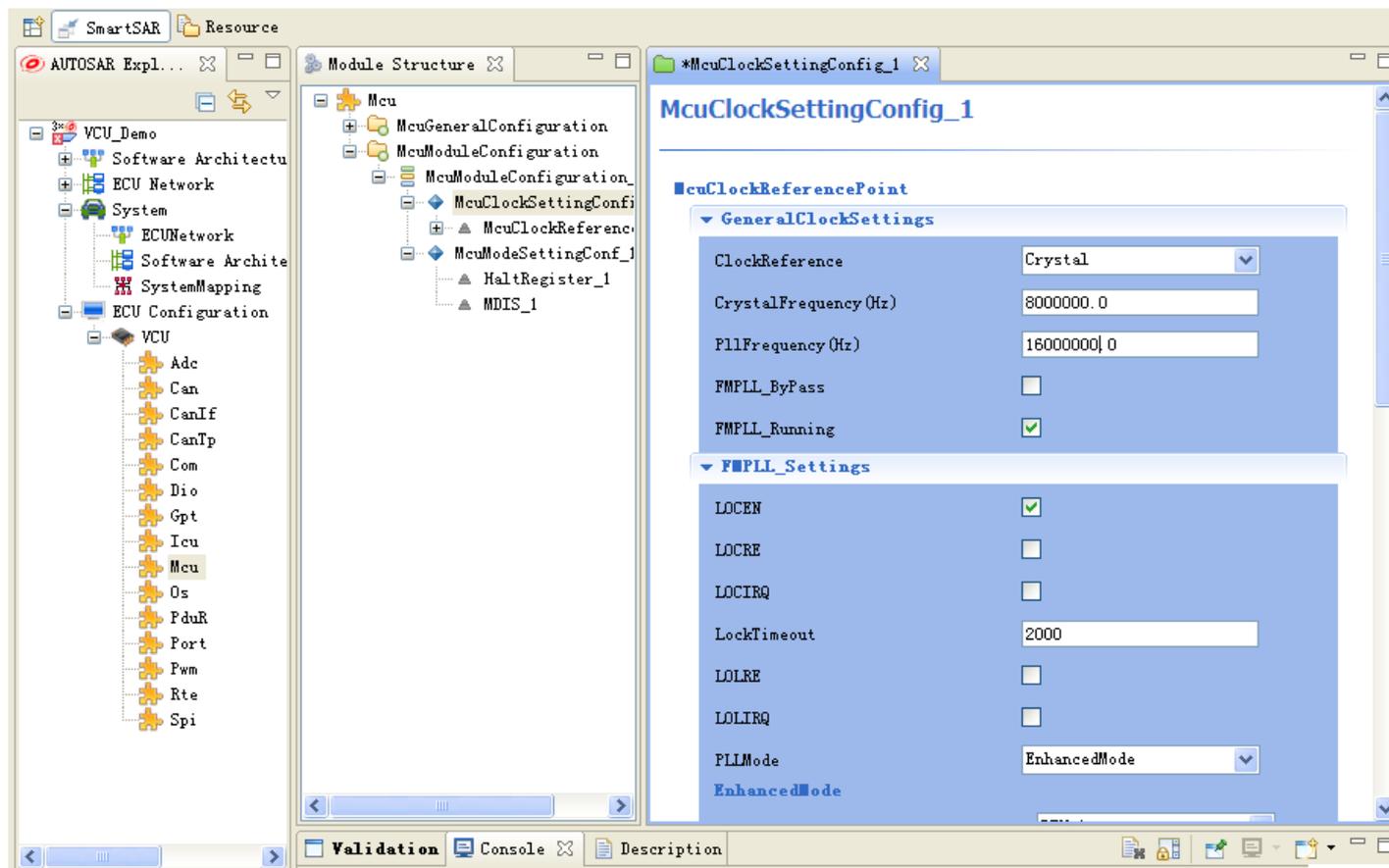
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