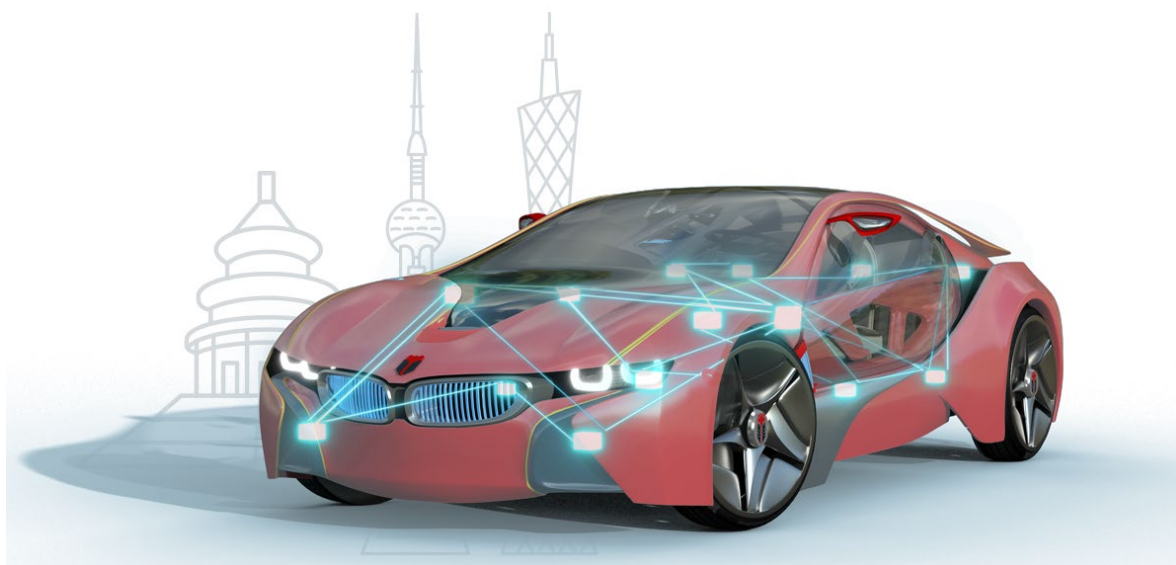


知从木牛操作系统 OS 产品手册

ZC.MUNIU OPERATING SYSTEM PRODUCT MANUAL

知从木牛操作系统 OS

ZC.MuNiu Operating System



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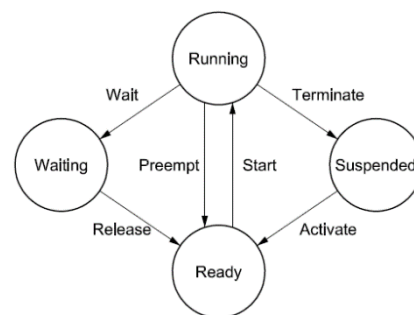
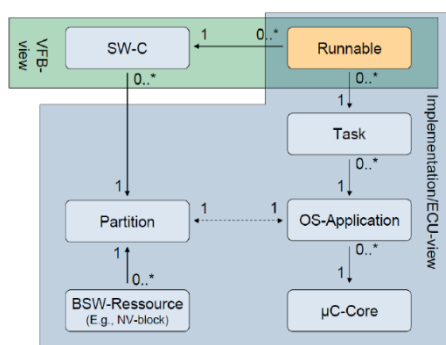
知从木牛操作系统 OS

ZC.MuNiu Operating System

1 功能概述 FUNCTIONAL OVERVIEW

知从木牛（ZC.MuNiu）为汽车电子控制器产品开发，提供完整的基础软件平台解决方案。该产品参考 AUTOSAR、OSEK 等国际规范，有基于 AUTOSAR ATOP 架构的上位机配置工具。木牛操作系统 OS 产品是适用于汽车芯片的高安全嵌入式实时操作系统（RTOS）。木牛操作系统 OS 为系统提供多任务管理、中断管理、定时管理、内存保护、时间保护等功能，支持多核体系架构，具备高实时性、高安全性和高可移植性特征。木牛操作系统 OS 产品具备卓越的性能，支持多任务并发，具备高效的任务调度、中断管理和核间通信机制。与上位机配置工具相结合，支持细粒度裁剪，可有效适应汽车电子控制器的多样化现状。

ZC.MuNiu offers comprehensive basic software platform solutions for the development of automotive electronic control units. The product adheres to international standards such as AUTOSAR and OSEK and features a configuration tool for the upper machine based on the AUTOSAR ATOP architecture. MuNiu Operating System (OS) product is a high-safety embedded real-time operating system (RTOS) designed for automotive chips. MuNiu OS provides the system with multi-task management, interrupt management, timing management, memory protection, and time protection, among other features, and supports multi-core architectures, characterized by high real-time performance, high security, and high portability. MuNiu OS product boasts excellent performance, supporting concurrent multi-tasking with efficient task scheduling, interrupt management, and inter-core communication mechanisms. Combined with the upper machine configuration tool, it supports fine-grained tailoring, effectively adapting to the diverse needs of automotive electronic control units.



