

Xenomai助力Linux kernel成为真正意义上的工业级安全RTOS
完美契合unix哲学：做一件事，把一件事做好

Xenomai实战

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Xenomai in Action

机械工业出版社
CHINA MACHINE PRESS

Xenomai在智能座舱中央控制RTOS车机仪表场景的落地应用实践
Application Practise of Xenomai in Intelligent Cockpit Central Control RTOS
Vehicle Instrument Scene

Xenomai

目录

DIRECTORY



未来智能座舱架构



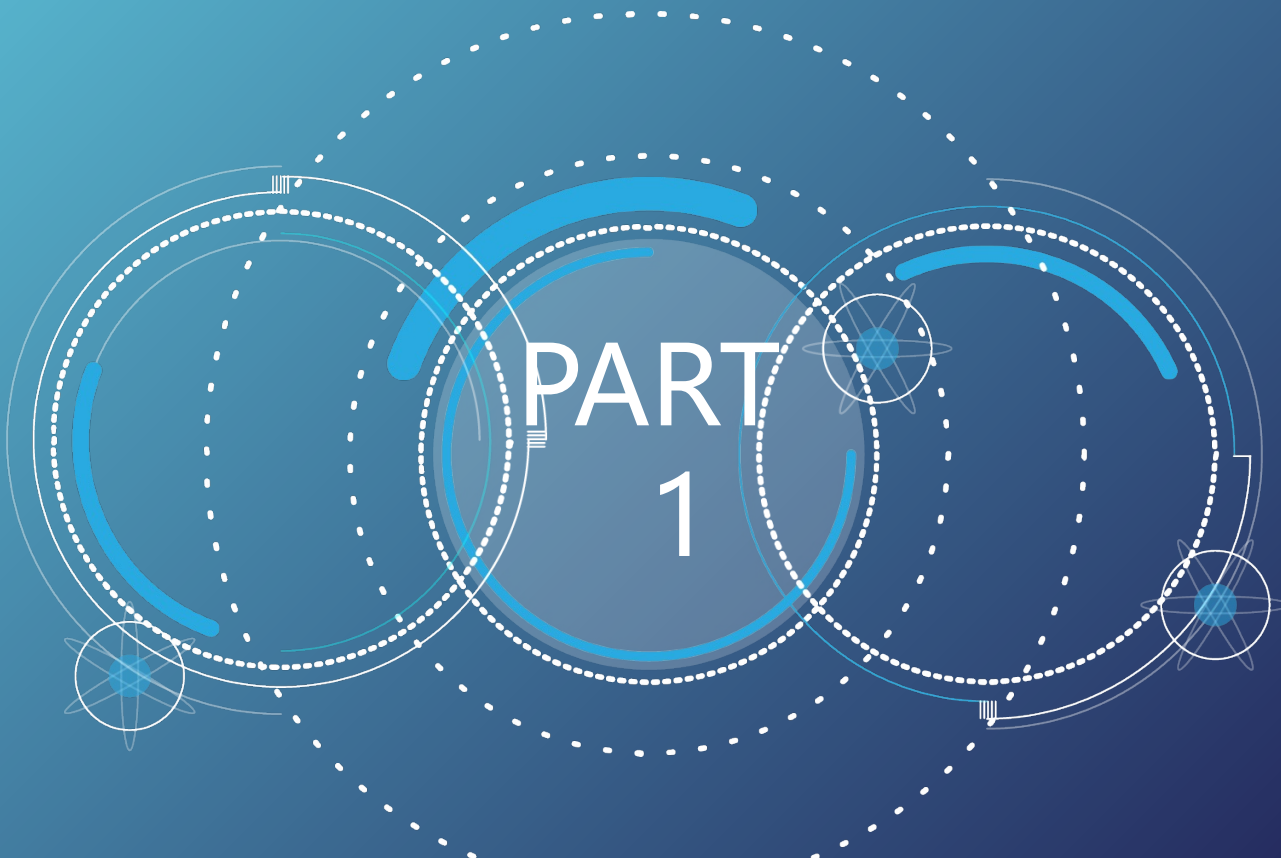
中央控制Linux RTOS-
Xenomai



Xenomai仪表机械臂硬实时控制



Xenomai4新特性



PART
1

未来智能座舱架构

软件定义智能座舱的未来架构

： 驾驶信息显示系统和车载信息娱乐系统一体化融合发展



未来的软件定义座舱

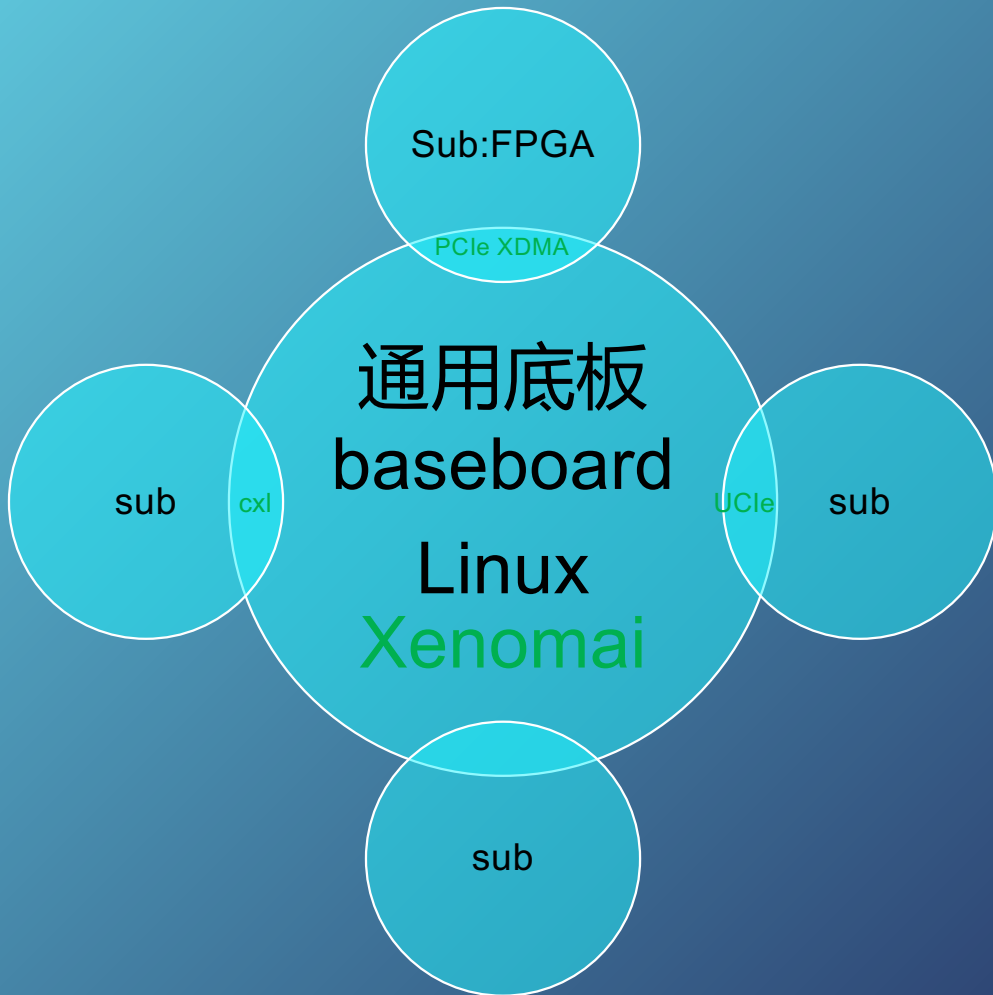
将会把汽车变成一台“行驶中的计算平台”