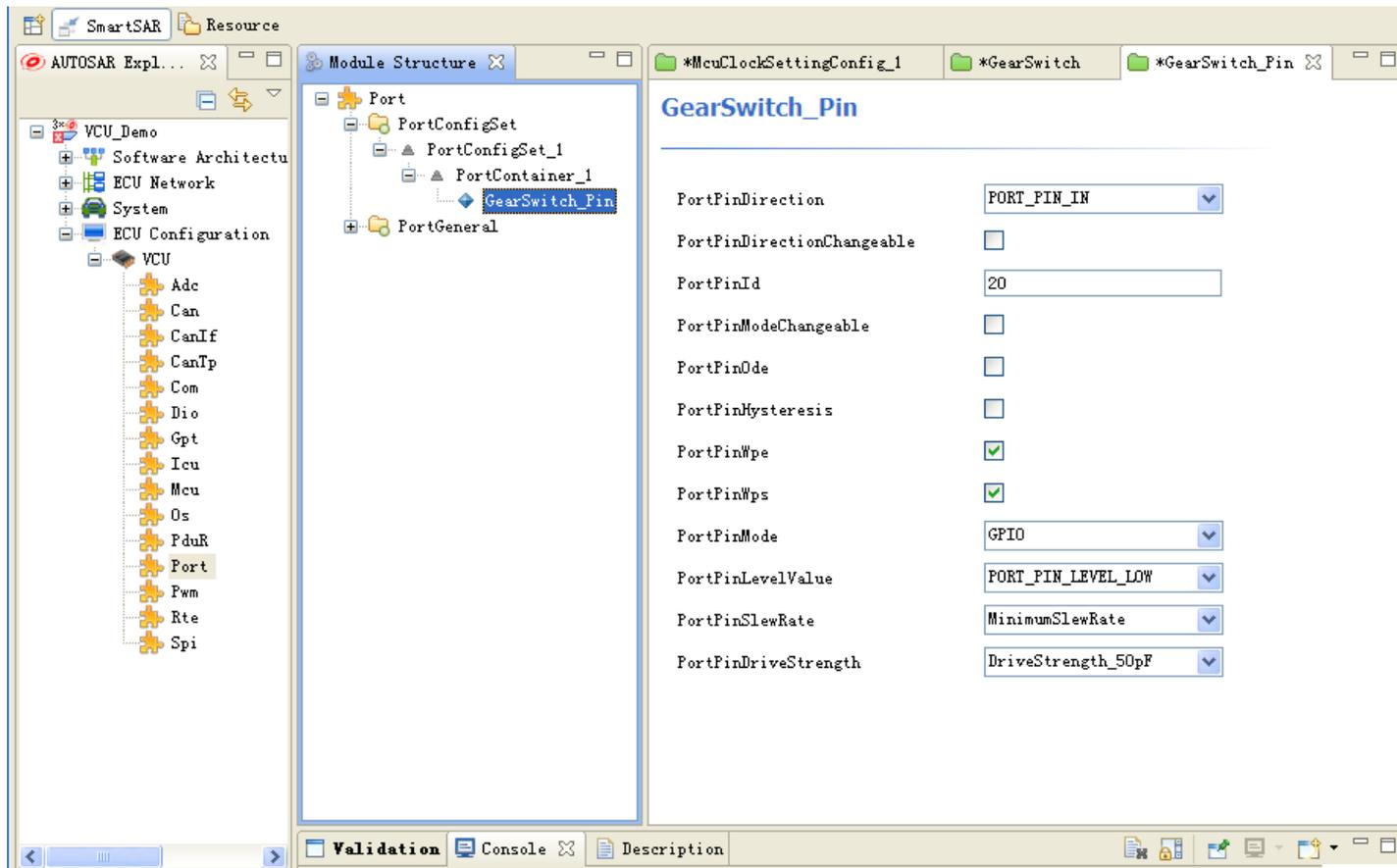
ECU配置