实时性

安全性

可移植

2 应用领域 APPLICATION FIELD

木牛操作系统 OS 产品可应用于汽车电子控制器产品开发。例如：

ZC.MuNiu OS product can be applied to the development of automotive electronic control unit products. For example:

- 新能源整车控制器(VCU)
Vehicle Control Unit for new energy vehicles (VCU)
- 电机控制器(MCU)
Motor Control Unit (MCU)
- 电池管理系统控制器(BMS)
Battery Management System (BMS)
- 电子助力转向控制器(EPS)
Electric Power Steering (EPS) Controller
- 车身控制器(BCM)
Body Control Module (BCM)
- 智能驾驶控制器安全岛(ADAS Safety Island)
Advanced Driver Assistance Systems (ADAS) Safety Island
- 智能网关控制器(Gateway)
Gateway Controller
- 智能刹车助力控制器
Intelligent Braking System Controller
- 电子驻车系统(EPB)
Electronic Parking Brake (EPB) System
- 发动机管理系统(EMS)
Engine Management System (EMS)

3 配置环境 CONFIGURATION ENVIRONMENT

木牛操作系统 OS 产品支持的芯片和相应编译器环境如下：

MuNiu operating system OS product supports the following chips and corresponding compiler environments:

厂商和型号 Manufacturer and Model	
NXP S32K 系列 NXP S32K series	S32K11x/S32K14x/S32K31x/S32K32x/ S32K33x/S32K34x/S32K35x
Renesas RH850 F1KM 系列 Renesas RH850 F1KM series	F1KM-S1/F1KM-S2/F1KM-S4
Infineon AURIX TriCore 系列 Infineon AURIX TriCore series	TriCore TC2xx/TriCore TC3xx
STMicroelectronics SPC5系列 ST Microelectronics SPC5 series	SPC56x/SPC57x/SPC58x
旗芯微 Flagchip	FC7300Fxx
杰发科技 Autochips	AC781x
兆易创新 GigaDevice	GD32Ax

i. 木牛操作系统 OS 产品的 NXP S32K 系列芯片软件配置：

Software configuration for the NXP S32K series chips of ZC.MuNiu operating system product:

配置环境 Configuration Environment	
Hardware (Chip)	S32K11x/S32K14x/S32K31x/S32K32x/ S32K33x/S32K34x/S32K35x
Compilers Supported	IAR Embedded Workbench 8.32.2
Evaluation Hardware	S32K1/S32K3 EVB
Debugger	Lauterbach Trace32 Isystem (IC5700)
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

ii. 木牛操作系统 OS 产品的 Renesas RH850 F1KM 系列芯片软件配置：

Software configuration for Renesas RH850 F1KM series chips of ZC.MuNiu Operating System product

配置环境 Configuration Environment	
Hardware (Chip)	F1KM-S1/F1KM-S2/F1KM-S4
Compilers Supported	GreenHillsV7.1.6 MULTI Compiler 2018.1
Evaluation Hardware	F1KM-S1/F1KM-S4 EVB
Debugger	Renesas E1 emulator Isystem (IC5700)
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

iii. 木牛操作系统 OS 产品的 Infineon AURIX TriCore 系列芯片软件配置：

Software configuration for the Infineon AURIX TriCore series chips of ZC.MuNiu Operating System product:

配置环境 Configuration Environment	
Hardware (Chip)	TriCore TC2xx/TriCore TC3xx
Compilers Supported	TASKING VX-toolset for TriCore v4.2(TC2) TASKING VX-toolset for TriCore v6.3(TC3)
Evaluation Hardware	TC2xx/TC3xx EVB
Debugger	DAP miniWiggler Lauterbach Trace32 Isystem (IC5700)
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

iv. 木牛操作系统 OS 产品的 STMicroelectronics SPC5 系列芯片软件配置：

Software configuration for STMicroelectronics SPC5 series chips of ZC.MuNiu Operating System product

