



ZEEKR

基于模型开发的面向服务的车载应用软件的设计与测试

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2024 MathWorks
中国汽车年会

1.背景介绍

2.框架模型配置

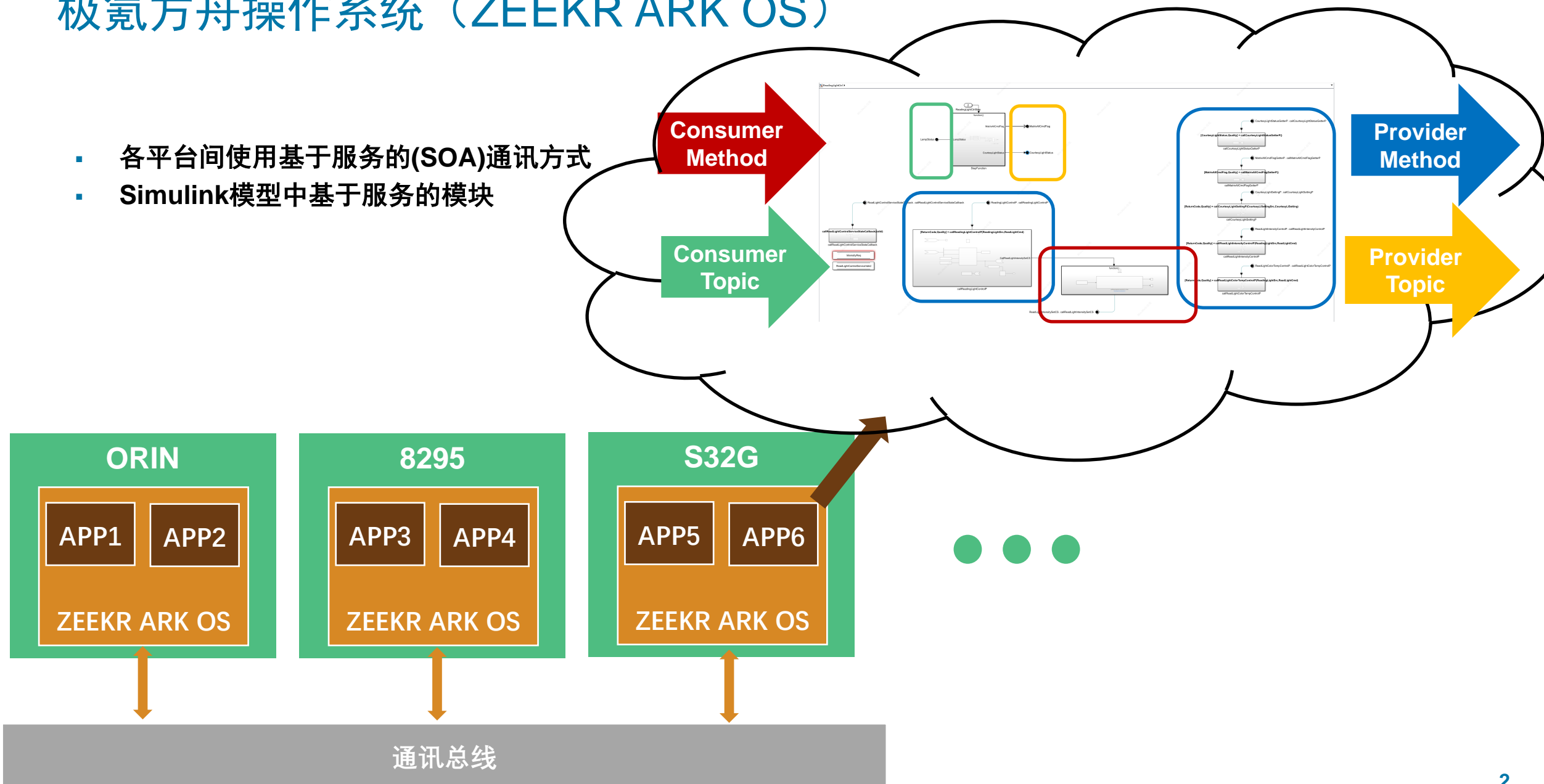
3.根据需求建模

4.模型测试

5.代码集成与测试

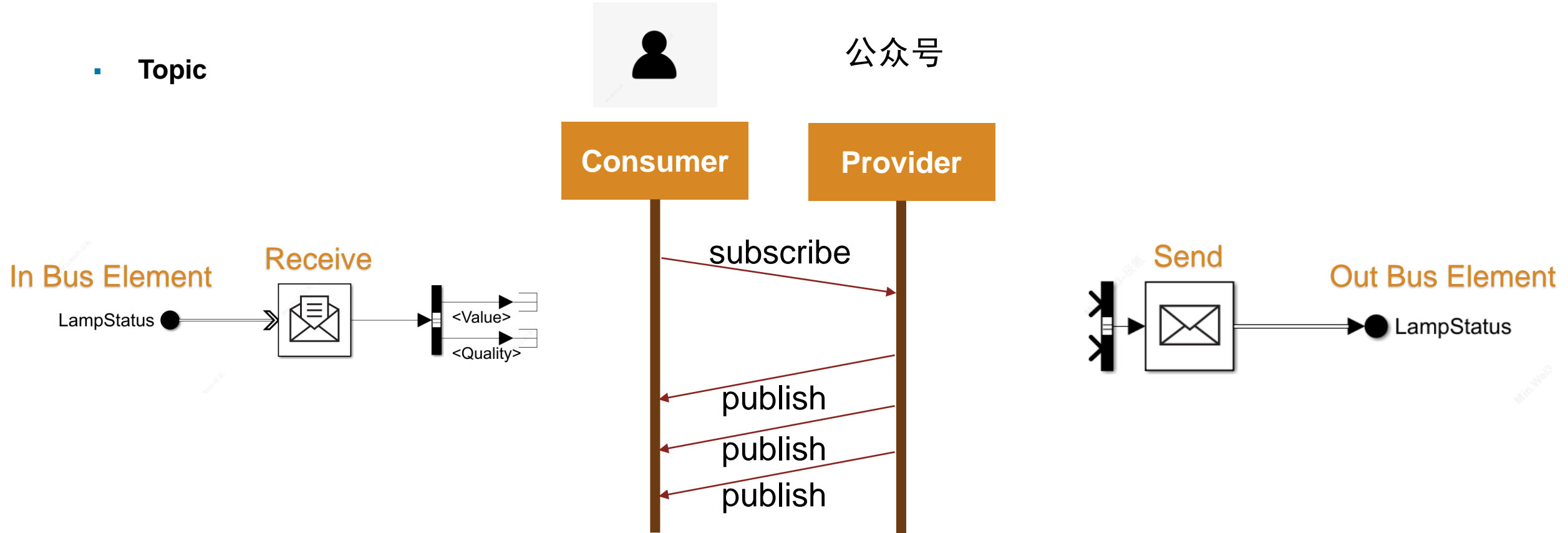
极氪方舟操作系统 (ZEEKR ARK OS)

- 各平台间使用基于服务的(SOA)通讯方式
- Simulink模型中基于服务的模块



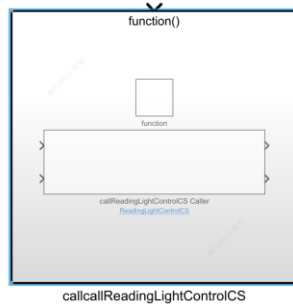
Simulink中服务化的接口

- **Topic**



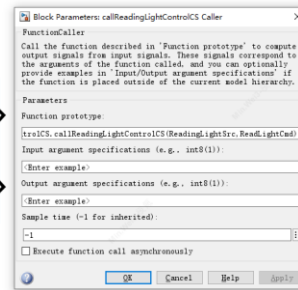
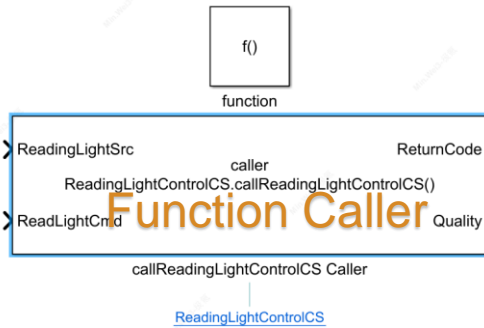
Simulink中服务化的接口

- Method**

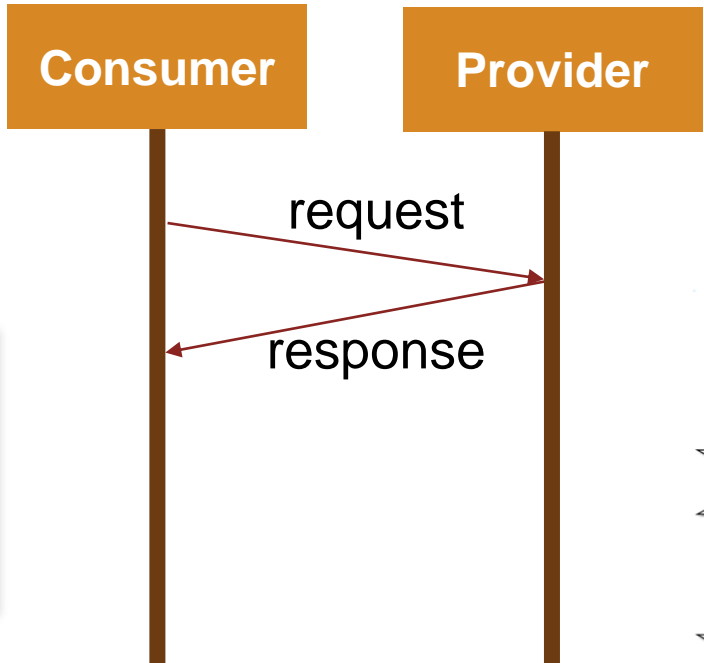


ReadingLightControlCS . callReadingLightControlCS

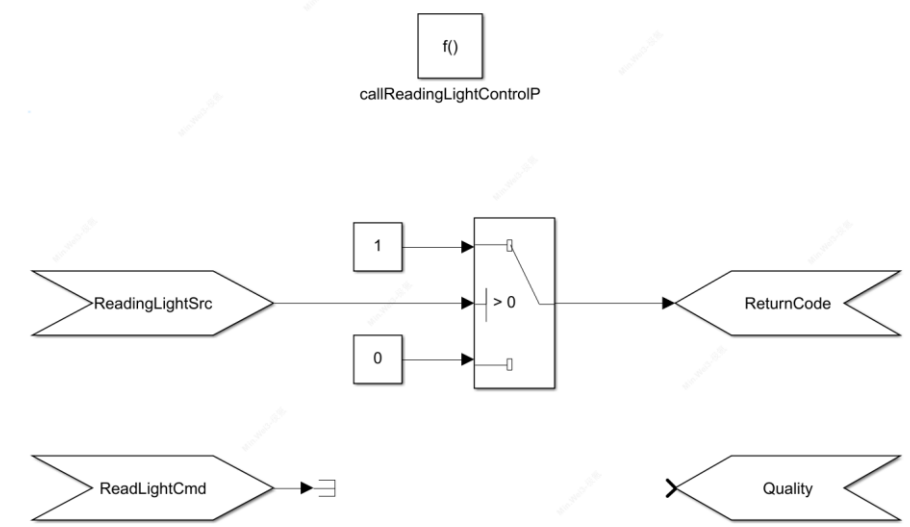
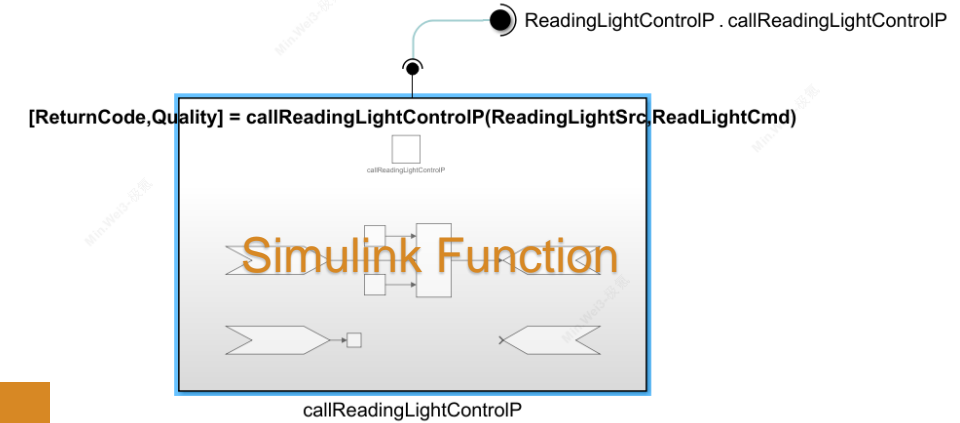
Function Element Call



“一问一答”