■ MCU基本配置



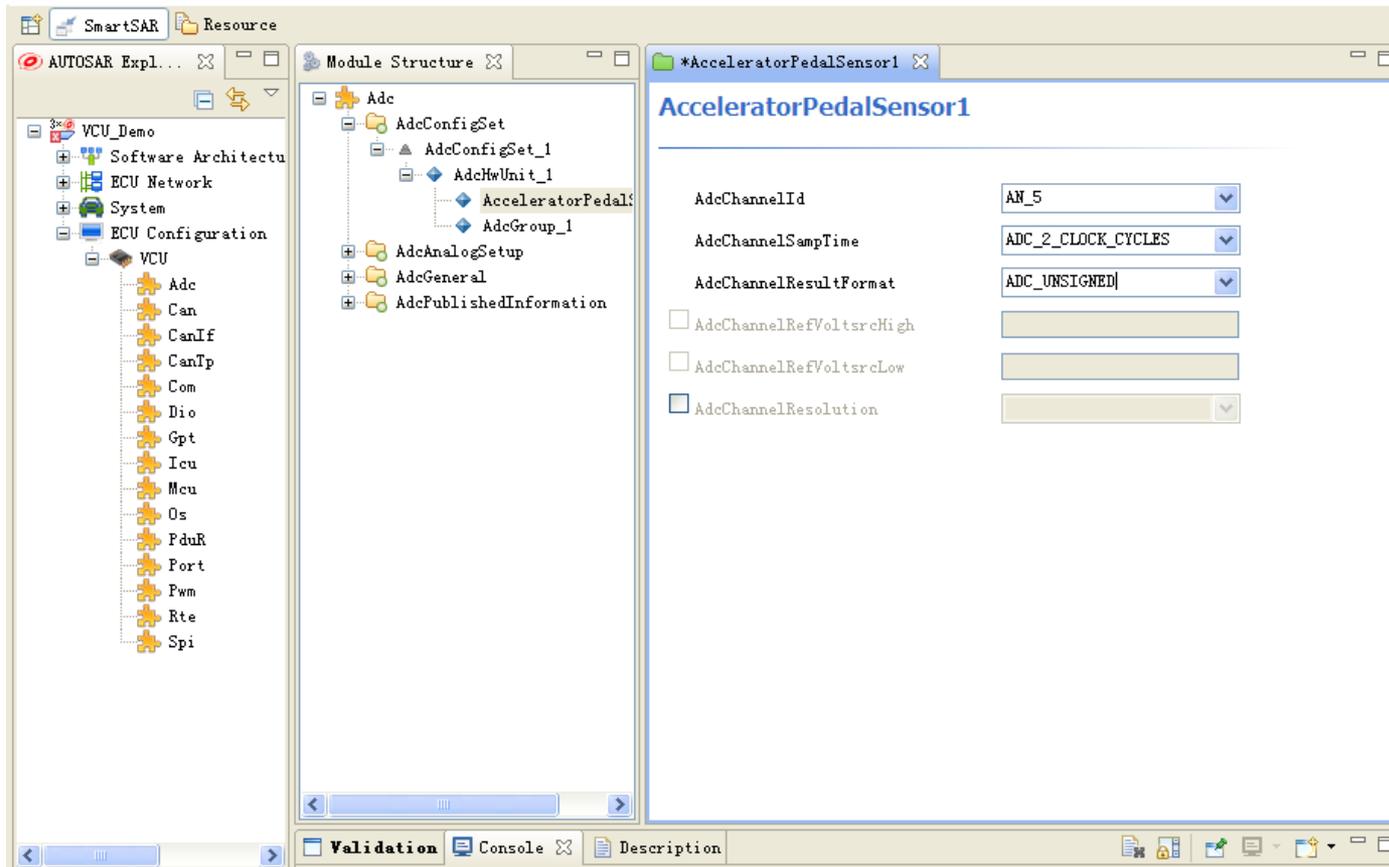
ECU配置

■ 信号引脚的配置