配置环境 Configuration Environment	
Hardware (Chip)	SPC56x/SPC57x/SPC58x
Compilers Supported	GreenHillsV7.1.6 MULTI Compiler 2022.14
Evaluation Hardware	SPC56x/SPC57x/SPC58x EVB
Debugger	Lauterbach Trace32 Isystem (IC5700)
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

v. 木牛操作系统 OS 产品的 Flagchip FC7300 系列芯片软件配置：

Software configuration for Flagchip FC7300 series chips of ZC.MuNiu Operating System product:

配置环境 Configuration Environment	
Hardware (Chip)	FC7300Fxx
Compilers Supported	IAR Embedded Workbench 8.32.2
Evaluation Hardware	FC7300Fxx EVB
Debugger	Lauterbach Trace32 Isystem (IC5700)
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

vi. 木牛操作系统 OS 产品 Autochips AC781x 的系列芯片软件配置：

Software configuration for Autochips AC781x series chips of ZC.MuNiu Operating System product:

配置环境 Configuration Environment	
Hardware (Chip)	AC781x
Compilers Supported	MDK-ARM Plus Version: 5.36.0.0
Evaluation Hardware	AC781x EVB
Debugger	J-Link
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

- vii. 木牛操作系统 OS 产品 GigaDevice GD32Ax 的系列芯片软件配置:
Software configuration for GigaDevice GD32Ax series chips of ZC.MuNiu Operating System product:

配置环境 Configuration Environment	
Hardware (Chip)	GD32Ax
Compilers Supported	MDK-ARM Plus Version: 5.36.0.0
Evaluation Hardware	GD32Ax EVB
Debugger	J-Link
Configuration Tools	Muniu_v4.4
Configuration Environment	Win7/Win10 64bit

4 开发背景 DEVELOPMENT BACKGROUND

木牛操作系统 OS 产品符合 AUTOSAR 和 OSEK (ISO17356-3) 标准，支持主流汽车电子控制器，实现了多任务抢占式调度和高效的中断管理机制，支持多核处理器，为系统实时性提供了良好保障。产品包含上位机配置工具，可实现灵活的配置和裁剪，自动化生成配置源代码和应用参考框架，大大降低汽车电子控制器开发成本。

MuNiu Operating System (OS) products comply with AUTOSAR and OSEK (ISO17356-3) standards and support mainstream automotive electronic controllers. They implement a multi-task preemptive scheduling and efficient interrupt management mechanism, supporting multi-core processors and providing a good guarantee for system real-time performance. The product includes a PC configuration tool that can achieve flexible configuration and tailoring, automatically generating configuration source code and application reference frameworks, greatly reducing the development cost of automotive electronic controllers.

木牛操作系统 OS 产品具备自主研发的轻量化内存保护和时间保护框架，支持最高 ASIL D 安全等级应用，满足系统的功能安全要求。与传统的分区型 OS 相比，木牛操作系统 OS 产品针对汽车领域微控制器（MCU）以及智能座舱、智能驾驶控制器中所集成的安全岛（Safety Island）进行深度定制和优化，具有执行效率高和应用代码部署灵活的特点。

MuNiu OS products have independently developed lightweight memory protection and time protection frameworks, supporting the highest ASIL D safety level applications, meeting the functional safety requirements of the system. Compared with traditional partitioned OS, MuNiu OS products are deeply customized and optimized for automotive field microcontrollers (MCU) and the safety islands (Safety Island) integrated in smart cockpit and intelligent driving controllers, featuring high execution efficiency and flexible application code deployment.

木牛操作系统 OS 产品 由知从科技自主研发，打破了高安全嵌入式实时操作系统软件在汽车电子控制器领域中长期以来依赖国外厂商的现状，率先实现基础软件产品自主可控。同时，知从科技积极投入对国产芯片的适配工作，率先基于旗芯微、杰发科技等国产芯片厂商的核心产品进行适配，不断完善木牛基础软件对国产芯片的兼容和支持。

Developed independently by ZC, ZC.MuNiu OS product breaks the long-standing reliance on foreign manufacturers for high-safety embedded real-time operating system software in the field of automotive electronic controllers, taking the lead in achieving independent control of basic software products. At the same time, ZC actively invests in the adaptation work of domestic chips, taking the lead in adapting to the core products of domestic chip manufacturers such as Flagchip and AutoChips Inc., continuously improving the compatibility and support of ZC.MuNiu basic software for domestic chips.

知从科技掌握 AUTOSAR 平台软件的开发和应用核心技术，提供本地现场支持，质量好，速度快，成本低。

ZC has mastered the core technology of AUTOSAR platform software development and application, providing local on-site support, with good quality, fast speed, and low cost.

