Zephyr Project:
Unlocking Innovation with an Open Source RTOS

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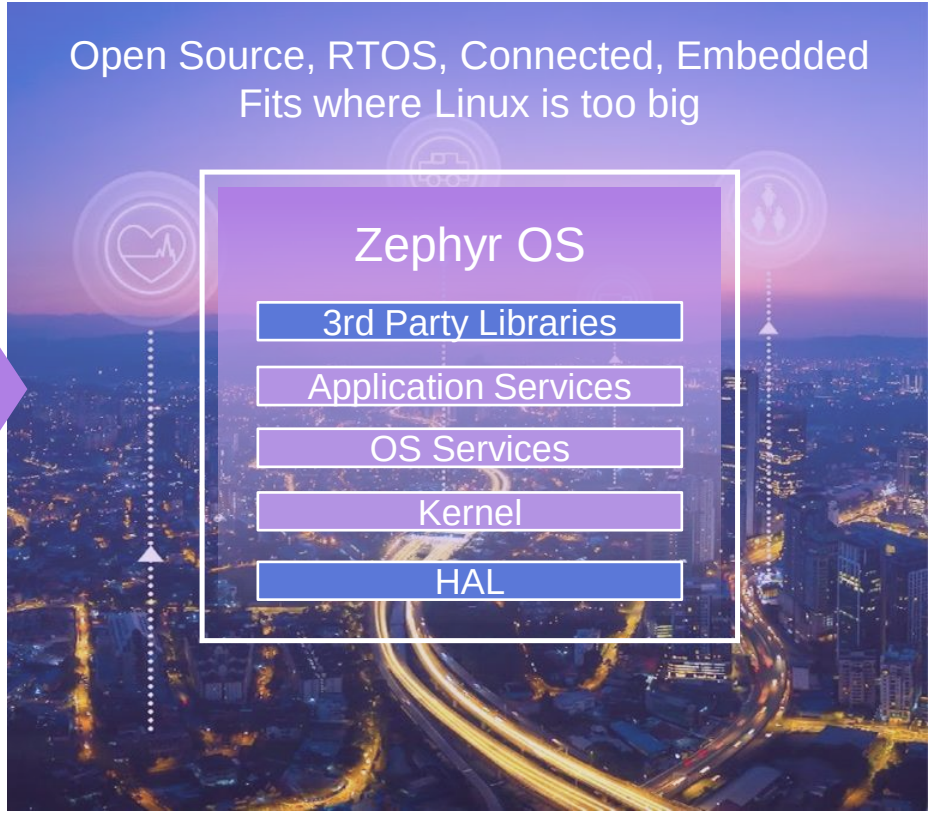
嵌入式系统联谊会
www.esbf.org

Vision Statement

The Zephyr Project strives to deliver the **best-in-class RTOS** for connected resource-constrained devices, built to be secure and safe.

Zephyr Project

- **Open source** real time operating system
- **Vibrant Community** participation
- Built with **safety and security** in mind
- **Cross-architecture** with broad SoC and development board support.
- **Vendor Neutral** governance
- **Permissively** licensed - Apache 2.0
- **Complete**, fully integrated, highly configurable, **modular** for **flexibility**
- **Product** development ready using LTS includes security updates
- **Certification** ready with Auditable



Zephyr in RTOS Landscape 2021/5/28

Total Contributors

Rank	RTOS	#
1	**Zephyr**	974
2	mbed OS	650
3	RT-Thread	346

Total Commits

Rank	RTOS	#
1	**Zephyr**	**52,806**
2	nuttX	41,583
3	RIOT	35,582

Zephyr Supported Hardware Architectures

ARC Synopsys

arm

Cortex-M, Cortex-R & Cortex-A

intel

X86 & x86_64

Nios II Processor

RISC-V

32 & 64 bit

SPARC

tensilica

Xtensa

Zephyr Project Members

and more...