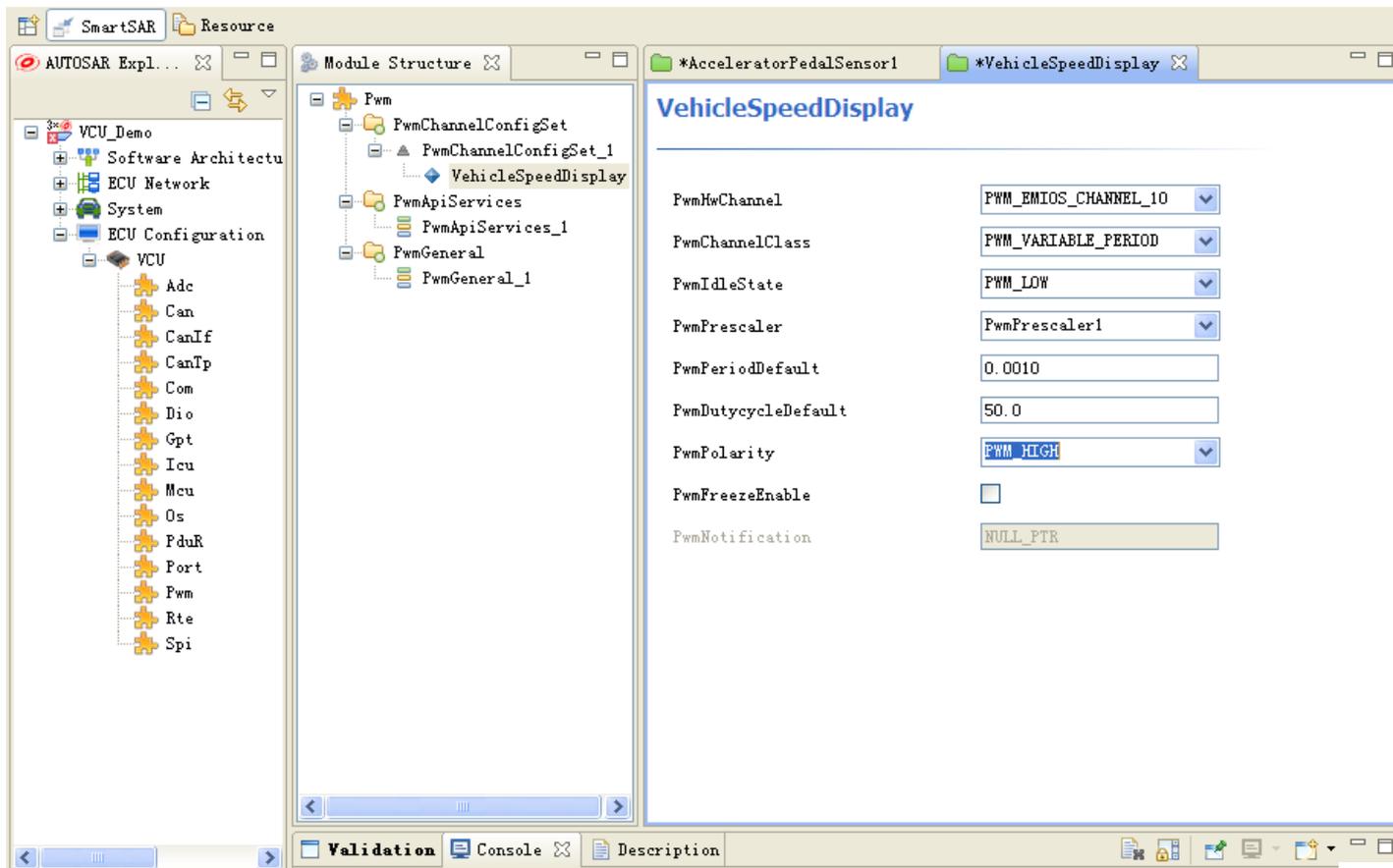
ECU配置

■ 模拟输入信号的配置 (ADC)