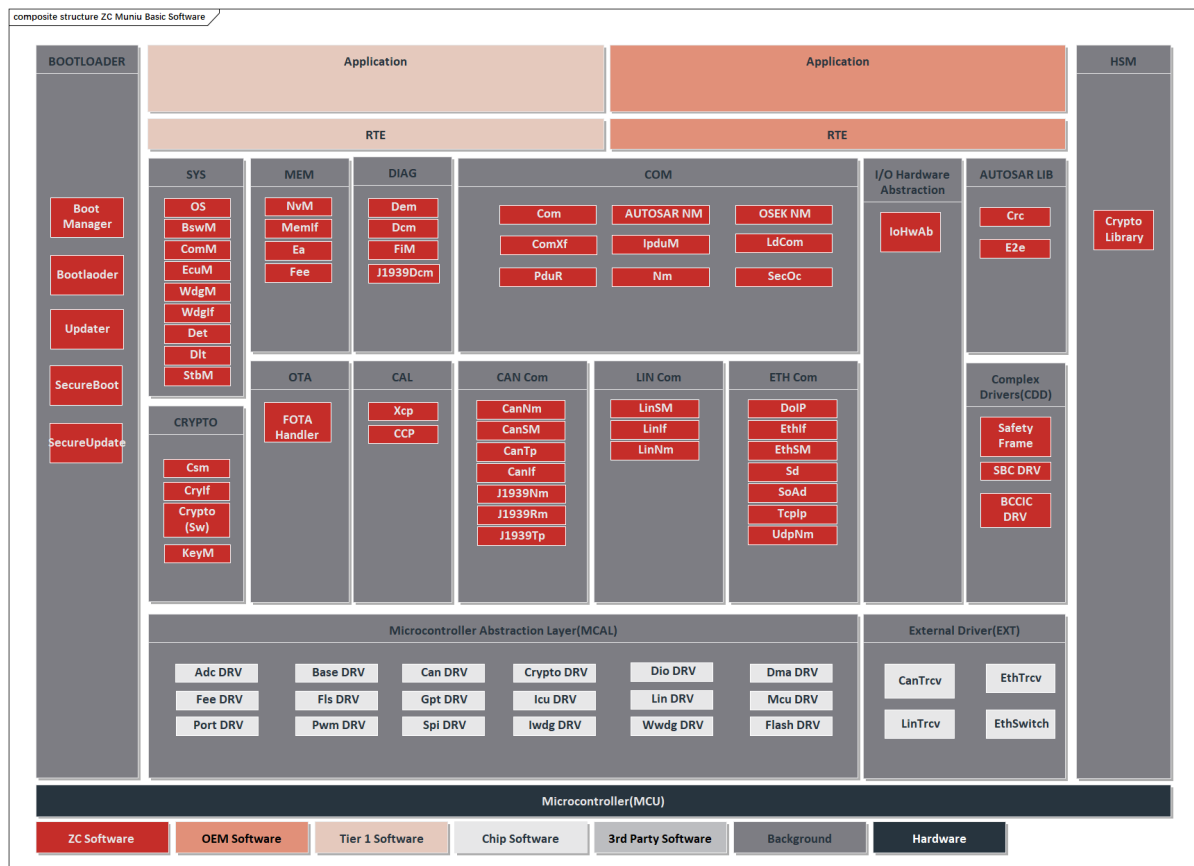
5 功能描述 FUNCTIONAL DESCRIPTION

5.1 产品特点 Product Feature

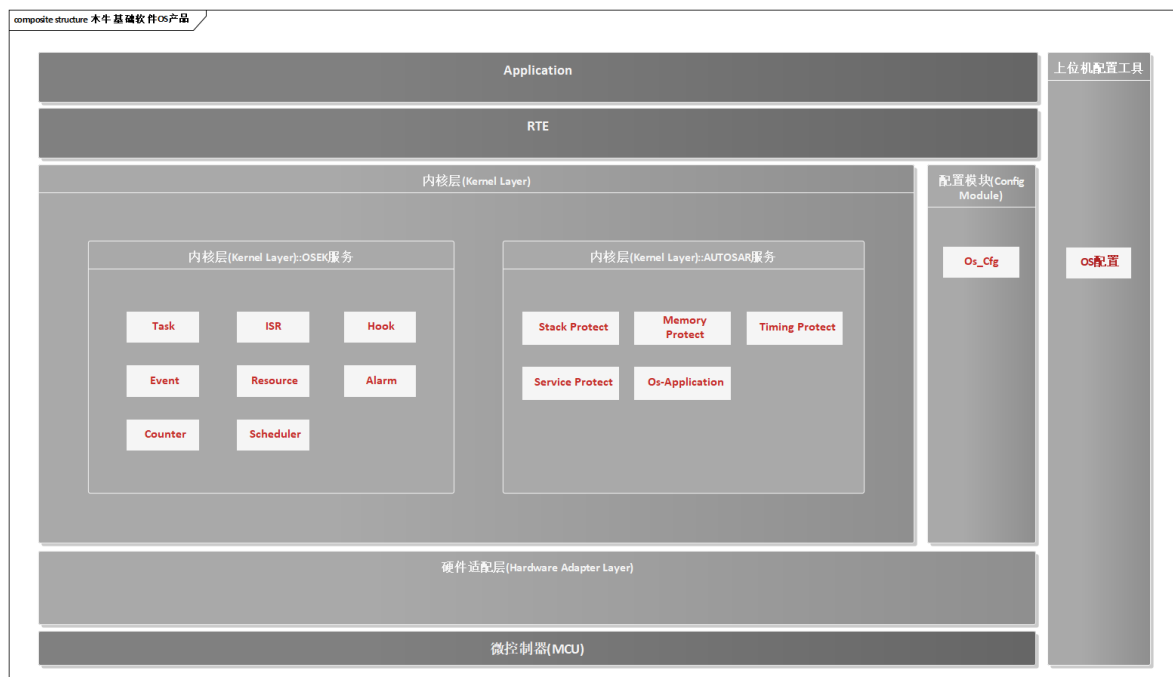
- ARTOP 架构上位机配置工具，符合 AUTOSAR 4.2.2/4.3.1/4.4.0 版本
ARTOP architecture upper computer configuration tool, compliant with AUTOSAR 4.2.2/4.3.1/4.4.0 versions
- 支持 AUTOSAR SC1、SC2、SC3 和 SC4 符合性类
Supports AUTOSAR Scalability Classes SC1, SC2, SC3, and SC4
- 符合 ISO17356-3（原 OSEK）标准
Compliant with the ISO17356-3 (formerly OSEK) standard
- 多核架构，提供高效的核间通信机制
Multi-core architecture, providing an efficient inter-core communication mechanism
- 轻量化内存保护和时间保护框架
Lightweight memory protection and time protection framework
- 多任务抢占式调度，兼容非抢占式调度
Multi-task preemptive scheduling, compatible with non-preemptive scheduling
- 强实时任务调度算法
Strong real-time task scheduling algorithm
- 高效的中断管理
Efficient interrupt management
- 服务保护 Service Protection
- 堆栈保护 Stack Protection
- 定制化服务 Customized Services

Feature	Described in Section	Scalability Class 1	Scalability Class 2	Scalability Class 3	Scalability Class 4	Hardware requirements
OSEK OS (all conformance classes)	7.1	✓	✓	✓	✓	
Counter Interface	8.4.17	✓	✓	✓	✓	
SWFRT Interface	8.4.18, 8.4.19	✓	✓	✓	✓	
Schedule Tables	7.3	✓	✓	✓	✓	
Stack Monitoring	7.5	✓	✓	✓	✓	
ProtectionHook	7.8		✓	✓	✓	
Timing Protection	7.7.2		✓		✓	Timer(s) with high priority interrupt
Global Time /Synchronization Support	7.4		✓		✓	Global time source
Memory Protection	7.7.1, 7.7.4			✓	✓	MPU
OS-Applications	7.6, 7.12			✓	✓	
Service Protection	7.7.3			✓	✓	
CallTrustedFunction	7.7.5			✓	✓	(Non-)privileged Modes