用户可以在车载投影仪上进行

AI

用户可以在车载投影仪上进行视频会议也
可以将演示文稿打印

落地实现畅想



Baseboard主要是实现规范定义的各种接口及通用外设，Linux Xenomai RTOS 硬实时任务调度管控；而可插拔的subboard则是实现各种功能的扩展cpu io板卡，例如：数字仪表盘系统、车载信息娱乐系统、车载机械臂子系统、核心计算板卡负责主控、自动驾驶车辆分流数据采集、backup板卡用于紧急情况的热切换，当某个板卡出现问题故障时系统可以将其工作负载转移到备用办卡

Baseboard硬件：Intel凌动处理器 E3960 ，由于是通用插卡设计，因此方便使用下一代的cpu板卡进行升级替换；

车规级subboard FPGA：

扩展CSI/DSI/IIC 等io；

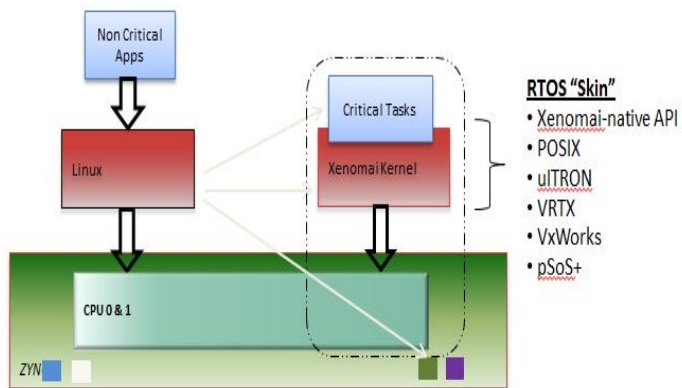
Camera(GMSL gPTP)、 screen、 sensor、 机械臂AMR、 ADAS