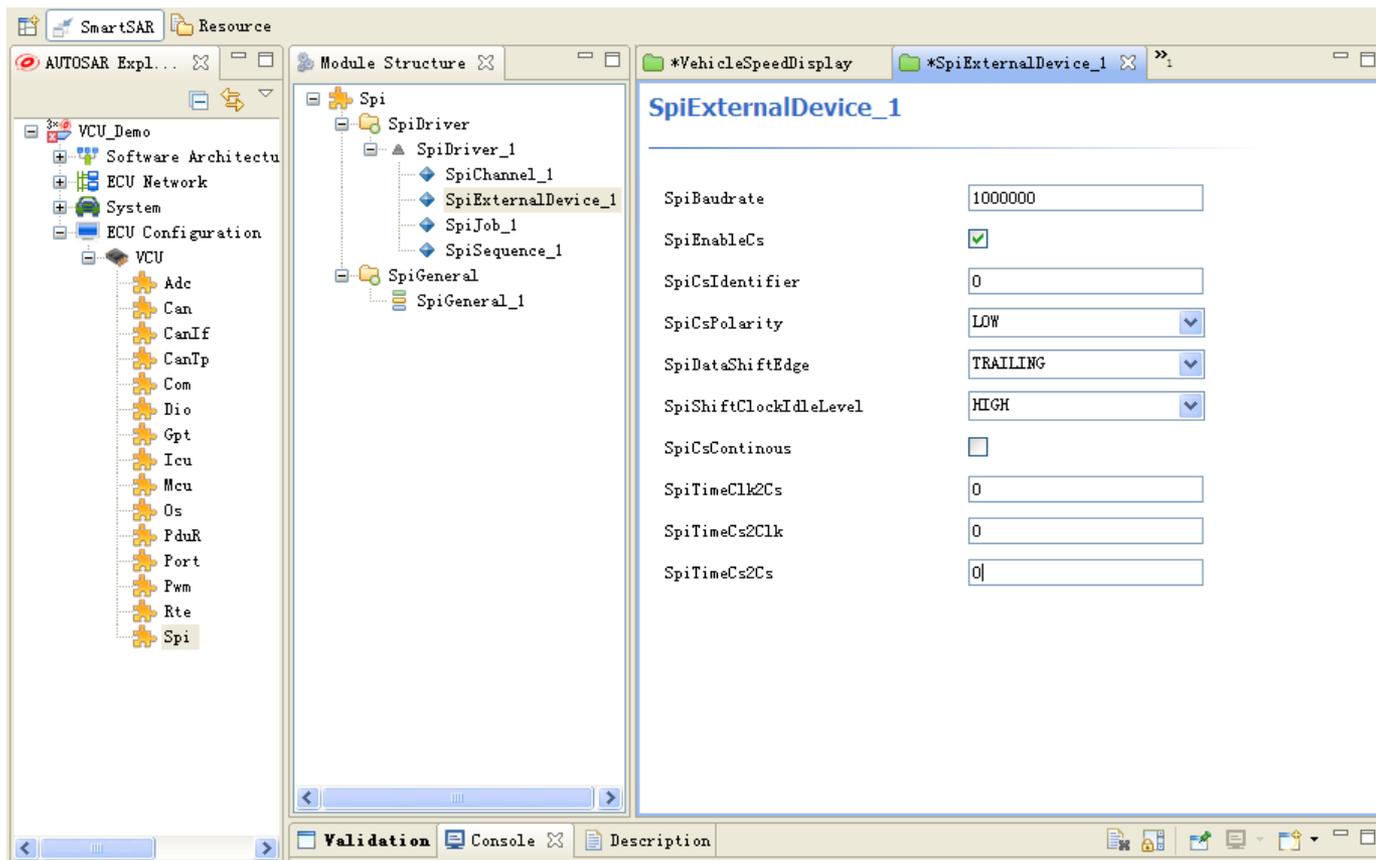
ECU配置

■ 模拟输出信号的配置 (PWM)