5.2 软件架构 Software Architecture



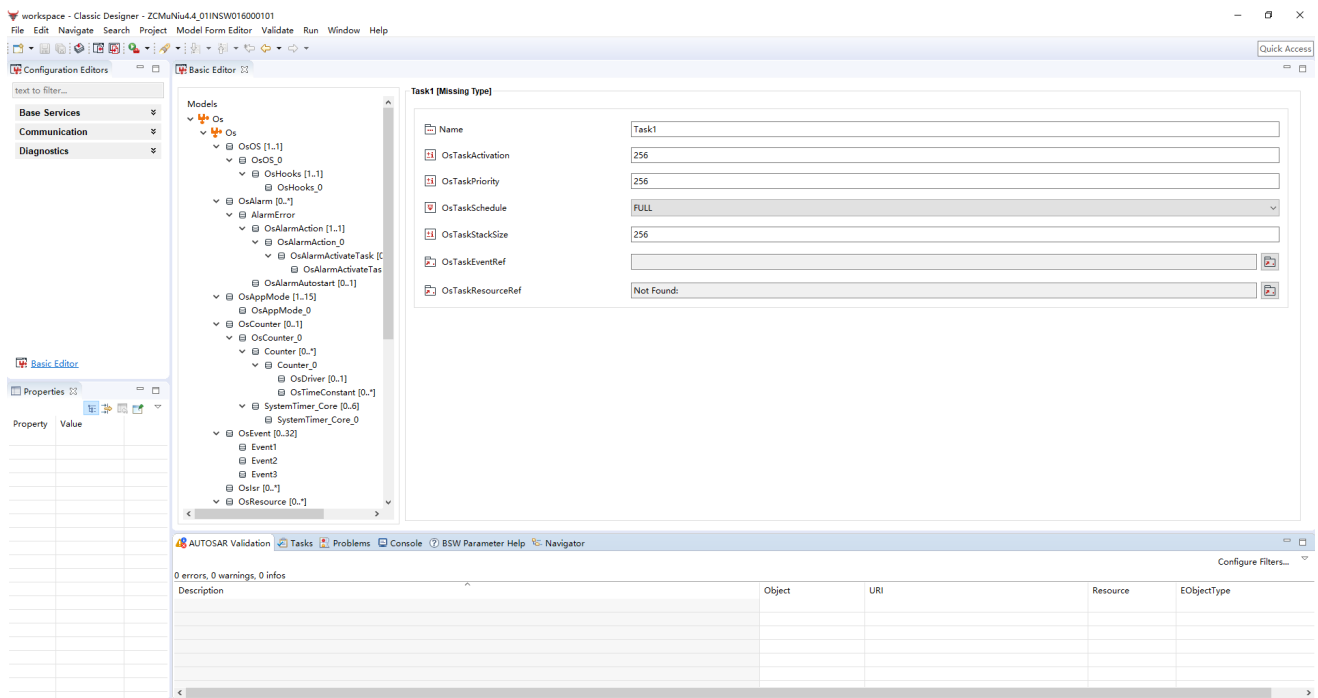
知从木牛基础软件平台架构
ZC.MUNIUI BASIC SOFTWARE PLATFORM ARCHITECTURE



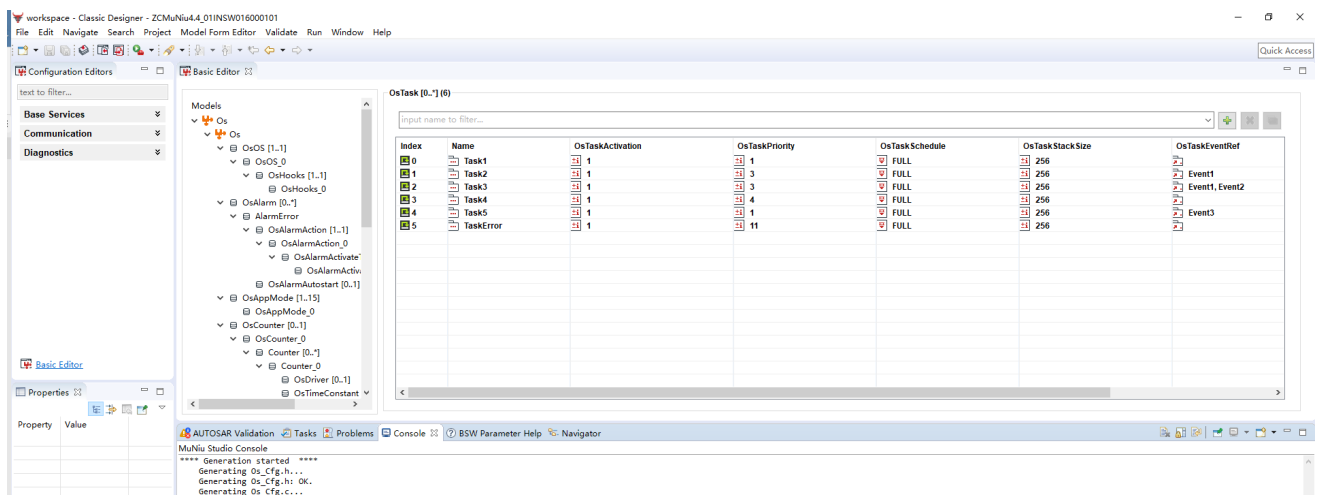
知从木牛操作系统 OS 产品软件架构
ZC.MUNIUI OPERATING SYSTEM PRODUCT SOFTWARE ARCHITECTURE