车辆分流采集等外设

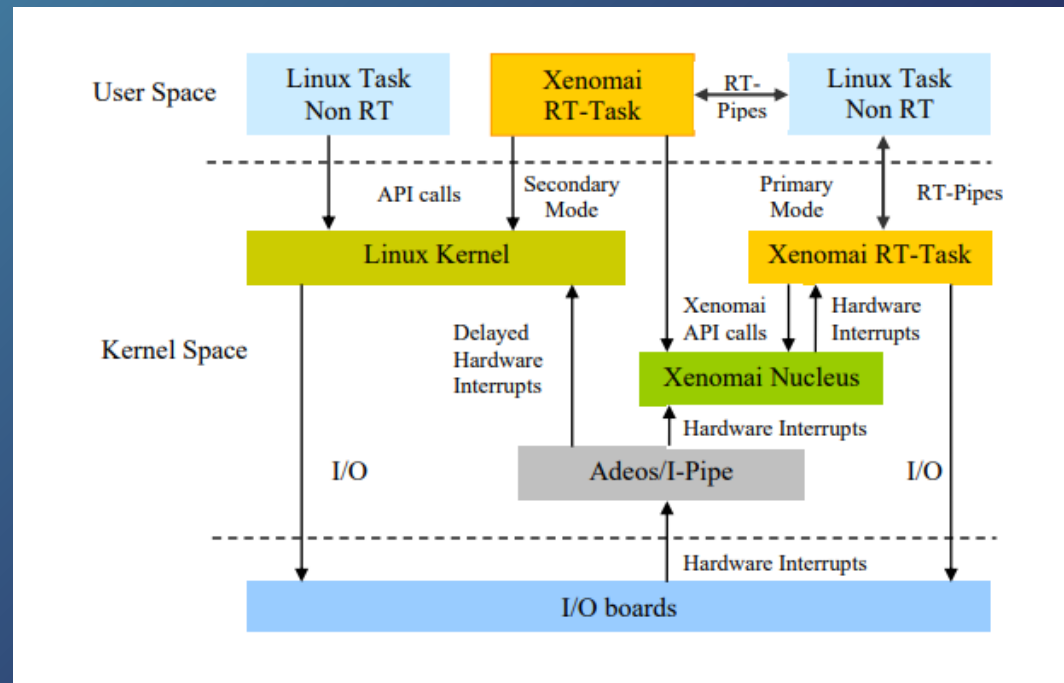
Xenomai 3

Xilinx RTOS

CPU-----AXI bus-----FPGA jitter us



- A potential solution for commercial RTOS API support (limited)
- Real-time threads can be assigned to CPU
- RTOS is prevented from corrupting Linux
- Linux kernel is not prevented from corrupting RTOS
 - However, violations should only occur from explicit calls or through specific types of crash
 - System design and comprehensive testing may mitigate customer real-world concerns



开发环境介绍

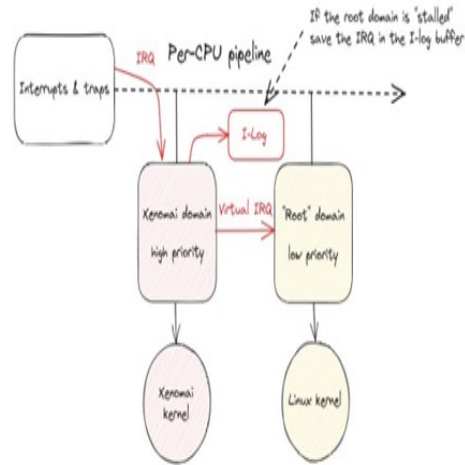
	Base board	Sub board			
cpu	Intel ATOM E3960/3950				
FPGA		车规级 FPGA			
os	Linux 4.x 5.x 6.x				
RTOS	Xenomai3 Xenomai4				
IDE	VS code vim	Vivado 2022.1			
HV	ACRN				
debug	gdb kgdb l-pipe latency tracer Cyclictest Ftrace is available for Xenomai (Cobalt events) <small># trace-cmd record -e "cobalt_**" # trace-cmd report</small>				

Interrupt dispatching principle

Linux kernel 6.6

The EEVDF scheduler, posted by Peter Zijlstra, offers the possibility of improving on CFS while reducing its dependence on often-fragile heuristics.

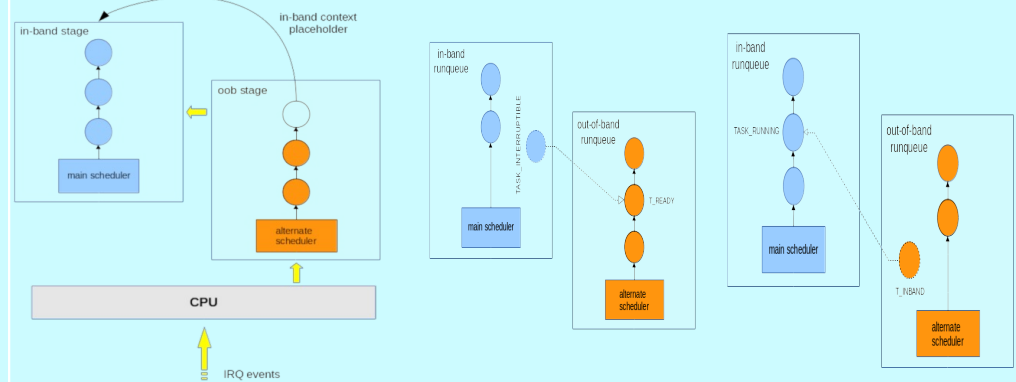
Xenomai3



Xenomai4

EVL defines five scheduling policies for running out-of-band threads:

- SCHED_FIFO;
- SCHED_RR;
- SCHED_TP;
- SCHED_QUOTA;
- SCHED_WEAK;
- SCHED_IDLE





PART
2

中央控制Linux RTOS-Xenomai

Cpu与FPGA通信Jitter控制

中央计算核心控制: X e n o m a i

CPU-FPGA

Intel凌动处理器E3960,PCIe扩展FPGA subboard

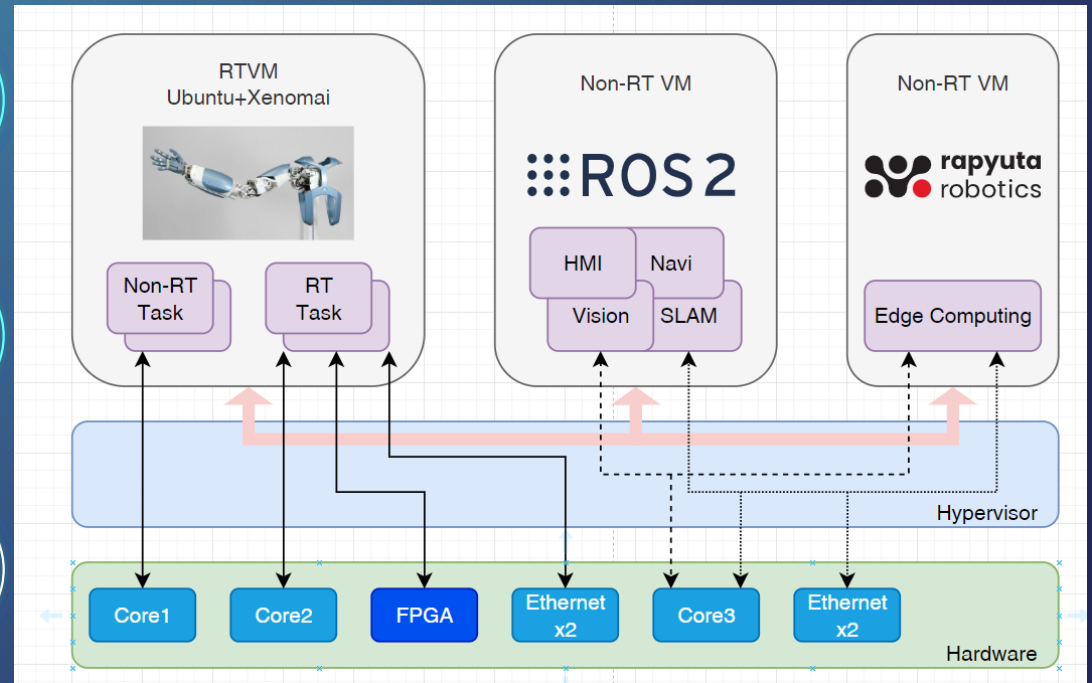


RT Task Xenomai



Edge Computing

rapyuta



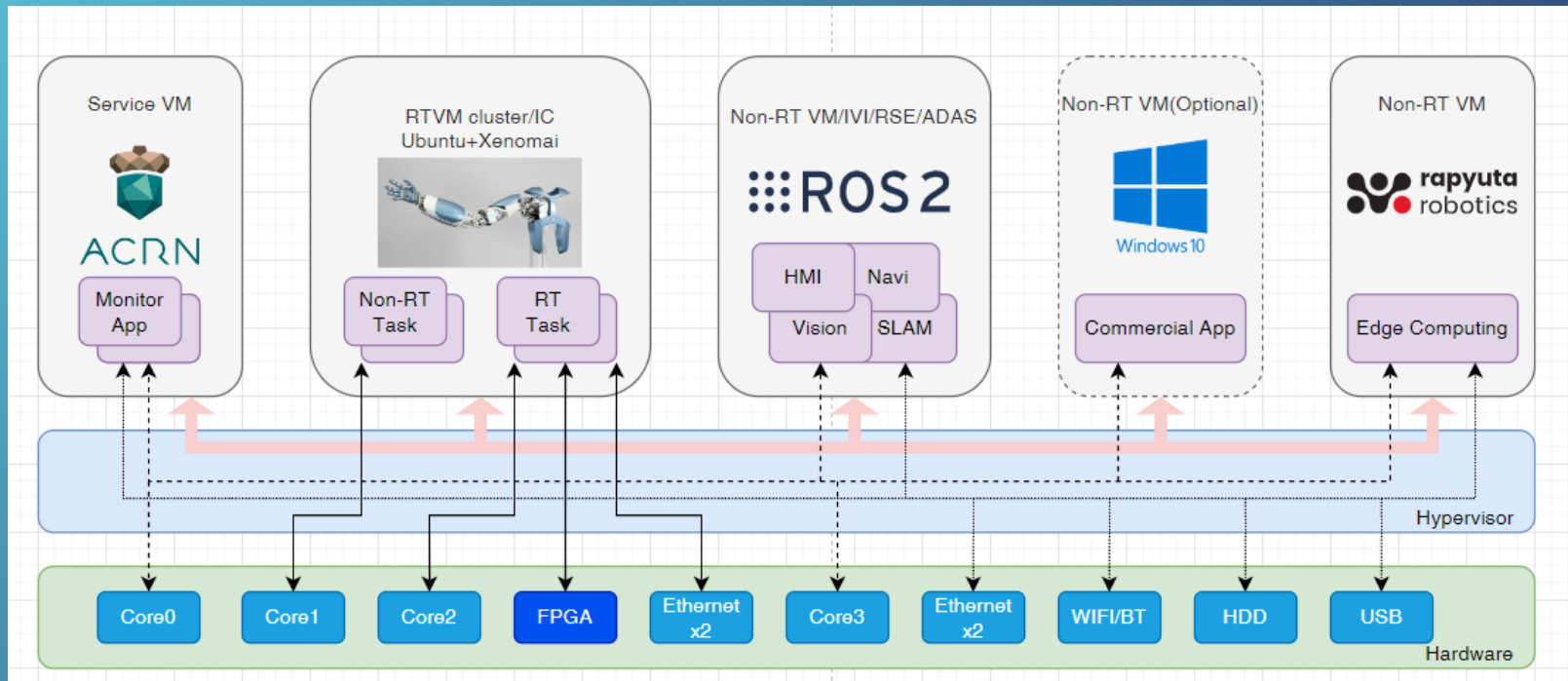
An abstract graphic consisting of several overlapping circles and dashed lines in white and light blue. The circles are of varying sizes and are arranged in a way that they appear to be part of a larger, interconnected system. The dashed lines form concentric and overlapping paths around the circles. The overall effect is a sense of motion and complexity.