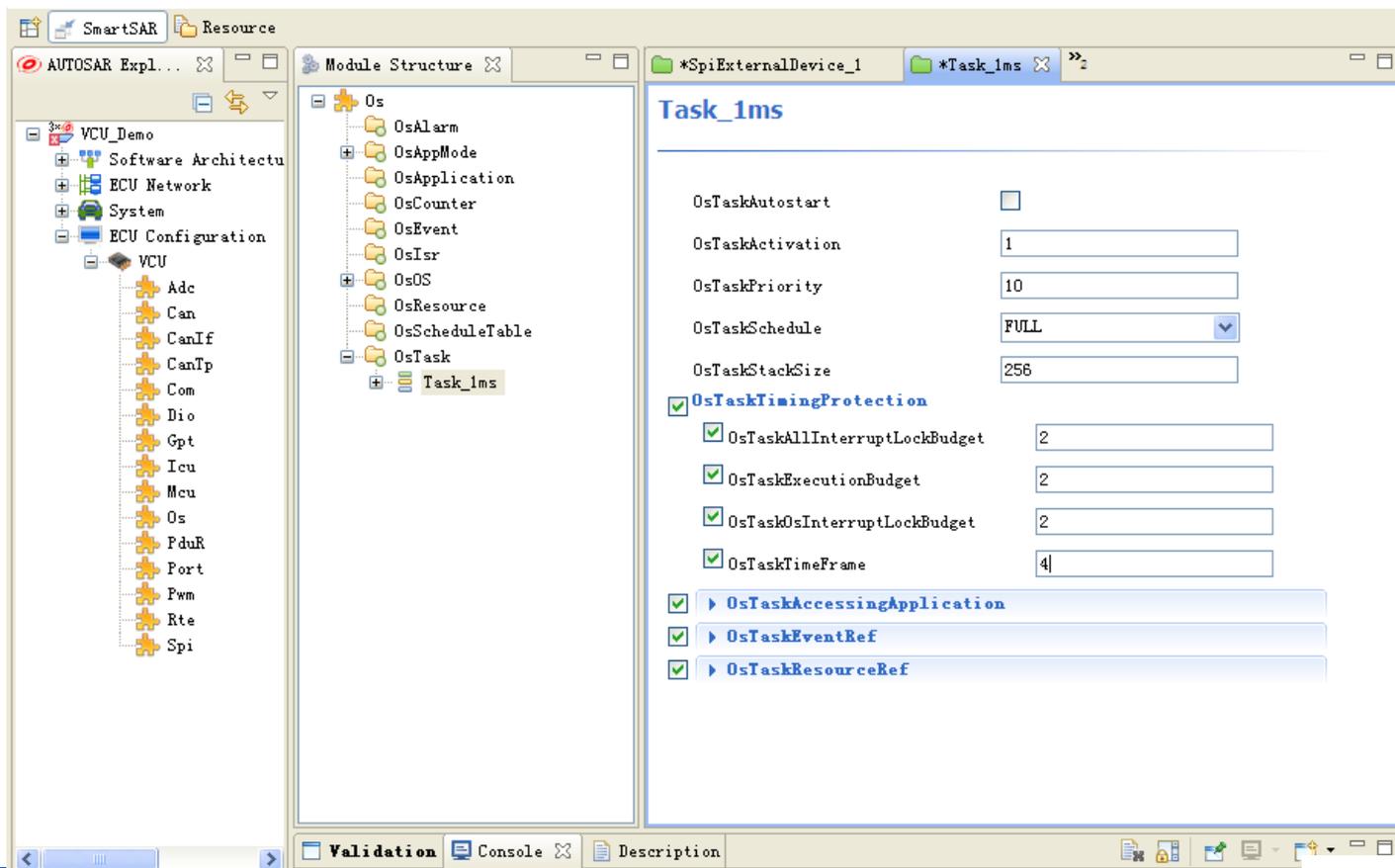
ECU配置

■ 总线信号的配置 (CAN, SPI)