模块 Module	子模块 Submodule	描述 Description
硬件适配层 Hardware Adaptation Layer (HWAP)	硬件适配层 Hardware Adaptation Layer	硬件处理器适配 Hardware processor adaptation
配置模块 Configuration Module (CONFIG)	OS配置文件 OS Configuration File	由上位机配置工具生成的配置源文件 Configuration source files generated by the upper computer configuration tool
内核层 Kernel Layer (KERNEL)	任务管理 Task Management	实现系统服务，包括OSEK和AUTOSAR中定义的接口和机制，是OS的核心组件 Implementing system services, including the interfaces and mechanisms defined in OSEK and AUTOSAR, is a core component of the OS.
	中断管理 ISR Management (GIC V3.0)	
	Hook管理 Hook Management	
	Event管理 Event Management	
	Resource管理 Resource Management	
	Alarm管理 Alarm Management	
	Counter管理 Counter Management	
	任务调度管理 Task Scheduling Management	
	堆栈保护 Stack Protect	
	空间保护 Memory Protect	
	时间保护 Timing Protect	
	服务保护 Service Protect	
	Application管理 Os-Application Management	

5.3 配置工具 Configuration Tool



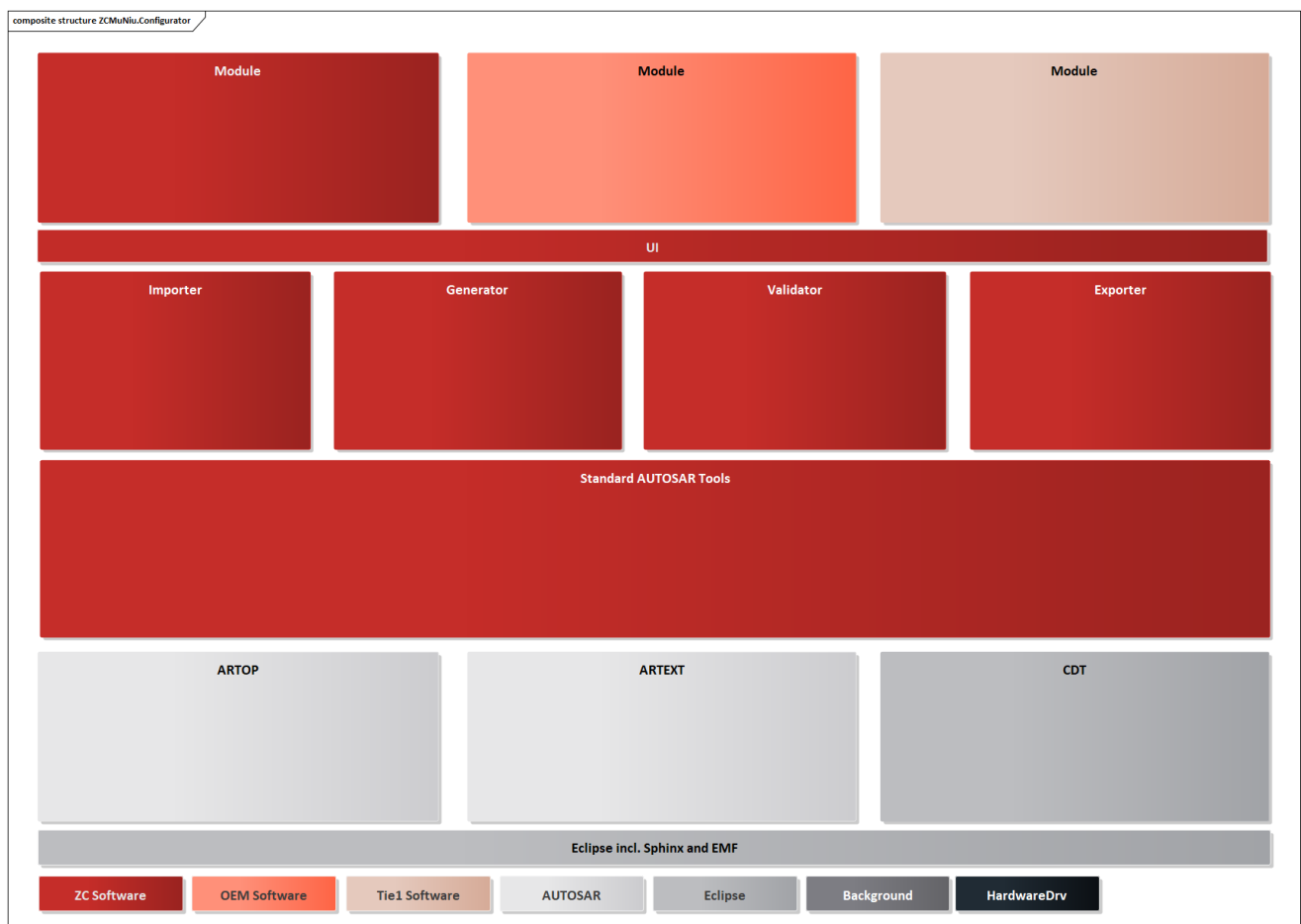
木牛配置工具 OS 主界面
MUNIU CONFIGURATION TOOL OS MAIN INTERFACE