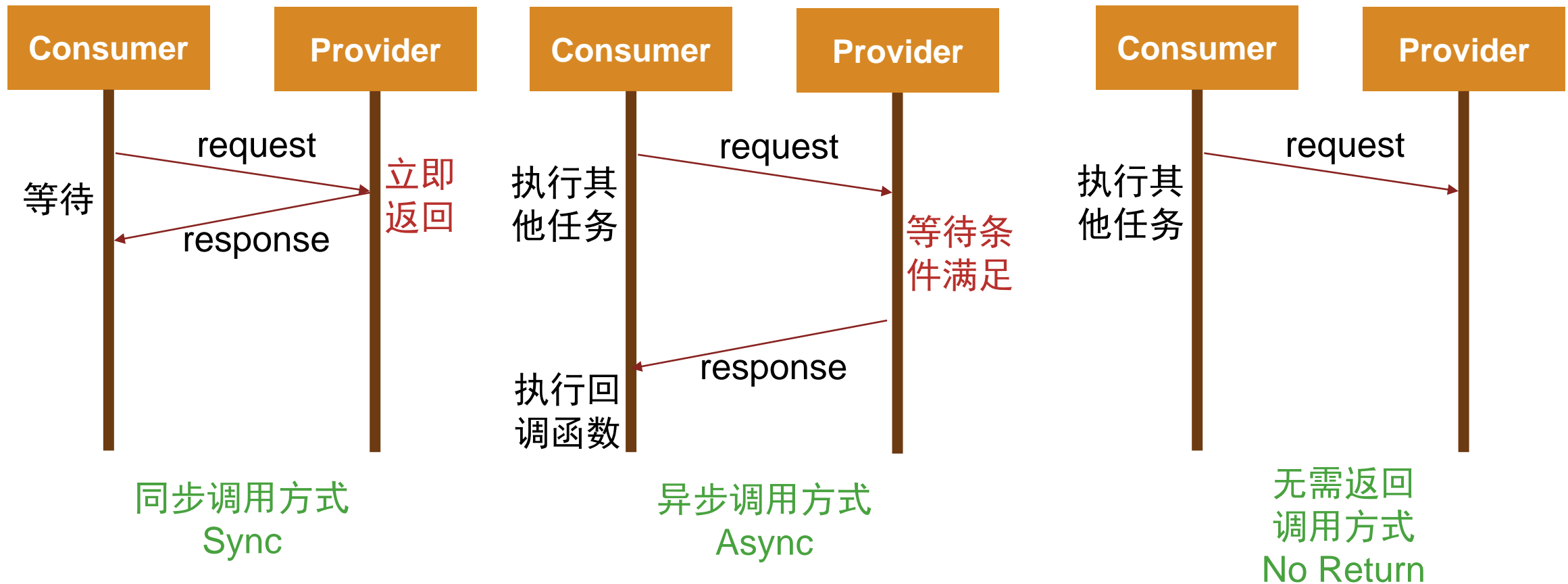


Function Element

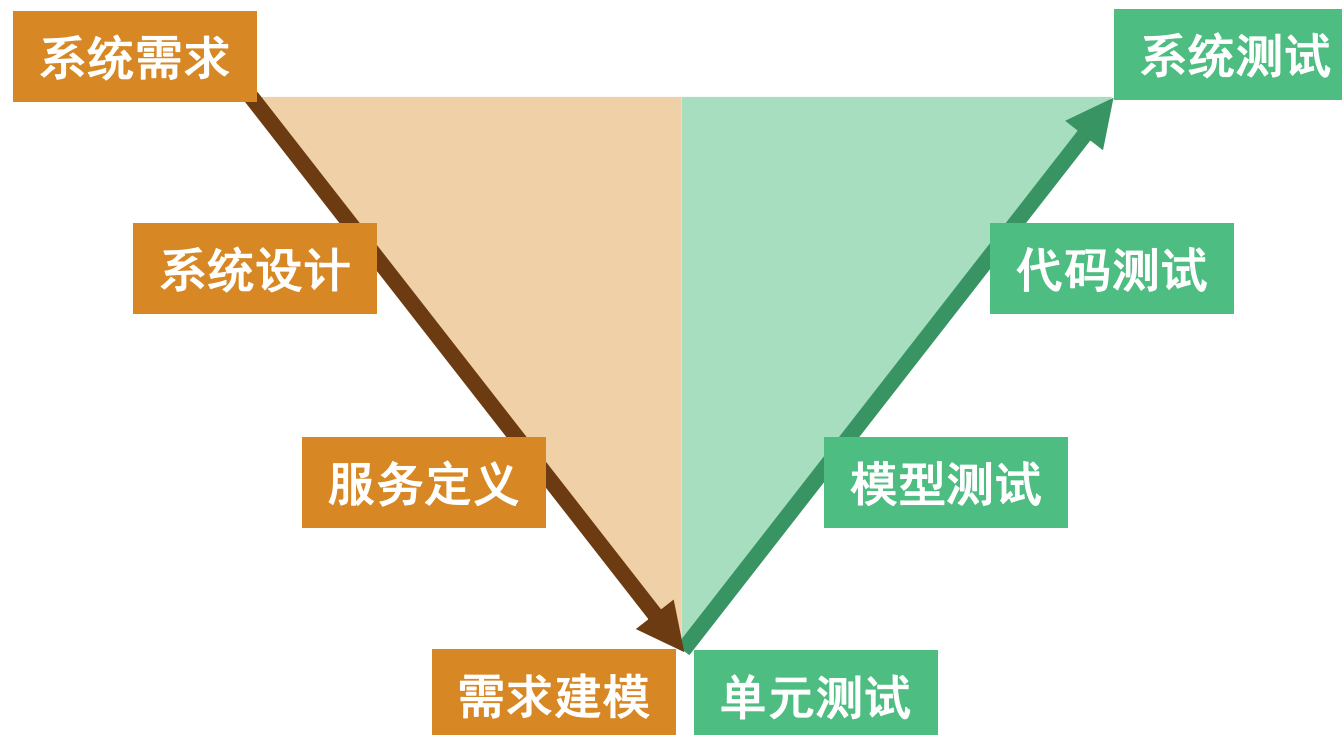


Simulink中服务化的接口

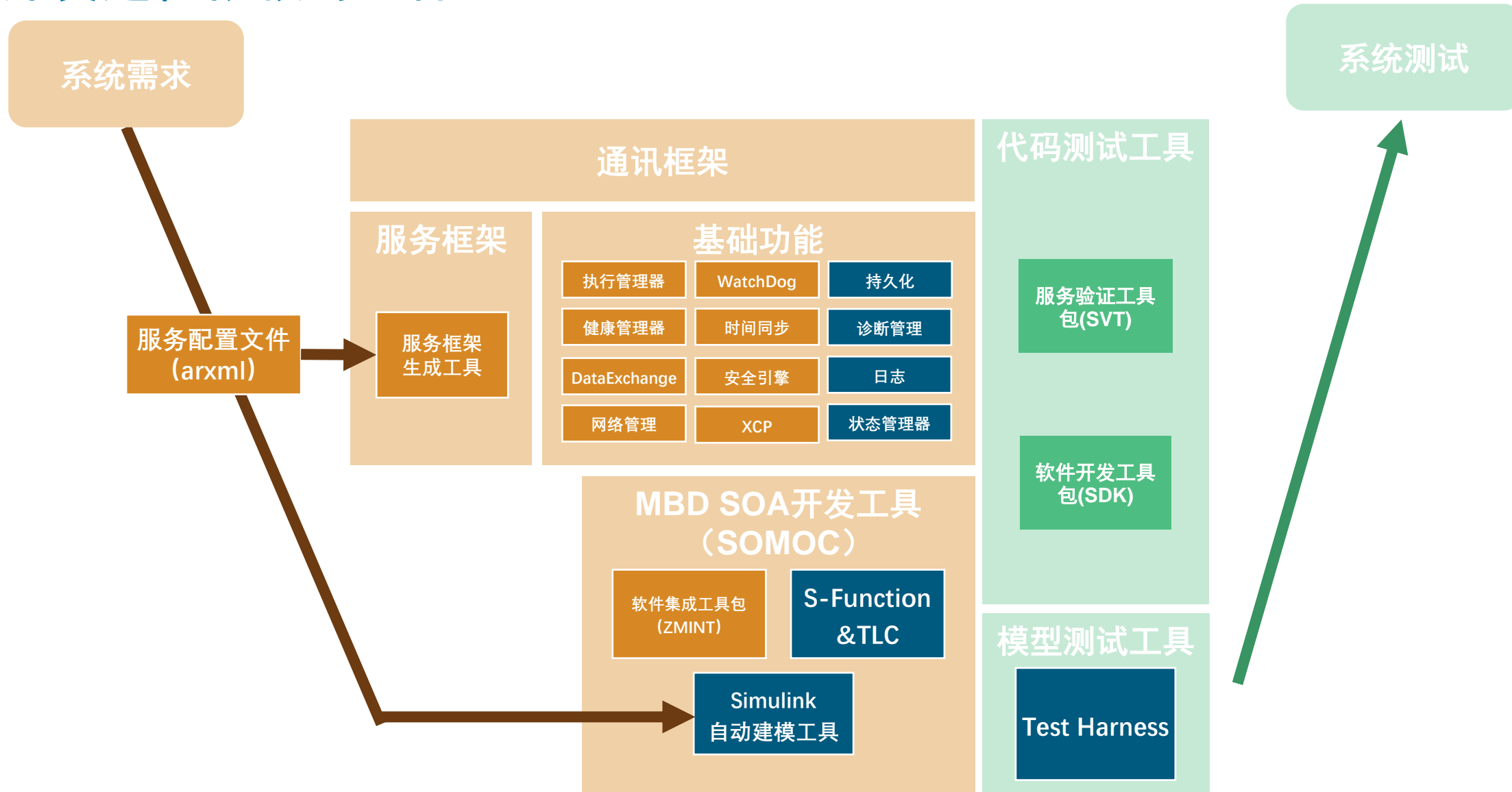
- Consumer Method的三种调用方式
- Provider Method的两种返回方式