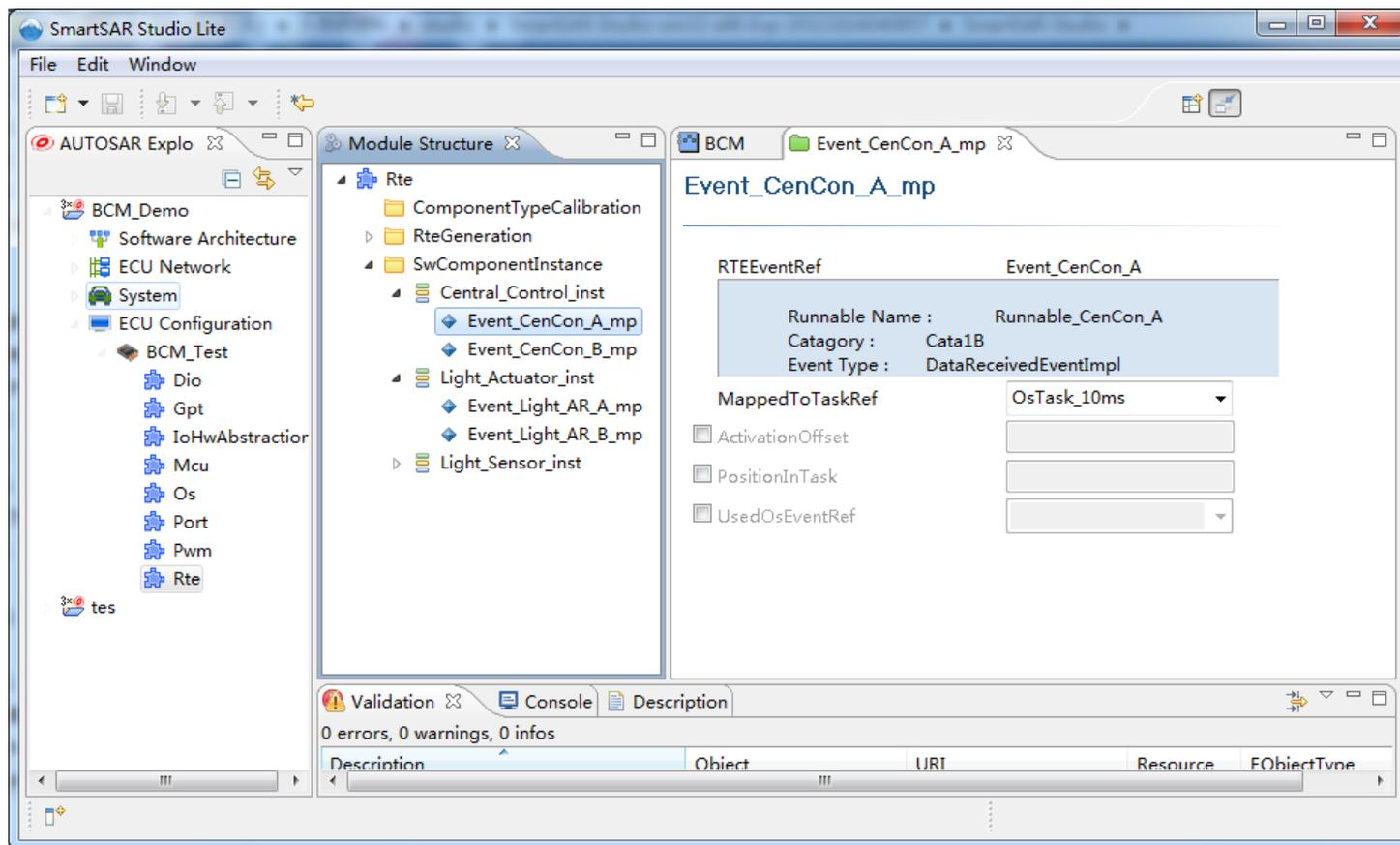
服务配置

■ RTOS等模块的配置



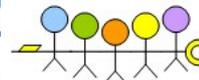
服务配置

■ RTE的配置



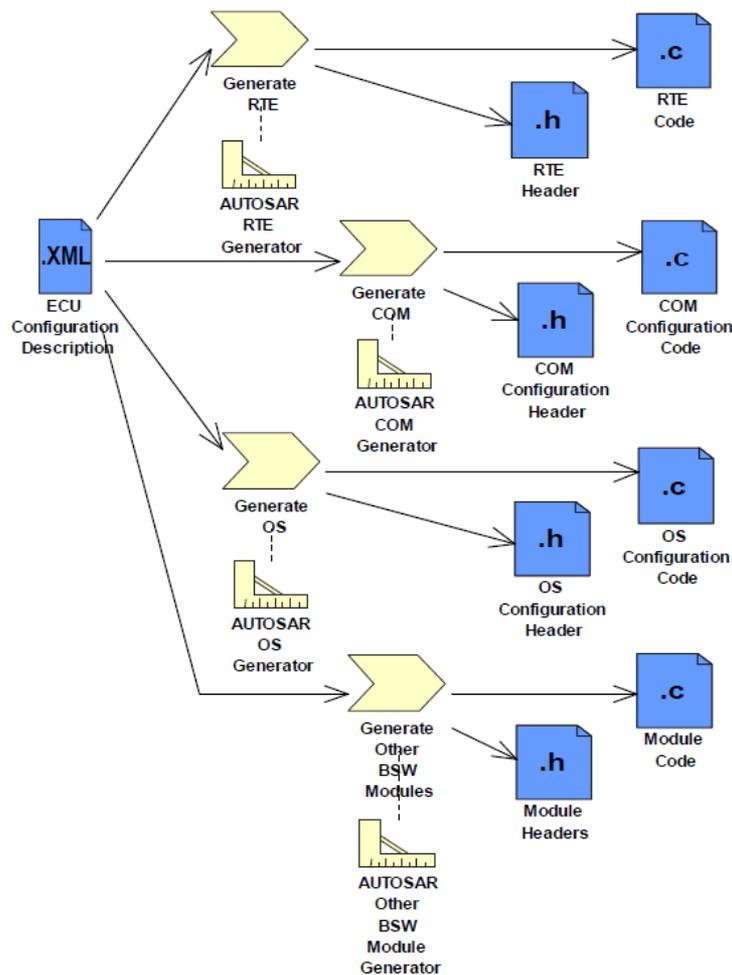
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生成代码