PART
3

Xenomai仪表机械臂硬实时控制

ADD DIRECTORY ONE TITLESADD DIRECTORY ONE TITLES ADD DIRECTORY ONE

Xenomai cluster/OROCOS RTT



- 车载机械臂
- Xenomai OROCOS RTT event-----action latency

An abstract graphic consisting of several overlapping circles and dashed lines in white and light blue. The circles are arranged in a roughly horizontal line, with some overlapping. The dashed lines form larger, concentric-like shapes around the circles. The overall style is clean and modern, typical of a technical presentation.

PART
4

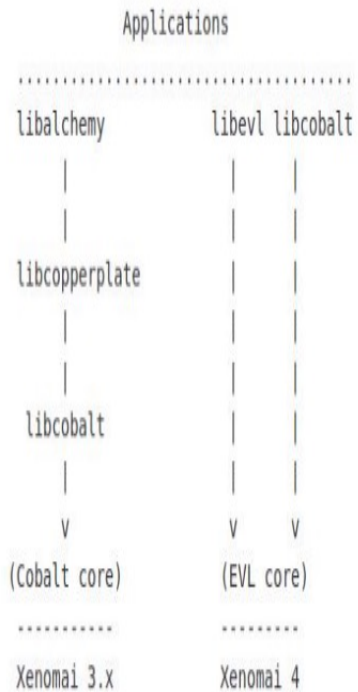
Xenomai4新功能

<https://v4.xenomai.org/>

Xenomai3 vs xenomai4

Xenomai3与xenomai4对比如下:

Common Xenomai Platform (CXP)