木牛配置工具生成 OS 配置代码
MUNIU CONFIGURATION TOOL GENERATES OS CONFIGURATION CODE

为了满足客户的不同项目需求，提高基础软件平台的扩展性，木牛基础软件平台实现了各个模块可配置性，并且实现了配置工具。客户可根据不同需求，在配置工具上完成各个模块的配置工作，可生成配置代码文件，将生成的配置文件集成到工程中即可。

To meet the diverse project requirements of our clients and enhance the extensibility of the basic software platform, ZC.MuNiu Basic Software Platform has implemented configurable modules and a configuration tool. Customers can use the configuration tool to tailor the modules according to their specific needs, generate configuration code files, and integrate these generated configuration files into their projects. This approach allows for a high degree of customization and adaptability, ensuring that the software platform can be easily adapted to various applications and use cases.



木牛配置工具架构
 ZC.MUNIUI CONFIGURATION TOOL ARCHITECTURE

木牛基础软件平台的配置工具是基于 Eclipse 平台，并基于 ARTOP 架构，实现 AUTOSAR 模型和 ARXML 的解析。除了 AUTOSAR 标准定义的模块之外，还支持 OEM 和 Tie1 厂商二次开发自己的模块。配置完成后，可生成各个模块的配置代码。

ZC.MuNiu basic software platform configuration tool is based on the Eclipse platform and is built on the ARTOP architecture, which implements the parsing of the AUTOSAR model and ARXML. In addition to the modules defined by the AUTOSAR standard, it also supports OEM and

Tier1 manufacturers to develop their own modules for secondary development. After the configuration is completed, the configuration code for each module can be generated.

6 过程文档 PROCESS DOCUMENTATION

开发流程 Development Process	文档描述 Document Description
需求收集 Requirement Collection	需求文档 Requirement Document
软件需求分析 Software Requirement Analysis	软件需求追踪表 Software Requirement Traceability Matrix 问题沟通表 Issue Communication Form
软件架构设计 Software Architecture Design	软件架构说明书 Software Architecture Specification 软件架构的追踪表 Software Architecture Traceability Matrix
软件详细设计和 单元设计 Software Detailed Design and Unit Design	软件详细设计说明书 Software Detailed Design Specification 配置工具设计文档 Configuration Tool Design Document 软件详细设计追踪表 Software Detailed Design Traceability Matrix 软件详细设计评审表 Software Detailed Design Review Form
软件单元测试 Software Unit Testing	QAC 分析报告 QAC Analysis Report Tessy 测试报告 Tessy Test Report 软件单元验证策略 Software Unit Verification Strategy
软件集成和集成 测试 Software Integration and Integration Testing	集成策略 Integration Strategy 集成手册 Integration Manual 集成测试策略 Integration Test Strategy 集成测试报告

开发流程 Development Process	文档描述 Document Description
	Integration Test Report
	资源分析报告 Resource Analysis Report
软件系统测试 Software System Testing	符合性测试报告 Compliance Test Report
	系统测试报告 System Test Report
	性能测试报告 Performance Test Report
	系统测试报告评审 System Test Report Review
发布 Release	发布文档 Release Documentation

7 证书 CERTIFICATE

中华人民共和国国家版权局
计算机软件著作权登记证书

证书号： 软著登字第6824926号

软件名称： 知从木牛基础软件平台
[简称： 知从木牛]
V4.4

著作权人： 上海知从科技有限公司

开发完成日期： 2020年06月18日

首次发表日期： 2020年09月30日

权利取得方式： 原始取得

权利范围： 全部权利

登记号： 2021SR0100609

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2021年01月19日

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公众号



业务联系

成为全球领先的**汽车基础软件**公司

To Be the Global Leading **Automotive Basic Software** Company