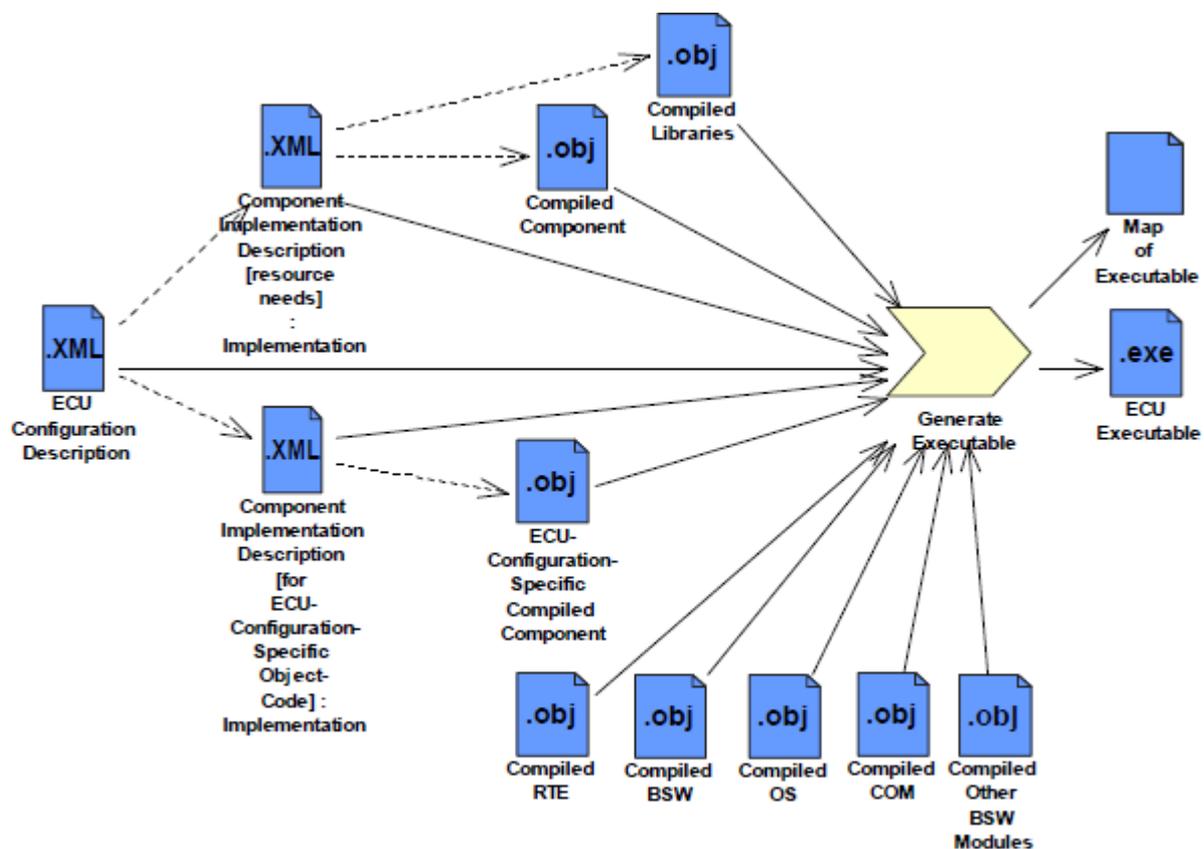
- 生成RTE
- 生成COM的应用
- 生成OS的应用
- 生成BSW的应用



生成可执行文件

■ 链接以下目标代码：

- 编译后的SW-C
- SW-C的相关库
- 编译后的RTE
- 编译后的BSW
- 编译后的COM
- 编译后的OS



参考文档

- 《AUTOSAR_Methodology.pdf》
- 《AUTOSAR_SWS_VFB.pdf》
- 《SmartSAR Studio User Manual.pdf》



Thanks

Q&A