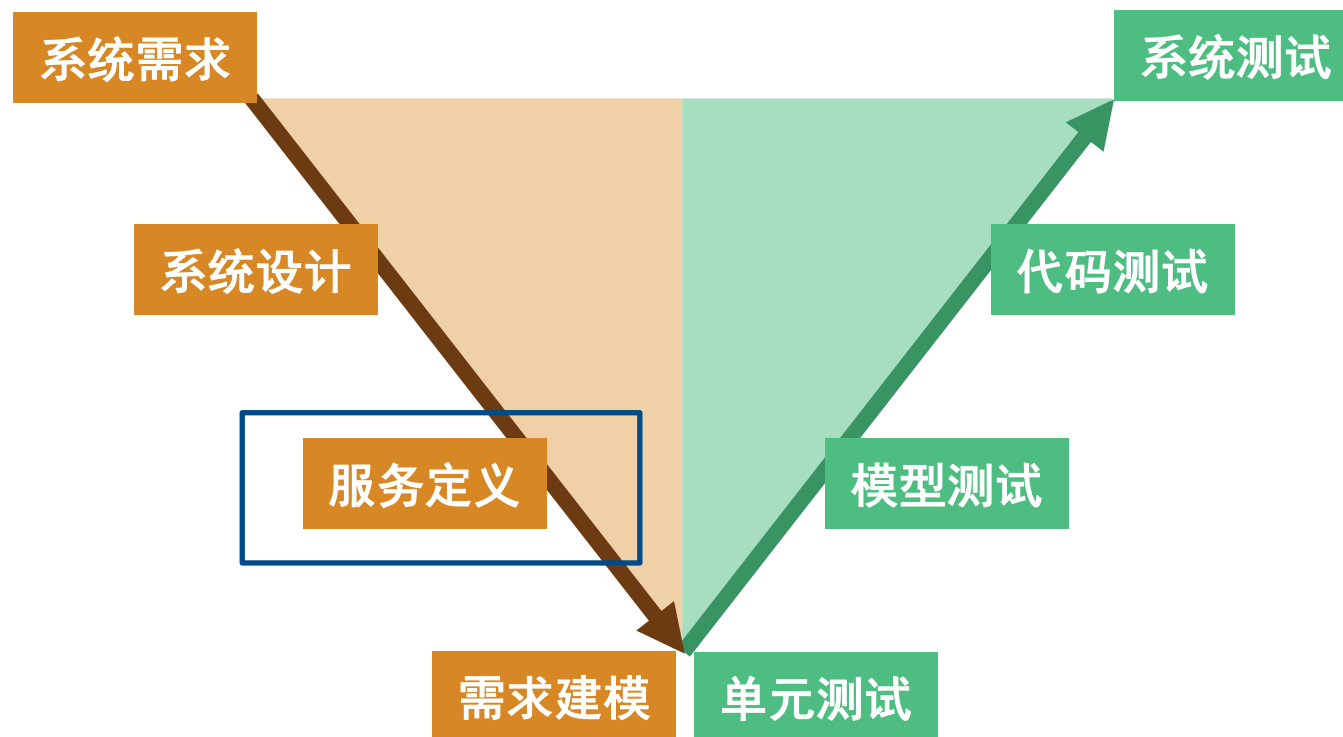
整体开发流程



开发过程依赖的组件



1. 背景介绍
- 2. 框架模型配置**
3. 根据需求建模
4. 模型测试
5. 代码集成与测试



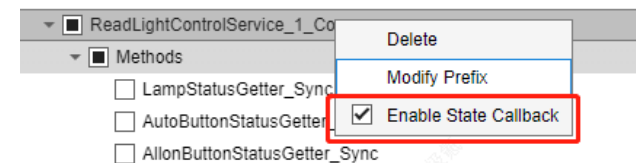
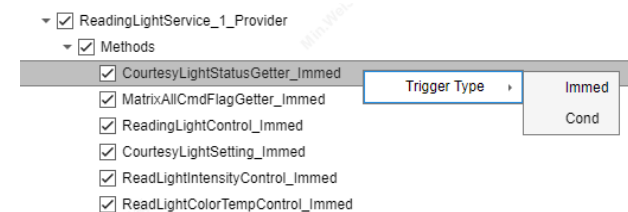
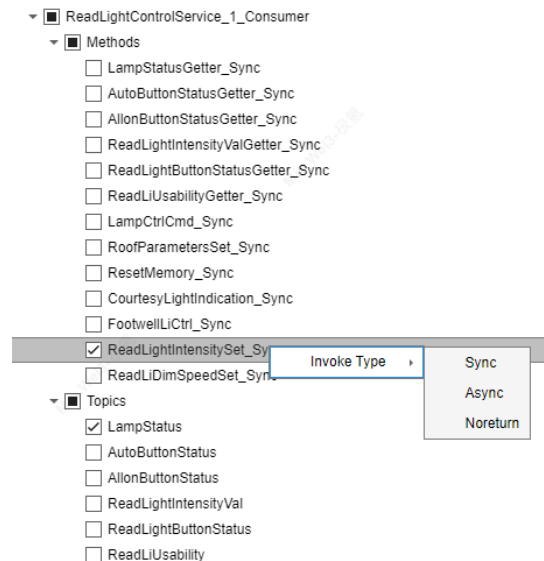
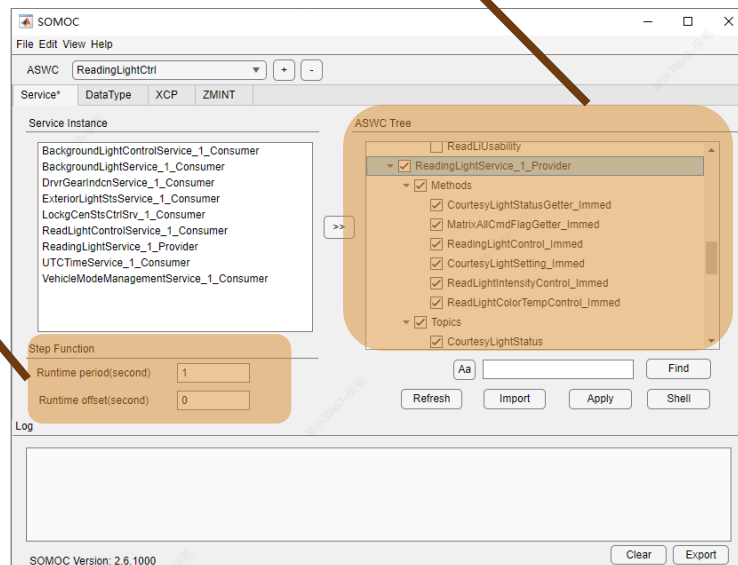
框架模型配置

配置服务接口

- C端选择需要的Method Topic
- C端Method的执行方式（同步、异步、无需返回）
- C端是否生成状态回调函数
- P端Method的返回方式（立即返回、条件返回）

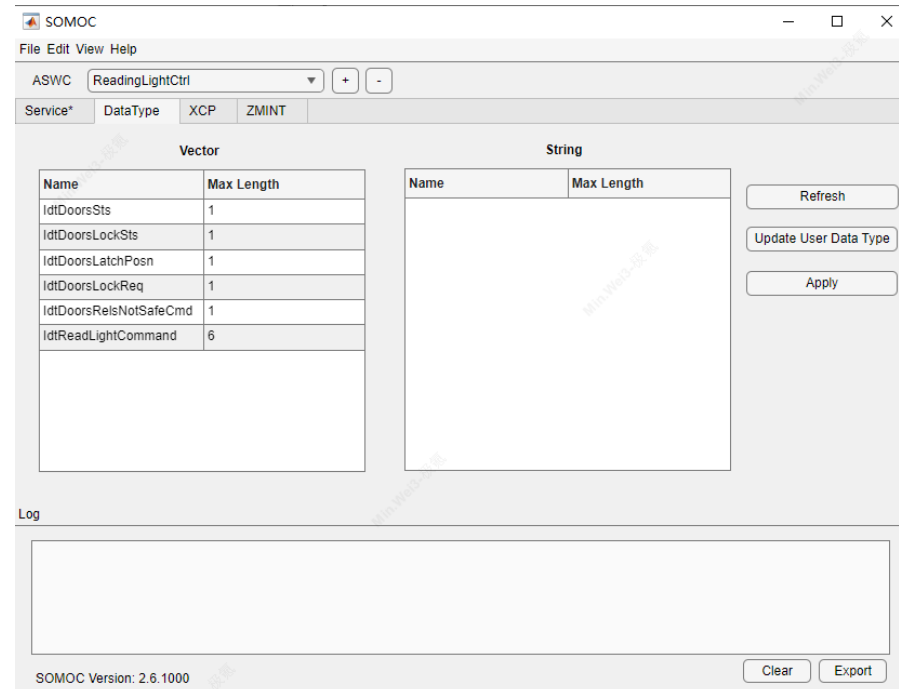
配置定时器

- 间隔时间
- 起始时间



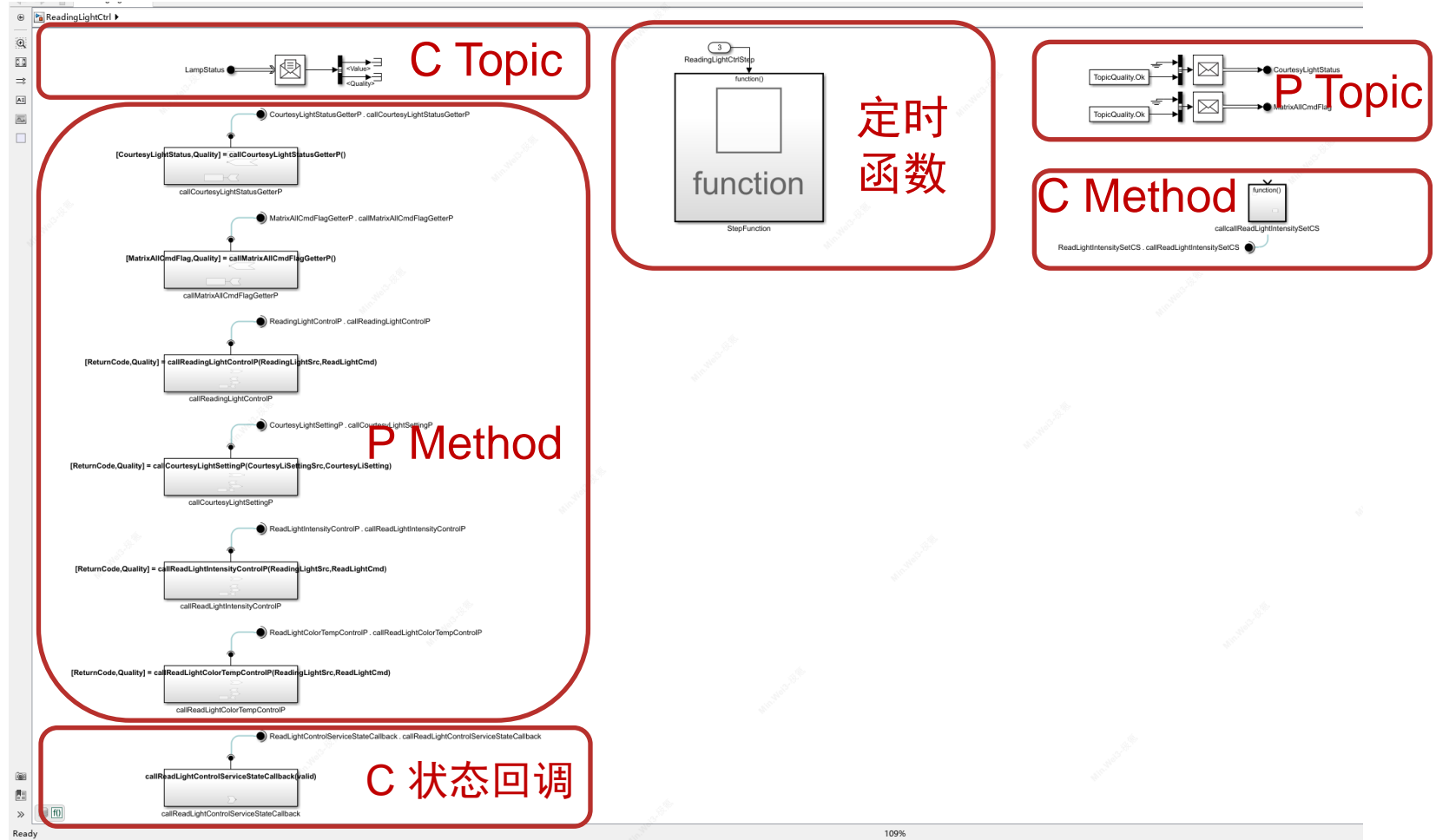
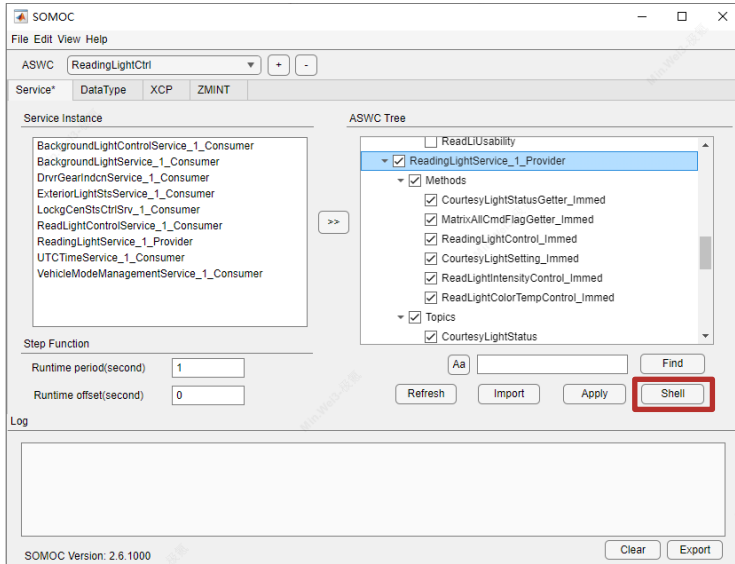
框架模型配置