Board Support – 250+ and growing


Arduino Due


Nucleo 103RB


Adafruit Feather


Nucleo64 L476RG


Nucleo F411RE


NRF91 pca10090


Nucleo F334R8


Synopsys EMSK


Minnowboard


Altera MAX10


Nucleo 401RE


Vega Board


ARM V2M MPS2


STM3210c


Atmel SAM E70


NRF51


NXP FRDM K64F


NRF52


Seed Carbon


TI Launchpad Wifi


BBC Microbit


STM32373c


Redbear BLE Nano


96b Neon Key


STM32 Olimexino


STM Mini A15


Seeed Nitrogen


ARM V2M Beetle


Zedboard Pulpino


NXP FRDM-KW41Z


SiFive HiFive1


NXP i.MX RT1050

http://docs.zephyrproject.org/boards/boards.html

Products Running Zephyr Today


Grush Gaming Toothbrush

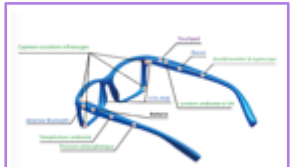

hereO Smartwatch


Proglove


Rigado IoT Gateway


Distancer


OB-4


Ellcie-Healthy Smart Connected Eyewear


Intellinium Safety Shoes


GNARBOX 2.0 SSD


Adero Tracking Devices


Anicare Reindeer Tracker


Sentrius


GEPS


Point Home Alarm

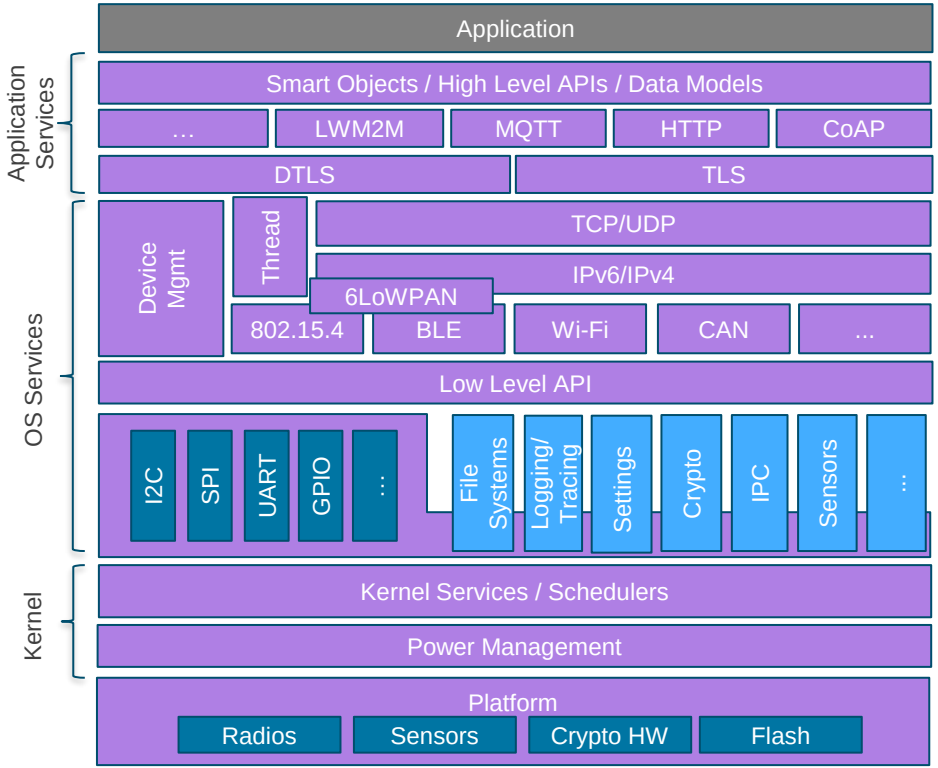

RUUVI Node


HereO Core Box


Safety Pod


Oticon More

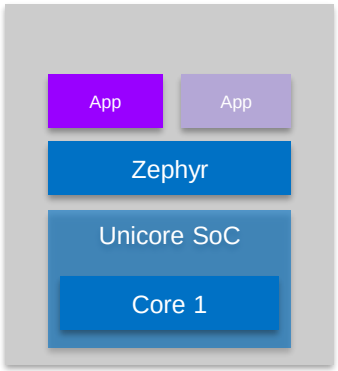
Architecture



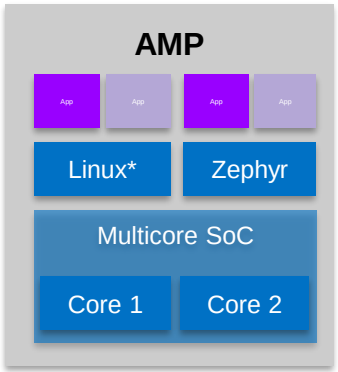
- Highly Configurable, Highly Modular
- Cooperative and Preemptive Threading
- Memory and Resources are typically statically allocated
- Integrated device driver interface
- Memory Protection: Stack overflow protection, Kernel object and device driver permission tracking, Thread isolation
- Bluetooth® Low Energy (BLE 5.1) with both controller and host, BLE Mesh
- 802.15.4 OpenThread
- Native, fully featured and optimized networking stack