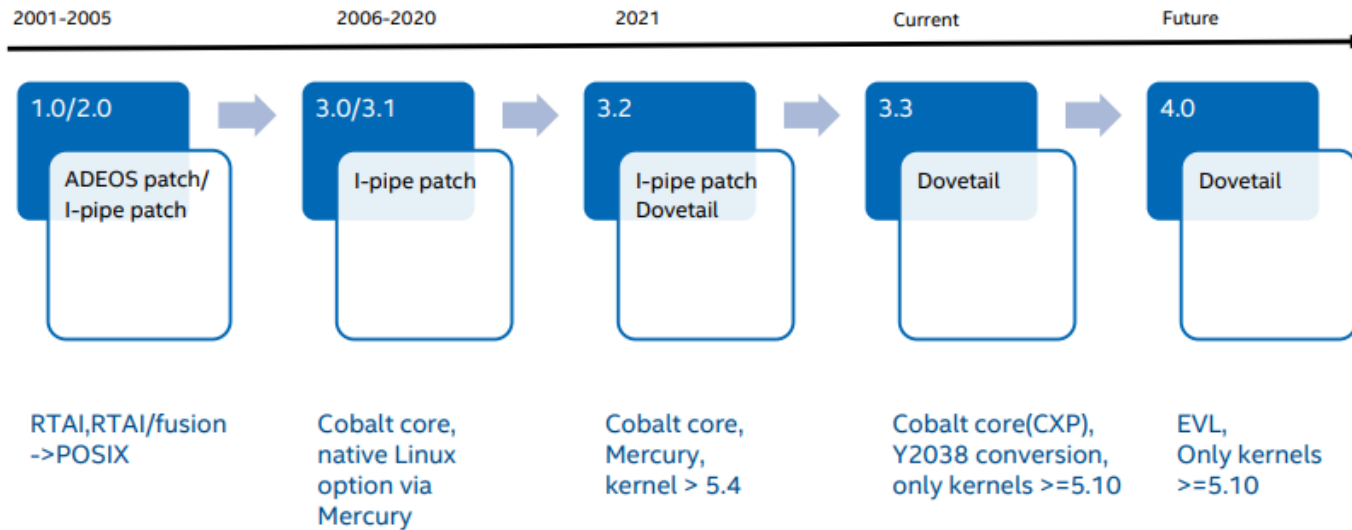


	Xenomai3	Xenomai4	note
User space	Libalchemy libcopperplate libcobalt	Libevl(c) libcobalt(Xenomai 3) revl(Rust)	the general purpose kernel and the real-time core operate almost asynchronously, both serving their own set of tasks, always giving the latter precedence over the former.
interface	ADEOS(I-pipe/Dovetail)	Dovetail	
Kernel space	Cobalt core	EVL core	

Repository	Branch	Latest
linux-evl (Tip)	v6.6-evl-rebase	v6.6
linux-evl (LTS)	v6.1.y-evl-rebase	v6.1.61-evl1
linux-evl (SLTS)	v5.10.y-evl-rebase	v5.10.199-evl1
libevl (C interface)	master	r47
revl (Rust interface)	master	0.4.0

Xenomai roadmap

Xenomai Roadmap



Xenomai系列图书规划介绍

系列书规划方案

1. 《Xenomai实战：入门与进阶》（如何使用）

读者定位：Xenomai的初级读者为主，中级读者为辅。

主要内容：Xenomai的概念、功能、使用、基本原理等。

2. 《深度实践Xenomai》（如何用好）

读者定位：Xenomai中级读者为主，初级和高级读者为辅

主要内容：Xenomai重要模块的原理、高级特性、最佳实践、二次开发等。

3. 《Xenomai技术内幕：架构设计与实现原理》（内核实现）

读者定位：Xenomai高级读者为主，中级读者为辅

主要内容：Xenomai的源代码分析、与底层原理相关的高级应用等。

这3本书依次递进，但是内容上会略有重叠，这个不影响每本书的单独定位。

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感谢观看

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