- 配置特殊数据类型
 - 在Simulink中实现动态数组的最大长度
 - 在Simulink中实现字符串的最大长度

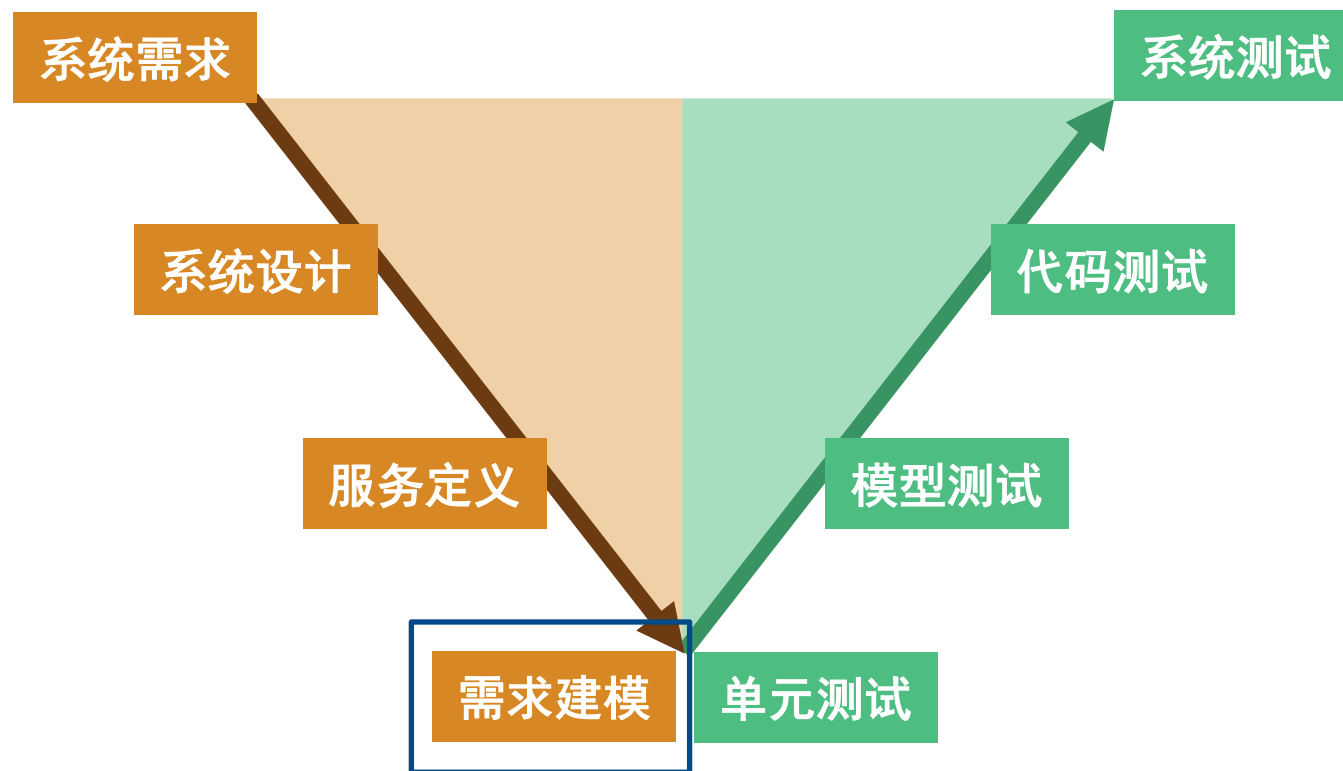


框架模型配置

- 生成框架模型

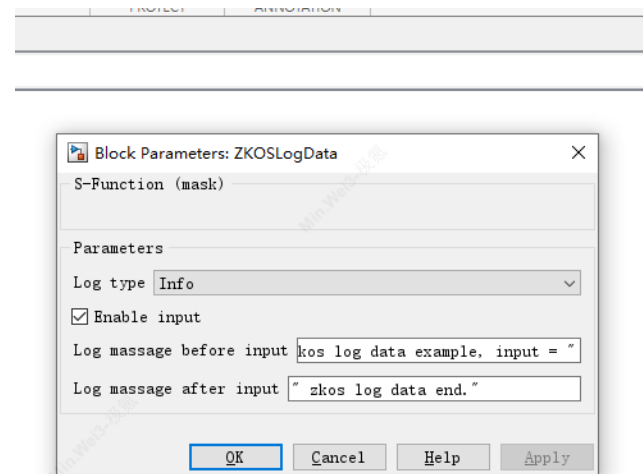
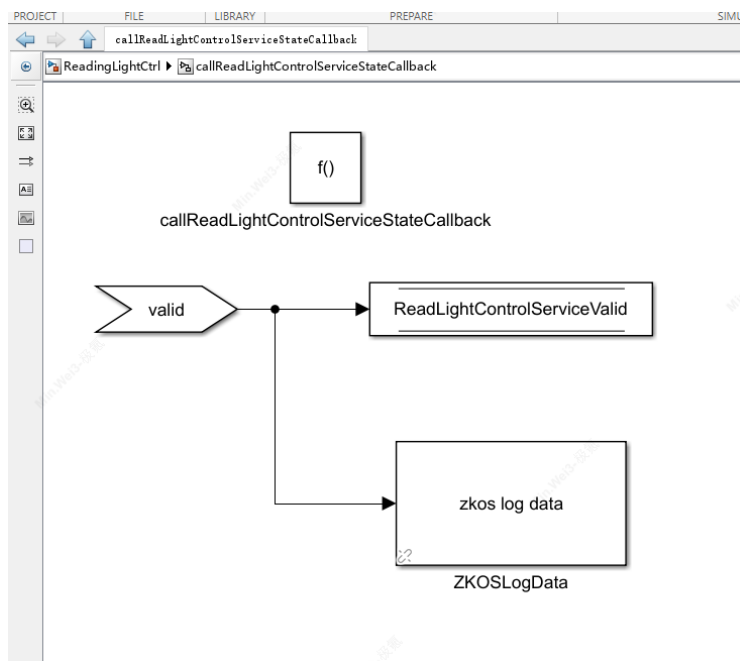
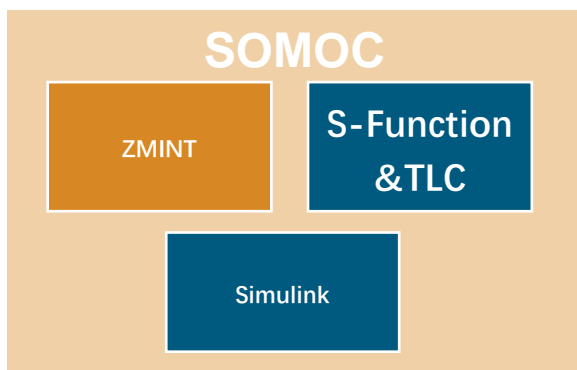
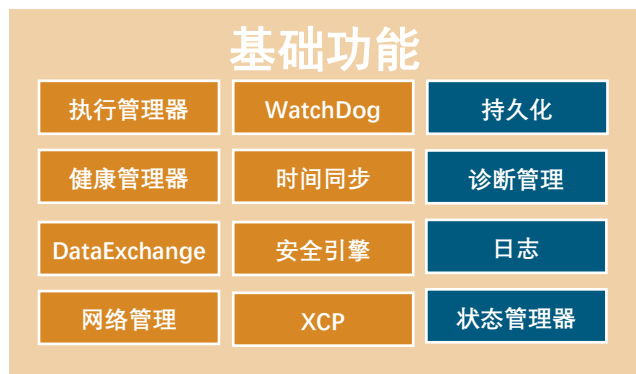
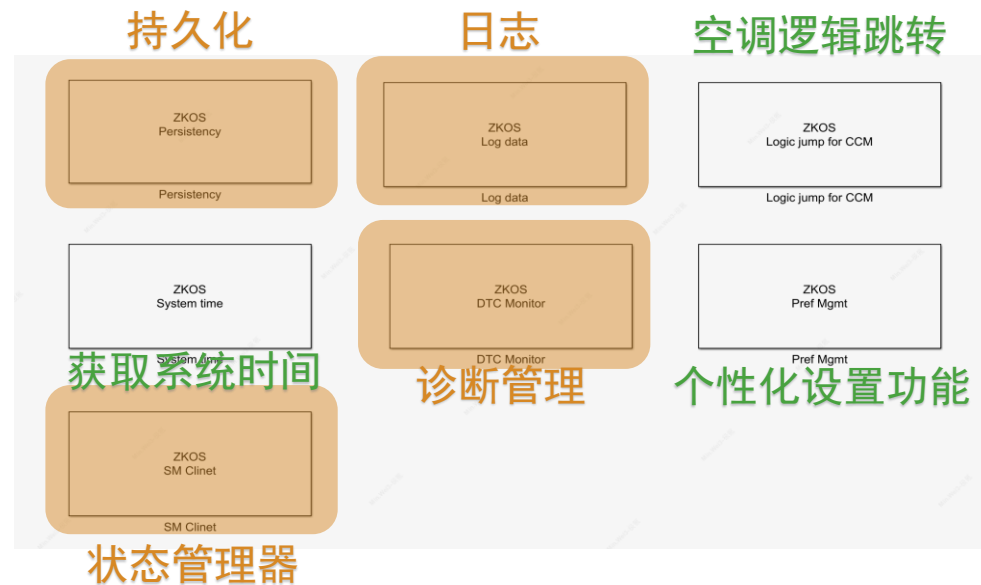
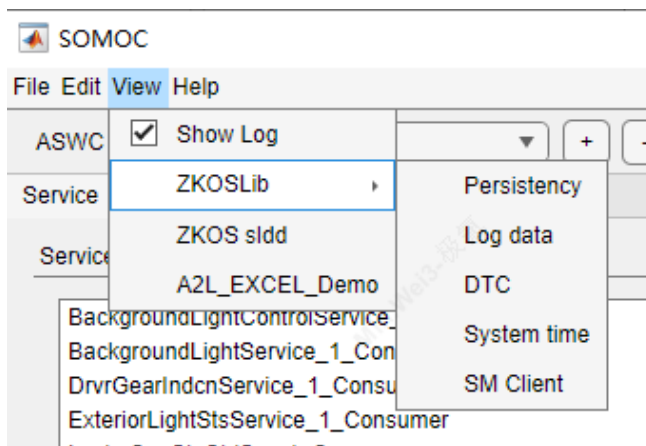


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需求建模

- 集成ZEEKR ARK OS中间件模块
- 集成定制化业务模块



需求建模

S-Function&TLC

```

Editor - D:\jenkinsWorkspaceForSOMOC\workspace\toolchain\somoc\somoc-develop\Toolkit\Interface\LogInterface\log_data.c
log_data.c
1  #define S_FUNCTION_NAME log_data
2  #define S_FUNCTION_LEVEL 2
3  #include "simstruc.h"
4  #include "matrix.h"
5
6  #define GET_LOGTYPE(S)          (ssGetSFcnParam(S,0))
7  #define GET_ENINPUT(S)         (ssGetSFcnParam(S,1))
8  #define GET_LOGMESSAGEBEFOREINPUT(S) (ssGetSFcnParam(S,2))
9  #define GET_LOGMESSAGEAFTERINPUT(S) (ssGetSFcnParam(S,3))
10
11 /*-----*
12  * S-function methods *
13  *-----*/
14
15 /* Function: mdlInitializeSizes -----*
16  * Abstract:
17  * The sizes information is used to determine the S-function
18  * block's characteristics (number of inputs, outputs, states, etc.).
19  */
20 static void mdlInitializeSizes(SimStruct *S){
21     ssSetNumSFcnParams(S, 4); /* Number of S-function parameters */
22     ssSetSFcnParamTunable(S, 0, false);
23     ssSetSFcnParamTunable(S, 1, false);
24     ssSetSFcnParamTunable(S, 2, false);
25     ssSetSFcnParamTunable(S, 3, false);
26
27     ssSetNumContStates(S, 0); /* Number of continuous states */
28     ssSetNumDiscStates(S, 0); /* Number of discrete states */
29
30     /* 读取Mask中是否使能输入功能 */
31     char_T *enInput = (char_T*)malloc(mxGetNumberOfElements(GET_ENINPUT(S)) + 1);
32     mxGetString(GET_ENINPUT(S), enInput, mxGetNumberOfElements(GET_ENINPUT(S)) + 1);
33
34     if (strcmp(enInput, "on") == 0)
35     {
36         /* Initialize one input port with direct feedthrough */
37         if (!ssSetNumInputPorts(S, 1)) return;
38         ssSetInputPortDataType(S, 0, DYNAMICALLY_TYPED);
39         ssSetInputPortWidth(S, 0, 1);
40         ssSetInputPortDirectFeedthrough(S, 0, 1);
41     }
42     else
43     {
44         /* Initialize one input port with direct feedthrough */
45         if (!ssSetNumInputPorts(S, 0)) return;
46     }
47
48     /* Initialize one output port */
49     if (!ssSetNumOutputPorts(S, 0)) return;
50
51     /* Initialize one sample time */
52     ssSetNumSampleTimes(S, 1);
53
54     ssSetOptions(S,
55                 SS_OPTION_WORKS_WITH_CODE_REUSE |
56                 SS_OPTION_EXCEPTION_FREE_CODE);
57
58     free(enInput);
59 }
60 }
61