Fully featured OS allows developers to focus on the application

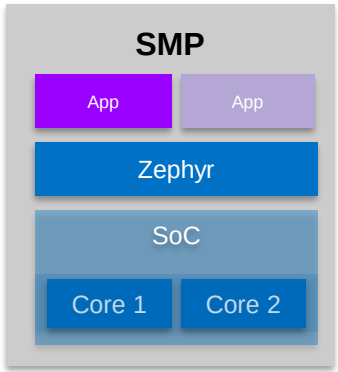
System Configurations



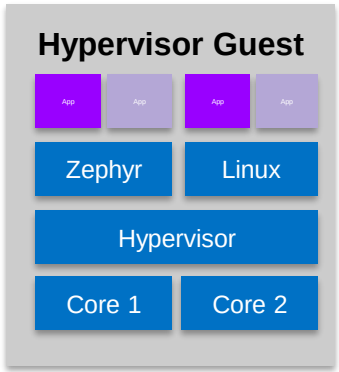
Single Core MCU



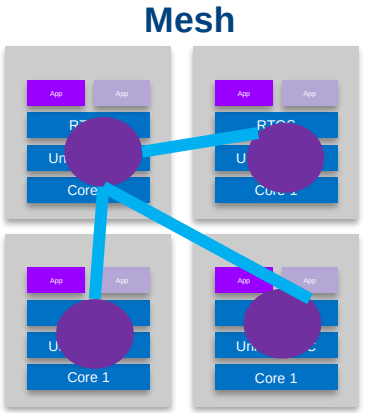
Supported with OpenAMP



Supported on some architectures

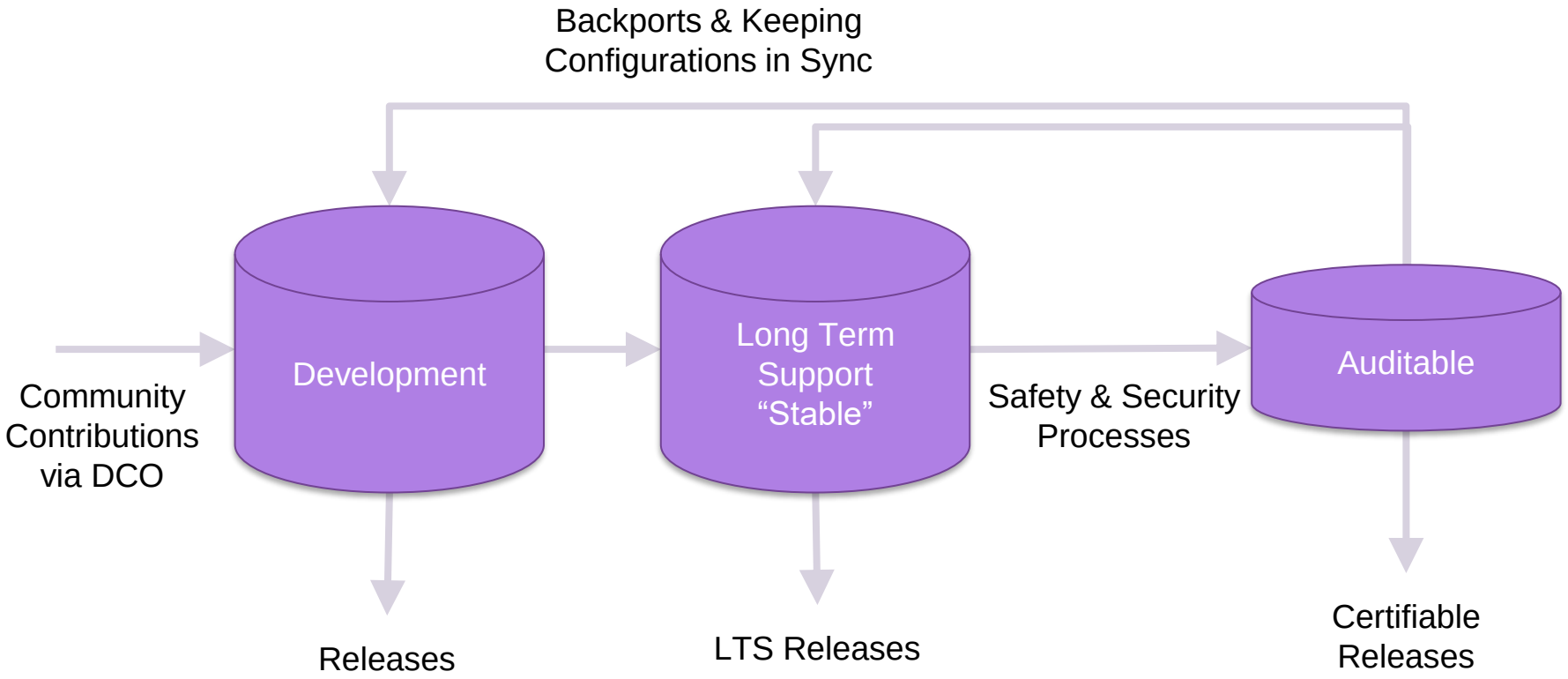


Supported with ACRN



Supported with Bluetooth & 15.4

Code Repositories



Zephyr OS: Long Term Support (LTS - 1.14)

It is:

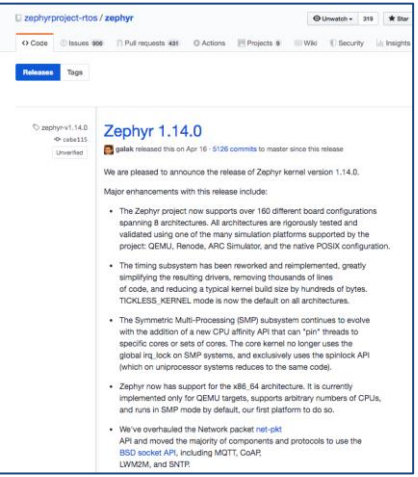
- **Product Focused**
- **Current with latest Security Updates**
- **Compatible with New Hardware**: We will make point releases throughout the development cycle to provide functional support for new hardware.
- **Tested**: Shorten the development window and extend the Beta cycle to allow for more testing and bug fixing
- **Supported** for 2 years