```

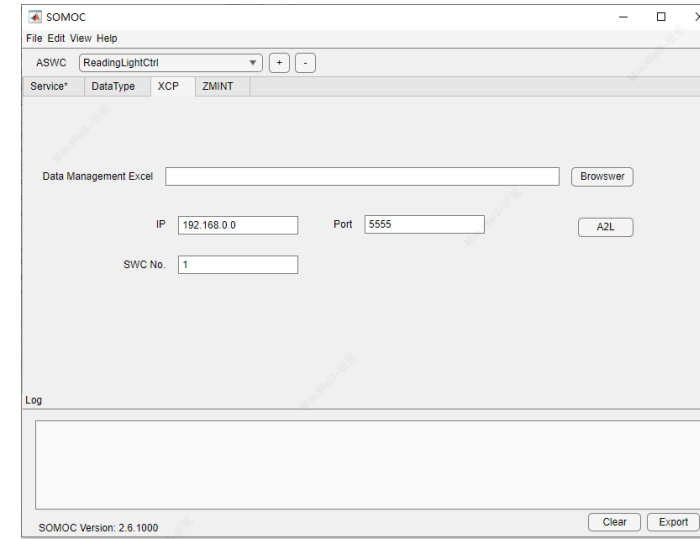
```

Editor - D:\jenkinsWorkspaceForSOMOC\workspace\toolchain\somoc\somoc-develop\Toolkit\Interface\LogInterface\log_data.tlc
log_data.c log_data.tlc
1  %implements "log_data" "C"
2
3  %function Outputs(block, system) Output
4
5  %assign T_logType = CAST("String", SFcnParamSettings.logType)
6  %assign T_enInput = CAST("String", SFcnParamSettings.enInput)
7  %assign T_logMessageBeforeInput = CAST("String", SFcnParamSettings.logMessageBeforeInput)
8  %assign T_logMessageAfterInput = CAST("String", SFcnParamSettings.logMessageAfterInput)
9  %assign modelName = LibGetModelName()
10
11 %assign logFunction = "LOGD"
12 %switch T_logType
13     %case CAST("String", "Debug")
14         %assign logFunction = "LOGD"
15         %break
16     %case CAST("String", "Info")
17         %assign logFunction = "LOGI"
18         %break
19     %case CAST("String", "Warn")
20         %assign logFunction = "LOGW"
21         %break
22     %case CAST("String", "Error")
23         %assign logFunction = "LOGE"
24         %break
25     %case CAST("String", "Fatal")
26         %assign logFunction = "LOGF"
27         %break
28     %case CAST("String", "Verbose")
29         %assign logFunction = "LOGV"
30         %break
31     %default
32         %break
33 %endswitch
34
35 %if T_enInput == CAST("String", "on")
36     %assign u0 = LibBlockInputSignal(0, "", "", 0)
37     %<logFunction> << %<T_logMessageBeforeInput> << %<u0> << %<T_logMessageAfterInput>;
38 %else
39     %<logFunction> << %<T_logMessageBeforeInput>;
40 %endif
41
42 %endfunction
43

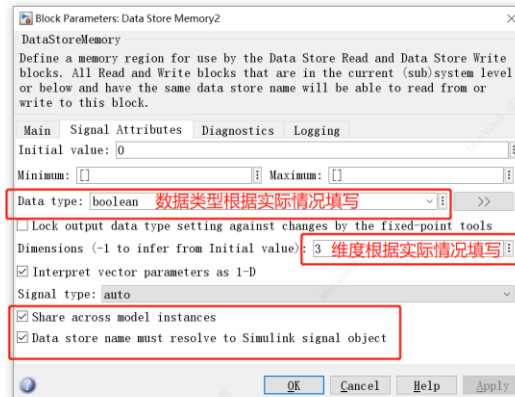
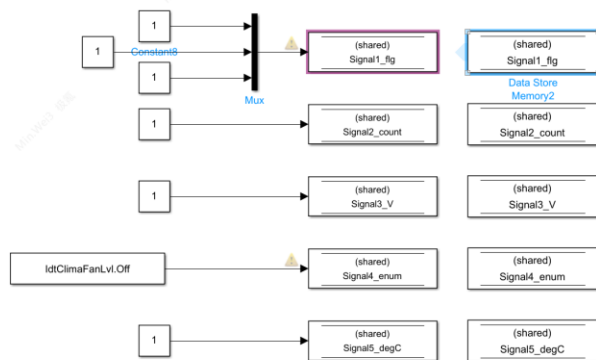
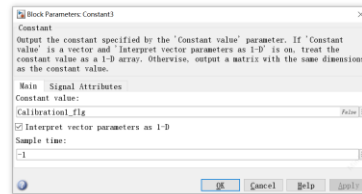
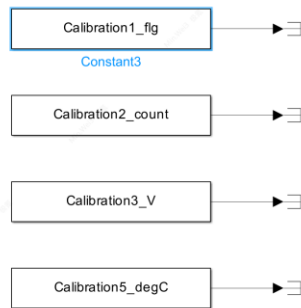
```

需求建模

- 支持以太网XCP的A2L文件生成（可选）
 - 使用Excel管理标定量与观测量，可以导出A2L文件
 - 在模型中创建标定量与观测量



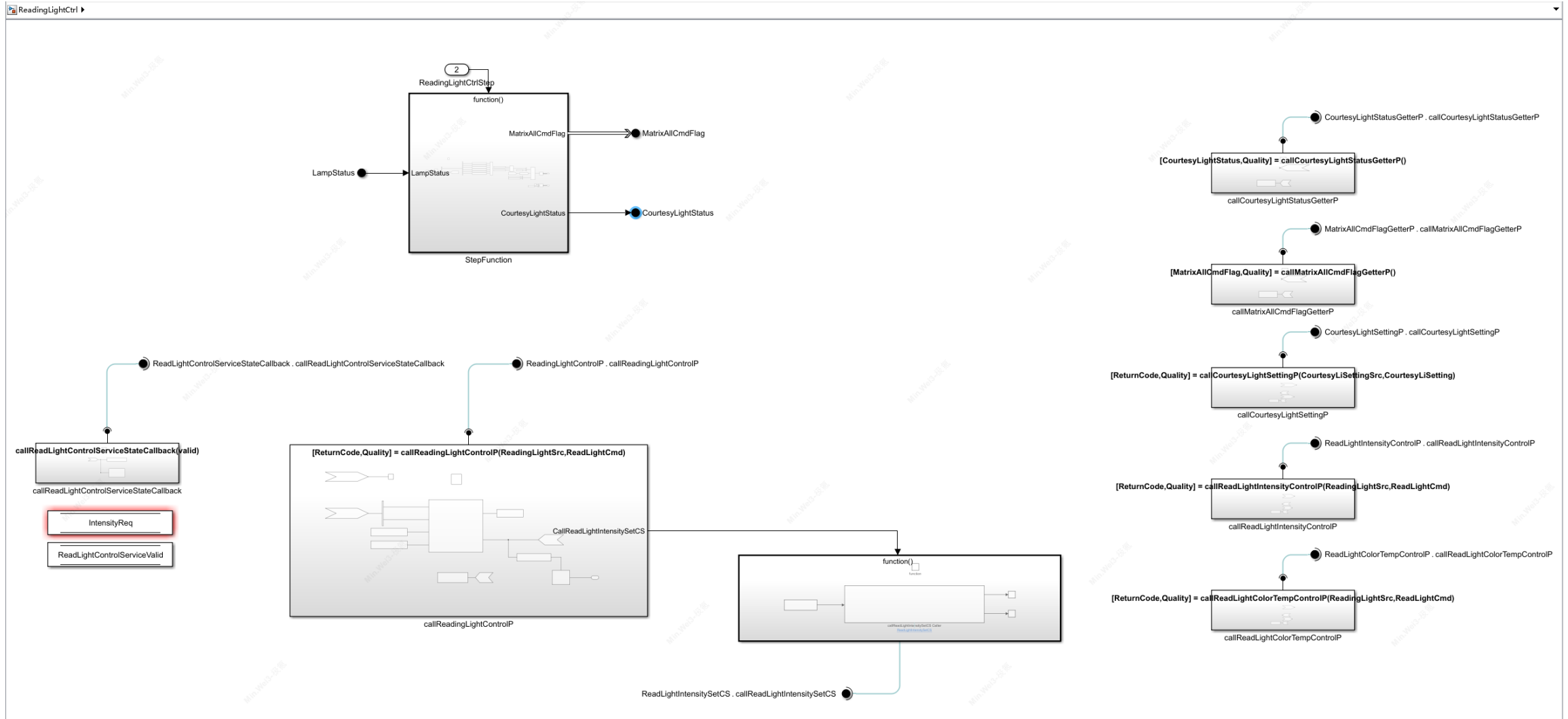
	A	B	C	D	E	F	G	H	I	J
1	Name	DefaultValue	DataType	Min	Max	Description	Unit	TableFormat	BreakpointsForDimension1	BreakpointsForDimension2
2	Calibration1_flg	0	boolean	0	1		flg	Non		
3	Calibration2_count	1	uint8	0	255		count	Non		
4	Calibration3_V	12	single	0	1000		V	Non		
10	Calibration4_enum		Enum: ldtClimaFanLvl				enum	Non		
11	Calibration5_degC		ldtClimaCmptmtT	-199	200		degC	Non		



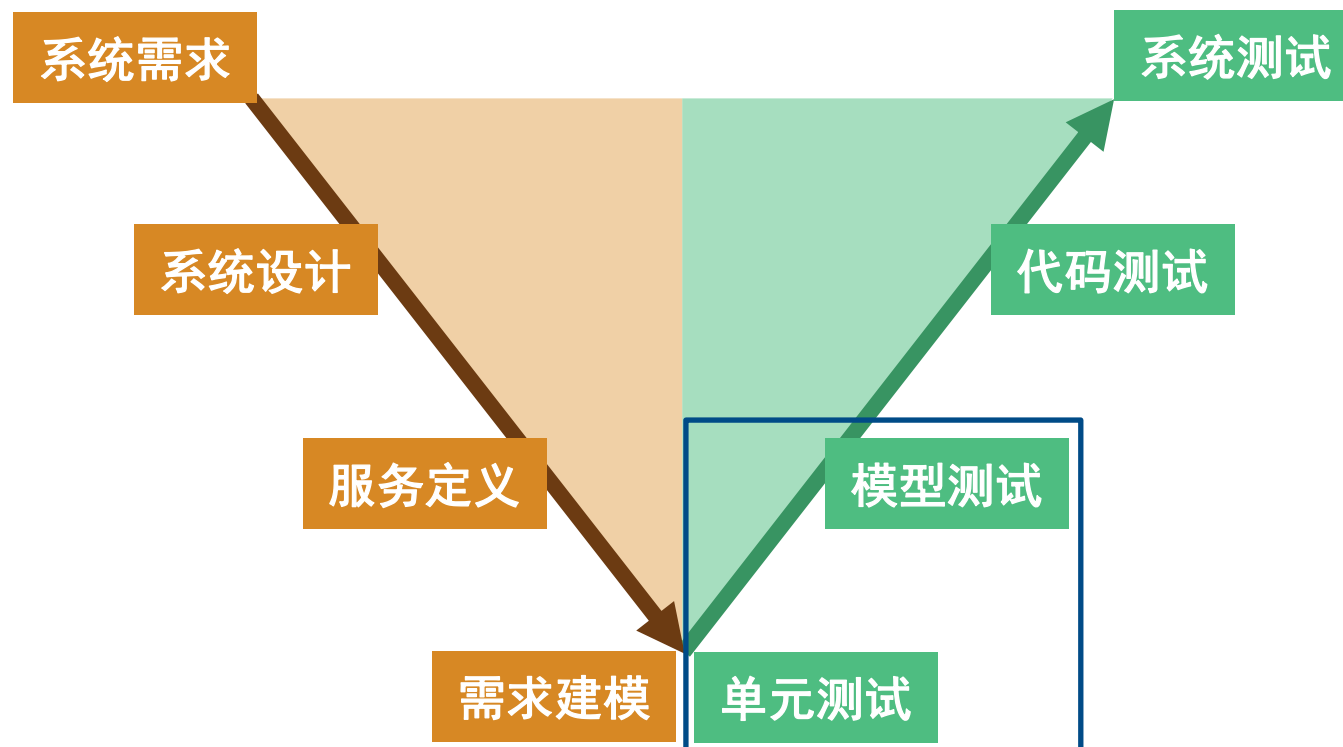
	A	B	C	D	E	F	G	H
1	Name	DefaultValue	DataType	Min	Max	Description	Unit	Dimensions
2	Signal1_flg		boolean	0	1		flg	3
3	Signal2_count		uint8	0	255		count	1
4	Signal3_V		single	0	1000		V	1
5	Signal4_enum		Enum: ldtClimaFanLvl				enum	1
6	Signal5_degC		ldtClimaCmptmtT	-100	200		degC	1

需求建模

- 根据实际业务需求，搭建Method和Topic的运行逻辑

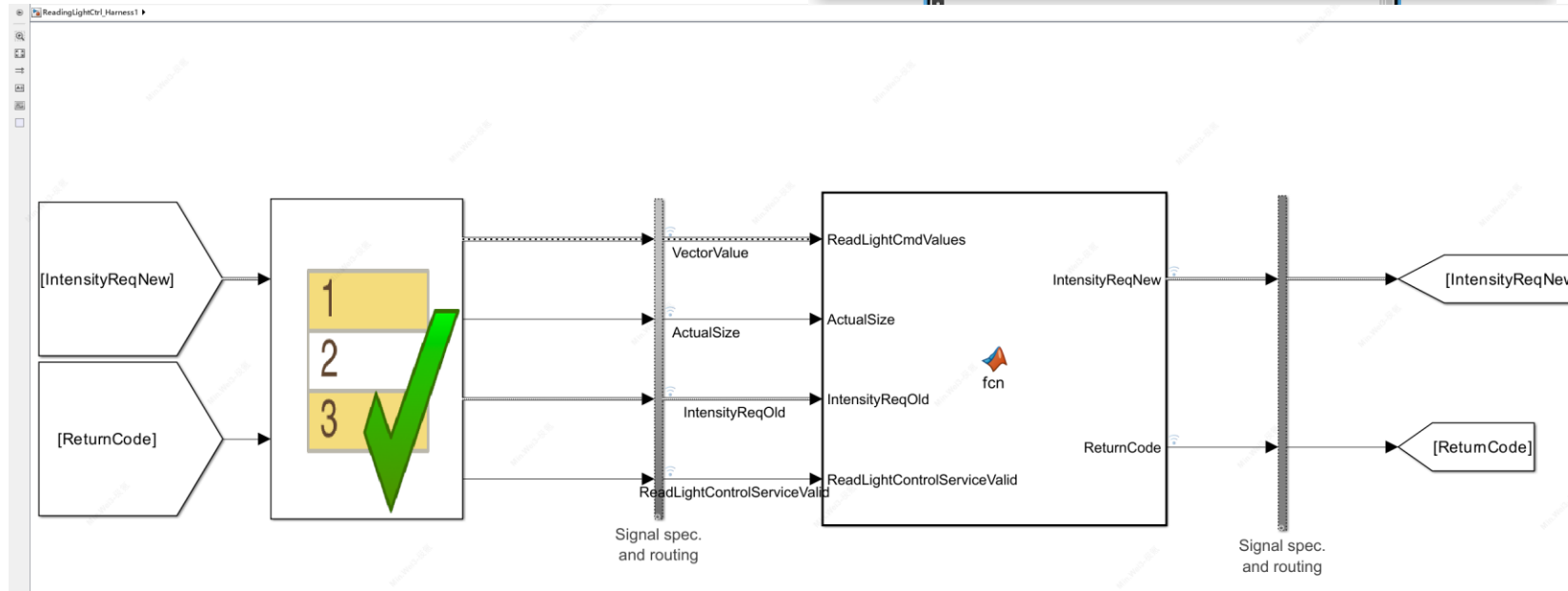
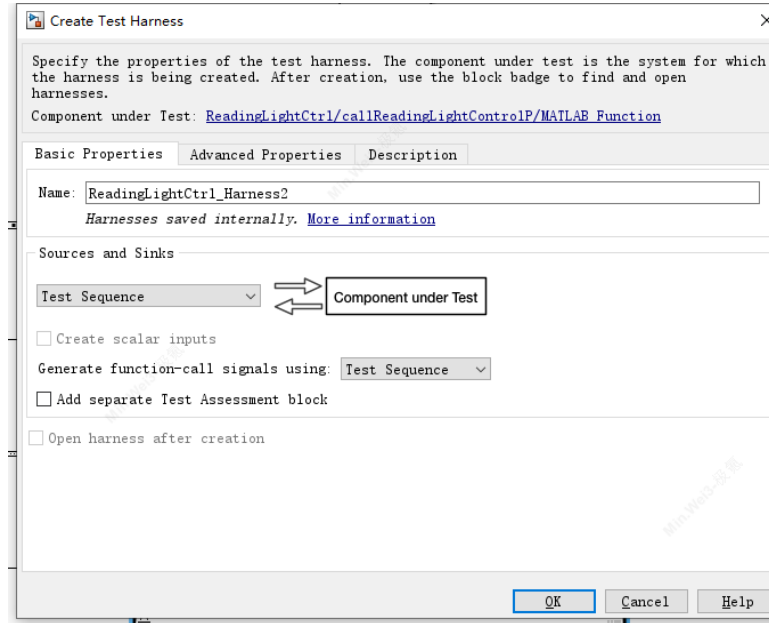


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单元测试

- Test Harness



单元测试

- Test Harness

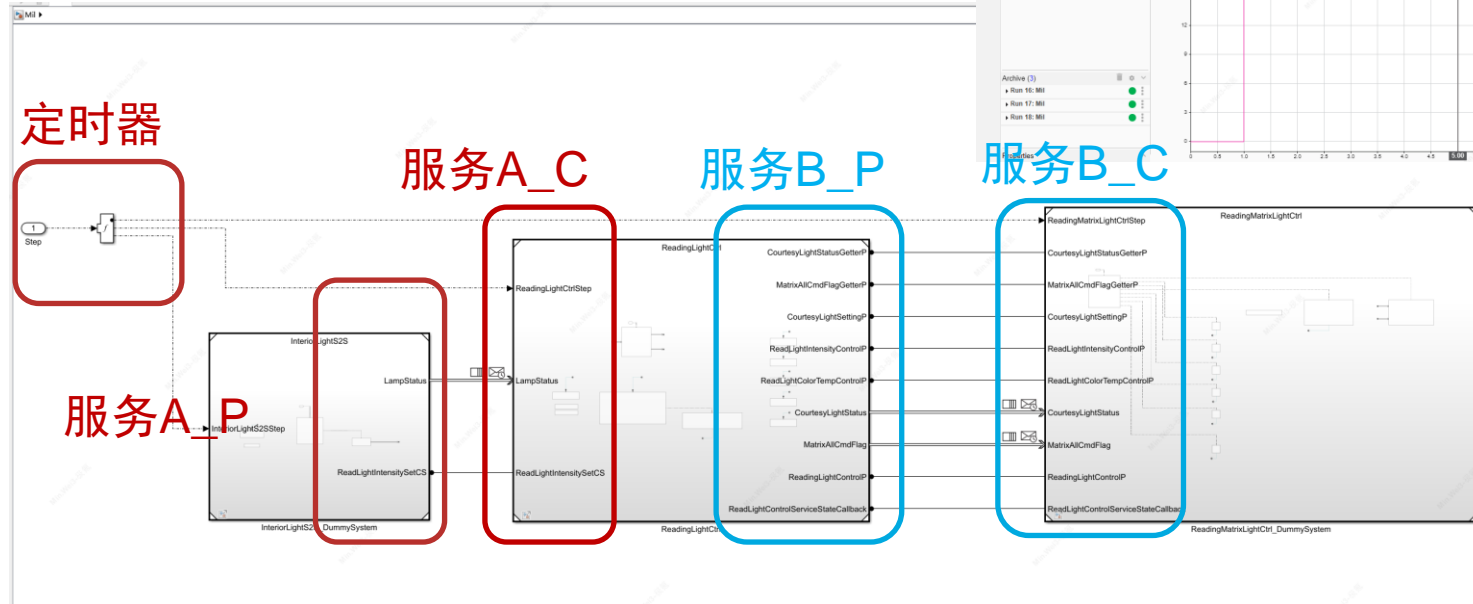
ReadingLightCtrl_Harness1/Test Sequence - Test Sequence Editor

Step	Transition	Next Step	Description
<pre> Init %% Initialize data outputs. ReadLightCmdValues(1).ReadingLightId = IdtReadingLightId.FLreadingLight; ReadLightCmdValues(1).ReadingLightReq = uint8(0); ReadLightCmdValues = repmat(ReadLightCmdValues(1), 6, 1); % bus array ActualSize = uint16(0); IntensityReqOld.FLReadLightIntensityVal = uint8(0); IntensityReqOld.FRReadLightIntensityVal = uint8(0); IntensityReqOld.FL2ReadLightIntensityVal = uint8(0); IntensityReqOld.FR2ReadLightIntensityVal = uint8(0); IntensityReqOld.FL3ReadLightIntensityVal = uint8(0); IntensityReqOld.FR3ReadLightIntensityVal = uint8(0); ReadLightControlServiceValid = false; </pre>	1 after(1,sec)	step_1	
<pre> step_1 ReadLightReqOld = IntensityReqNew; ReadLightControlServiceValid = true; ReadLightCmdValues(1).ReadingLightId = IdtReadingLightId.FLreadingLight; ReadLightCmdValues(1).ReadingLightReq = uint8(20); ReadLightCmdValues(2).ReadingLightId = IdtReadingLightId.FL2readingLight; ReadLightCmdValues(2).ReadingLightReq = uint8(30); ReadLightCmdValues(2).ReadingLightReq = uint8(80); ActualSize = uint16(2); </pre>	1 after(3,sec)	step_2	
<pre> step_2 IntensityReqOld = IntensityReqNew; ReadLightCmdValues(1).ReadingLightId = IdtReadingLightId.FLreadingLight; ReadLightCmdValues(1).ReadingLightReq = uint8(40); ReadLightCmdValues(2).ReadingLightId = IdtReadingLightId.FR2readingLight; ReadLightCmdValues(2).ReadingLightReq = uint8(50); ReadLightCmdValues(3).ReadingLightId = IdtReadingLightId.FR3readingLight; ReadLightCmdValues(3).ReadingLightReq = uint8(60); ActualSize = uint16(3); </pre>			

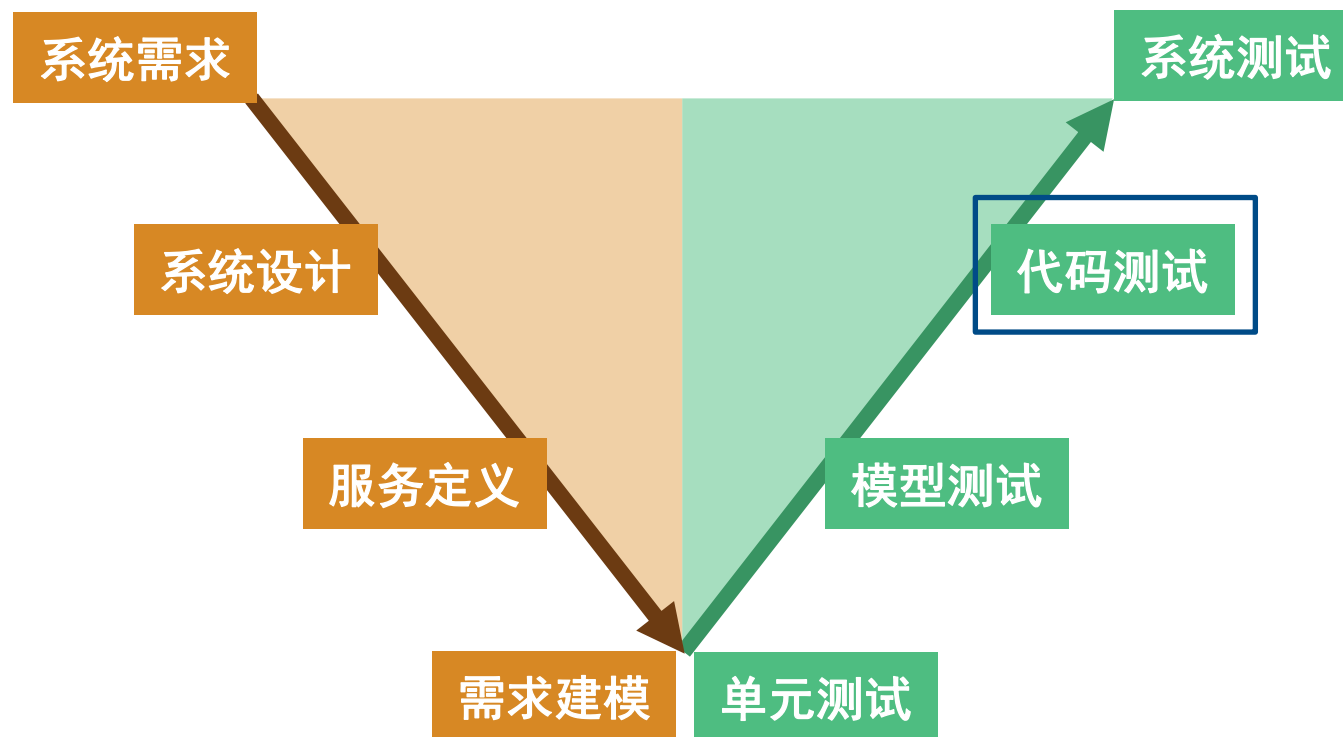


服务模型测试

- 建立对端模型



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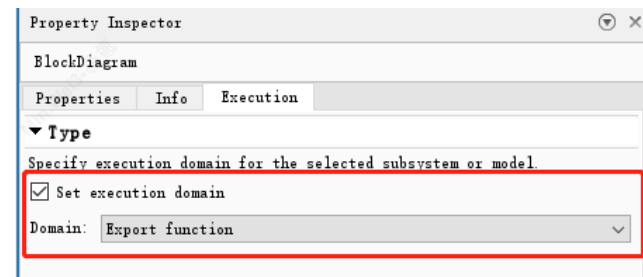
生成Simulink代码并集成到ZEEKR ARK OS

■ SOMOC自动配置模型参数

Target selection	
System target file:	ert.tlc
Description:	Embedded Coder
Shared coder dictionary:	<empty>
Language:	C++
Language standard:	C++11 (ISO)

Build process	
<input checked="" type="checkbox"/> Generate code only	
<input checked="" type="checkbox"/> Package code and artifacts	
Toolchain:	AUTOSAR Adaptive CMake
Build configuration:	Faster Builds
▶ Toolchain details	

Code generation objectives	
Prioritized objectives:	Unspecified
Check model before generating code:	Off

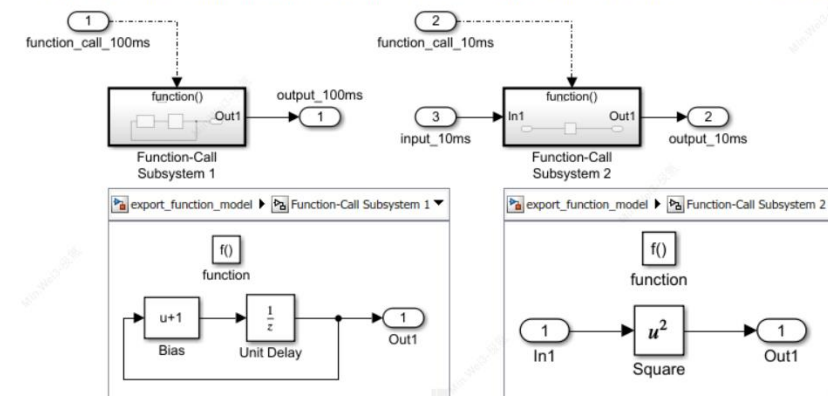


导出函数模型概述

R2024a

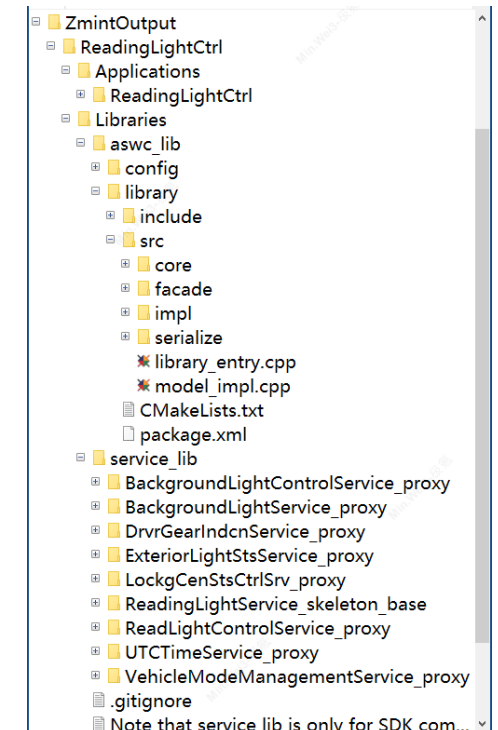
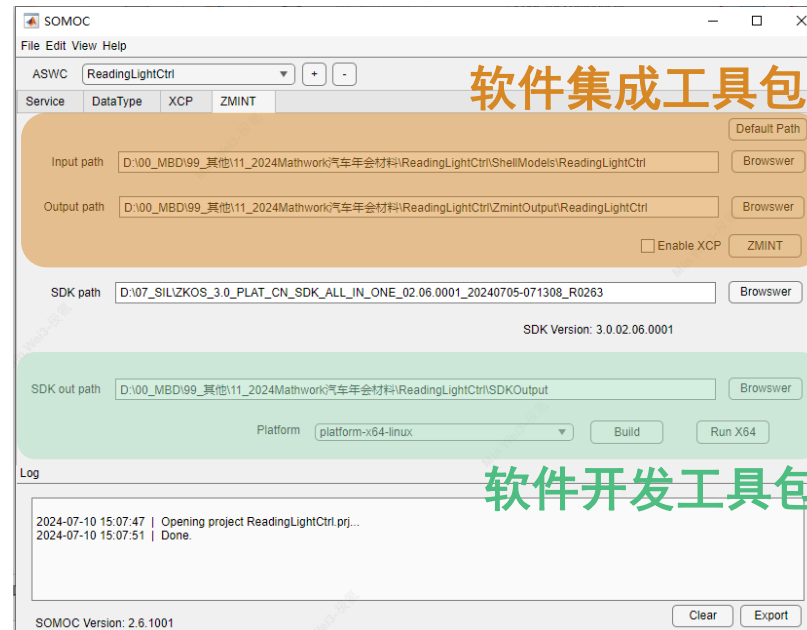
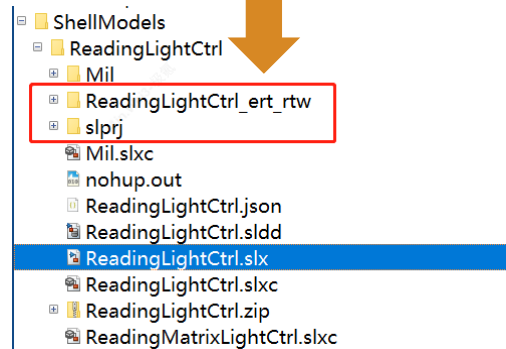
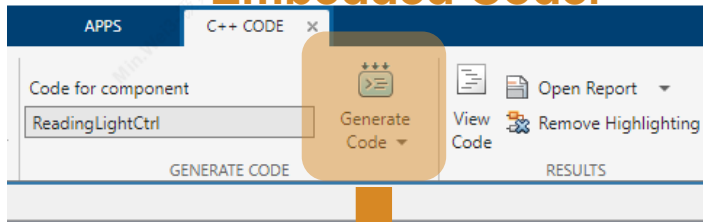
导出函数模型是 Simulink® 模型，它们可以生成可与外部环境和调度器集成的独立函数的代码。函数是使用 Function-Call Subsystem、函数调用 Model、Simulink Function、Message Triggered Subsystem 和 S-Function 模块定义的。

以下导出函数模型包含使用 Function-Call Subsystem 模块定义的两个函数。有关创建此模型的分步过程，请参阅 [Create Export-Function Model](#)。



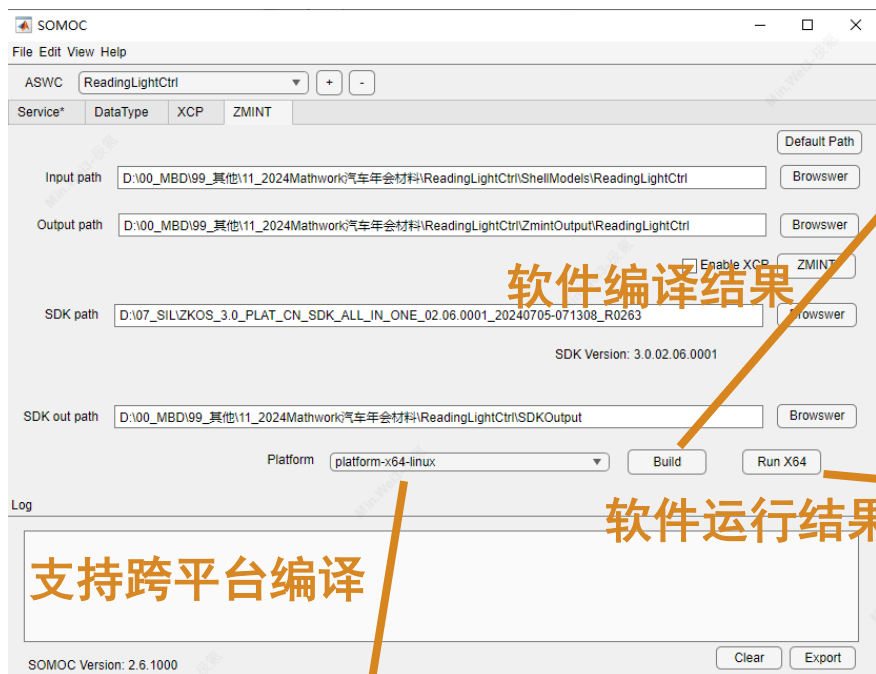
生成Simulink代码并集成到ZEEKR ARK OS

Embedded Coder



代码测试

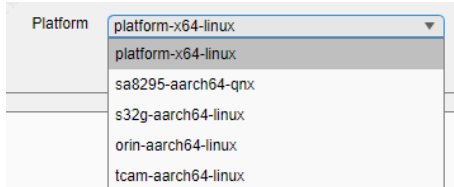
编译与运行APP



软件编译结果

软件运行结果

支持跨平台编译



```

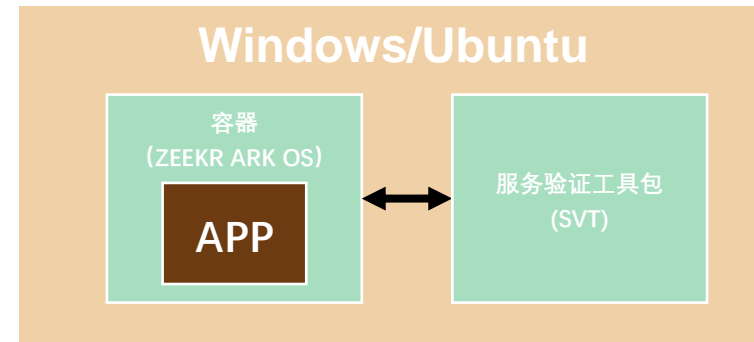
from D:\01\K\home\zkos_docker\D\00_MBD\99_其他\11_2024Mathwork汽车年会材料\ReadingLightCtrl\Zmi
from D:\01\K\home\zkos_docker\D\00_MBD\99_其他\11_2024Mathwork汽车年会材料\ReadingLightCtrl\Zmi
[01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1673 | static bool [01:35m[KGetStructValueFromKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyV
|
| [01:35m[K~-----[m[K
| [01:35m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/Zmi
from D:\01\K\home\zkos_docker\D\00_MBD\99_其他\11_2024Mathwork汽车年会材料/ReadingLightCtrl/Zmi
from D:\01\K\home\zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/Zmi
[01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1439 | static bool [01:35m[KSetStructValueToKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyVal
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1429 | static bool [01:35m[KGetStructValueFromKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyV
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1386 | static bool [01:35m[KSetStructValueToKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyVal
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1376 | static bool [01:35m[KGetStructValueFromKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyV
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1331 | static bool [01:35m[KSetStructValueToKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyVal
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1321 | static bool [01:35m[KGetStructValueFromKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyV
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1098 | static bool [01:35m[KSetStructValueToKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyVal
|
| [01:35m[K~-----[m[K
| [01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/Zmi
from D:\01\K\home\zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/Zmi
from D:\01\K\home\zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/Zmi
[01m[K/home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl/ZmintOutput/ReadingLightC
1088 | static bool [01:35m[KGetStructValueFromKV[m[K(std::shared_ptr<zkos::iper::kv::KeyValueStorage>4 keyV
|
| [01:35m[K~-----[m[K
| [01:35m[K~-----[m[K
make[2]: warning: Clock skew detected. Your build may be incomplete.
make[1]: warning: Clock skew detected. Your build may be incomplete.
---
Finished <<< readinglightservice_skeleton_impl [35.3s]
[0]rcolcon build [10/11 done] [0] ongoing[0Starting >>> ReadingLightCtrl
[0]rcolcon build [10/11 done] [1] ongoing[0Finished <<< ReadingLightCtrl [0.58s]
[0]rcolcon build [11/11 done] [0] ongoing[0
Summary: 11 packages finished [39.0s]
1 package had stderr output: readinglightservice_skeleton_impl
[0] >> |

```

```

root@zkos-build: /home/zkos_docker/D/00_MBD/99_其他/11_2024Mathwork汽车年会材料/ReadingLightCtrl
start run EM!
start run PM!
[0]server done
[0]ROS running
parse json success: /usr/zkos///platform/modules/libraries//zkos_log/etc/logging_client.json
parse json success: ./etc/logging_client.json
ClientManager-3: config params missing 'log_dir_path!', use default path
Invalid number of arguments
comm_api ->Connect suc
2024/07/08 11:19:27.520402 2879667370 BC_A 0092 SVFW warn [140417699944192 servicemanagerclient.cpp : 152 SendToService
Manager TickHeartBeats SendToServerNotification failed, RegisterServiceRequest(app_name: readinglightctrl service_addr
: ark_service:///ReadLightControlService/1 register_status: kRegister ]]
2024/07/08 11:19:27.615061 2879668316 BC_A 0092 SVFW warn [140417699944192 servicemanagerclient.cpp : 152 SendToService
Manager TickHeartBeats SendToServerNotification failed, RegisterServiceRequest(app_name: service_addr: ark_service:
//ReadingLightService/1 register_status: kRegister ]]
2024/07/08 11:19:27.800040 2879670166 BC_A 0092 COMM error [140417429395200 tcp_role_client.cpp:457 TcpRole
Client connect 10.205.0.1:51889 failed: No route to host]
2024/07/08 11:19:30.520417 2879697370 BC_A 0092 SVFW warn [140417699944192 servicemanagerclient.cpp : 152 SendToService
Manager TickHeartBeats SendToServerNotification failed, RegisterServiceRequest(app_name: readinglightctrl service_addr
: ark_service:///ReadLightControlService/1 register_status: kRegister ]]
2024/07/08 11:19:30.615077 2879698316 BC_A 0092 SVFW warn [140417699944192 servicemanagerclient.cpp : 152 SendToService
Manager TickHeartBeats SendToServerNotification failed, RegisterServiceRequest(app_name: service_addr: ark_service:
//ReadingLightService/1 register_status: kRegister ]]
2024/07/08 11:19:33.520467 2879727370 BC_A 0092 SVFW warn [140417699944192 servicemanagerclient.cpp : 152 SendToService
Manager TickHeartBeats SendToServerNotification failed, RegisterServiceRequest(app_name: readinglightctrl service_addr
: ark_service:///ReadLightControlService/1 register_status: kRegister ]]
2024/07/08 11:19:33.615133 2879728317 BC_A 0092 SVFW warn [140417699944192 servicemanagerclient.cpp : 152 SendToService
Manager TickHeartBeats SendToServerNotification failed, RegisterServiceRequest(app_name: service_addr: ark_service:
//ReadingLightService/1 register_status: kRegister ]]

```



代码测试

▪ 服务验证工具包 (SVT)

The screenshot displays the Service Verification tool within the ZKOS IDE. The interface is divided into several sections:

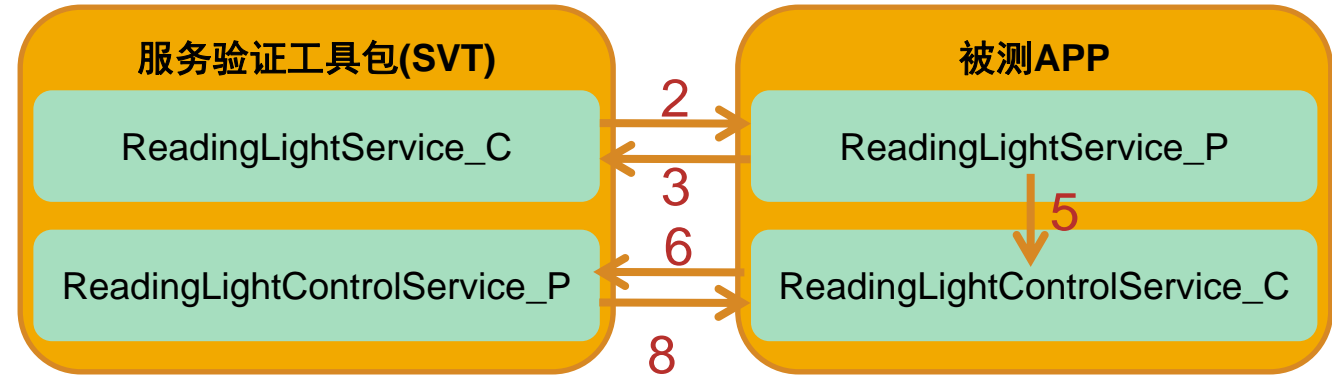
- Left Panel (Toolchain):** Shows the 'CODE GENERATOR' and 'COMPILATION DEBUGGING TOOLS' sections. The 'Service Verification' tool is highlighted under 'VERIFICATION DEBUGGING TOOLS'.
- ARXML File Path:** A tree view showing the project structure. The 'ReadLightControlService_1' service is selected.
- Service Verification Panel:** Displays the selected service 'ReadLightControlService_1' with a 'Start' button.
- Topic Table:** A table listing various topics and their methods. Each row includes a checkbox, the topic name, and a 'Publish' button.
- Request Data Display:** A table for displaying request data, currently showing 'No Data'.

Topic	Method	Operations
<input type="checkbox"/>	Topic Name	
<input type="checkbox"/>	LampStatus	Parameter settings Publish
<input type="checkbox"/>	AutoButtonStatus	Parameter settings Publish
<input type="checkbox"/>	AllonButtonStatus	Parameter settings Publish
<input type="checkbox"/>	ReadLightIntensityVal	Parameter settings Publish
<input type="checkbox"/>	ReadLightButtonStatus	Parameter settings Publish
<input type="checkbox"/>	ReadLiUsability	Parameter settings Publish

Timestamp	Message Type	Method Name	Operations
No Data			

代码测试

SVT 代码测试



Consumer: ReadingLightService

Success

Topic	Method	Operations
ReadingLightControl	Parameter settings	Send
CourtesyLightSetting	Parameter settings	Send
ReadLightIntensityControl	Parameter settings	Send
ReadLightColorTempControl	Parameter settings	Send
CourtesyLightStatusGetter	Parameter settings	Send
MatrixAllCmdFlagGetter	Parameter settings	Send

Request Data Display

Timestamp	Message Type	Method Name	Operations
2024-07-09 20:20:17 788	response	ReadingLightControl	Detail

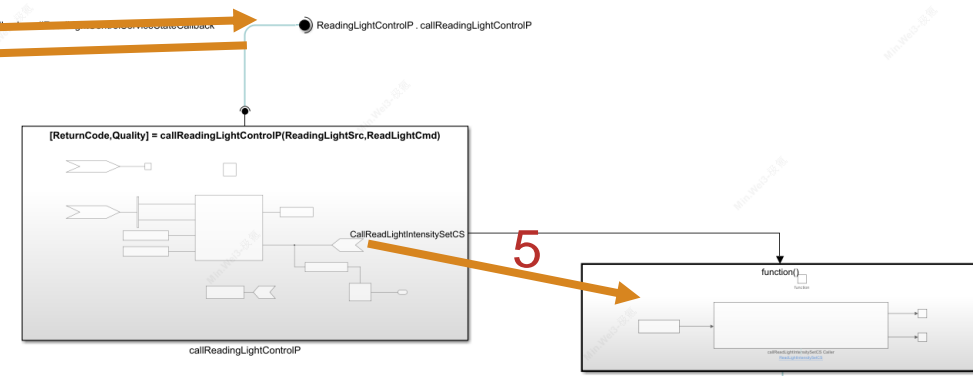
Parameter settings

Key	Value
ReadingLightSrc	Softinput
ReadingLightId	FLreadingLight
ReadingLightReq	30
ReadLightCmd	Key
ReadingLightId	FLreadingLight
ReadingLightReq	60

Request Data Display

```

1 {
2   "methods": [
3     {
4       "method_id": 1,
5       "protocol": "udp",
6       "method_name": "ReadingLightControl",
7       "output": {
8         "ReturnCode": true,
9       }, // 1 entries
10      "input": {}, // 5 entries
11    }, // 1 elements
12  ], // 1 elements
13 }
    
```



Request Data Display

```

1 {
2   "methods": [
3     {
4       "method_id": 7,
5       "protocol": "udp",
6       "method_name": "ReadLightIntensitySet",
7       "input": {
8         "IntensityReq": {
9           "FLReadLightIntensityVal": 30,
10          "FRReadLightIntensityVal": 0,
11          "FL2ReadLightIntensityVal": 60,
12          "FR2ReadLightIntensityVal": 0,
13          "FL3ReadLightIntensityVal": 0,
14          "FR3ReadLightIntensityVal": 0,
15        }, // 6 entries
16      }, // 1 entries
17      "output": {}, // 5 entries
18    }, // 1 elements
19  ], // 1 elements
20 }
    
```

Provider: ReadLightControlService

Stop

Topic	Method	Operations
LampCtrlCmd	Parameter settings	Settings
RoofParametersSet	Parameter settings	Settings
ResetMemory	Parameter settings	Settings
CourtesyLightIndication	Parameter settings	Settings
FootwellLictrl	Parameter settings	Settings
ReadLightIntensitySet	Parameter settings	Settings

Request Data Display

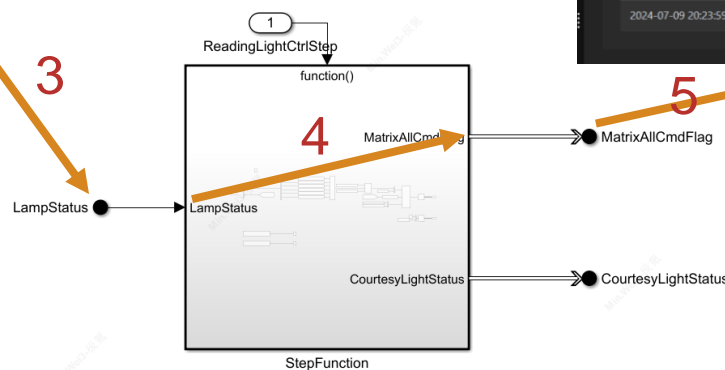
Timestamp	Message Type	Method Name	Operations
2024-07-09 20:20:17 781	request	ReadLightIntensitySet	Detail

代码测试

SVT 代码测试

Parameter settings

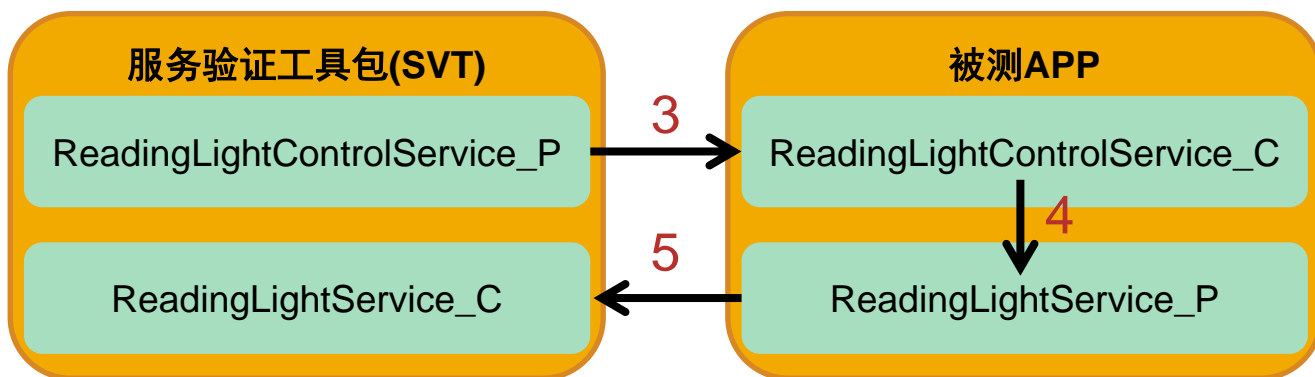
Key	Value
data	
FLReadingLightStatus	OFF
FRReadingLightStatus	OFF
FL2ReadingLightStatus	ON
FR2ReadingLightStatus	OFF
FL3ReadingLightStatus	OFF
FR3ReadingLightStatus	OFF



Request Data Display

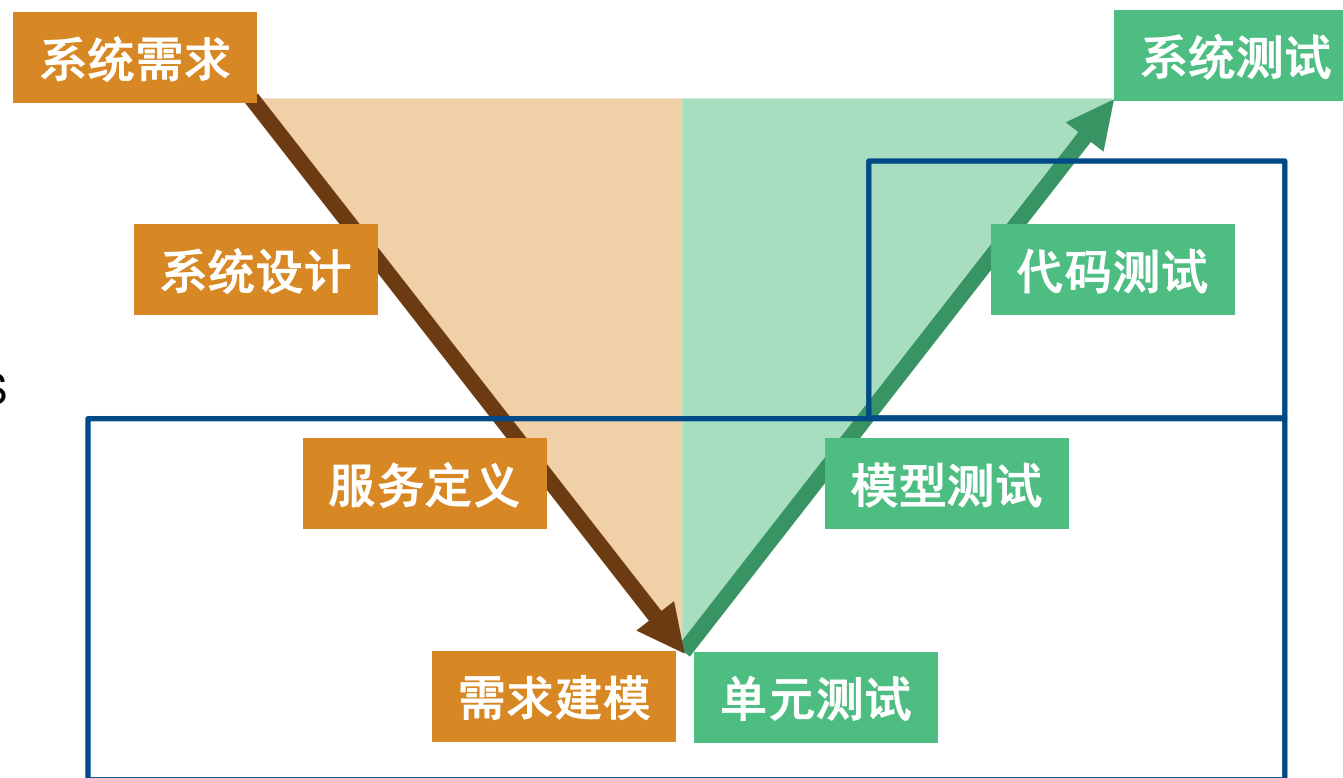
```

1  {
2  {
3  {
4    "topic_name": "MatrixAllCmdFlag",
5    "notifier_id": 36866,
6    "protocol": "udp",
7    "eventgroups": [
8      1, // 1 elements
9    ],
10   "input": {
11     "data": 1, // 1 entries
12   },
13   "output": {}, // 6 entries
14 }, // 1 elements
15 } // 1 entries
    
```



6.总结

- ZEEKR ARK OS与MATLAB/Simulink结合
- 根据服务信息自动生成服务化的框架模型
- 使用S-Function&TLC封装ZEEKR ARK OS中间件模块
- 使用Test Harness进行测试
- 使用ZEEKR ARK OS的软件开发与测试工具包进行代码测试



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Thank you