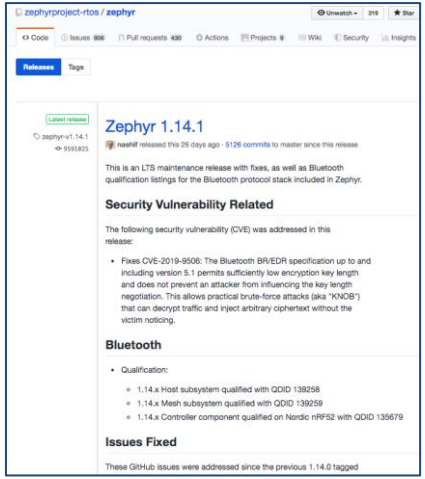
It is *not*:

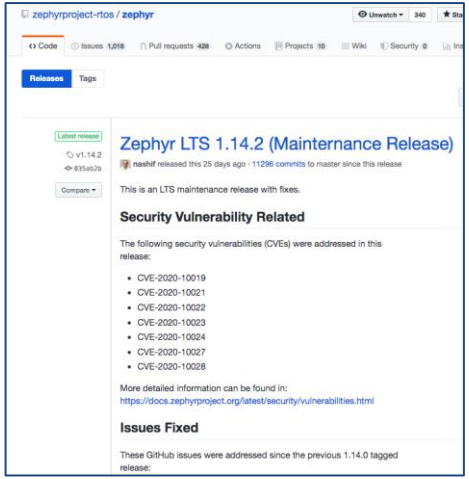
- **A Feature-Based Release**: focus on hardening functionality of existing features, versus introducing new ones.
- **Cutting Edge**

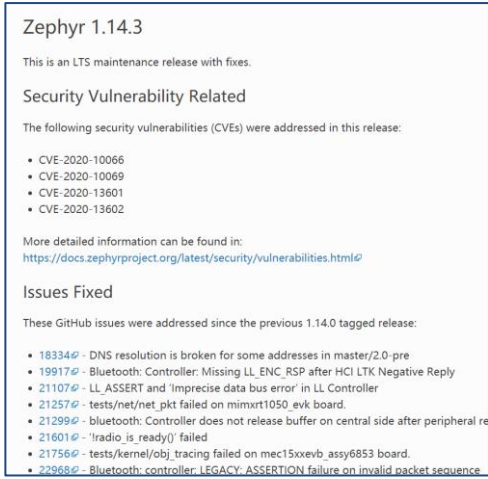
Next LTS will be Zephyr 2.7, available in October!

Zephyr OS: Long Term Support (LTS - 1.14)









Delivering bug fixes and latest security updates!

Zephyr OS: Auditable

An auditable code base will be established from a subset of the **Zephyr OS LTS**.

- Code bases will be kept in sync.
- More rigorous processes (necessary for certification) will be applied to the auditable code base.

Processes to achieve selected certification to be:

- Determined by **Safety** Committee and **Security** Committee
- Coordinated with **Technical Steering** Committee

Building in Security for LTS & Auditable

- Established **Security Committee in 2016** – meets bi-weekly.
- Secure Coding Practices have been documented for project.
- Zephyr Project registered as a CVE Numbering Authority with MITRE.
- Security Working Group has vulnerability response criteria publicly documented
  - addressed weaknesses and vulnerabilities already
- “Gold” Best Practices for projects as defined by CII
  - https://bestpractices.coreinfrastructure.org/projects/74
- Leveraging Automation to **prevent regressions**:
  - Weekly Coverity Scans to detect bad practices in imported code
  - MISRA scans being incorporated, to evolve to conformance and address issues.

Building in Safety for LTS → Auditable

- Established **Safety Committee in 2019**, meets bi-weekly. Community that understands Safety considerations, and implications.
- Initial target was decided by Governing Board to be **IEC 61508** (it is a common basis for others standards that the members care about)
- Build on Coding Practices have been documented for the project to establish more general **Coding Guidelines**
- Passing Best Practices for **project quality** as defined by CII
  - https://bestpractices.coreinfrastructure.org/projects/74
- Leveraging Automation to **prevent regressions**:
  - Weekly Coverity Scans to detect bad practices in imported code
  - MISRA scans being incorporated, to evolve to conformance and address issues.
  - Looking for open source as well as commercial tooling to help here.

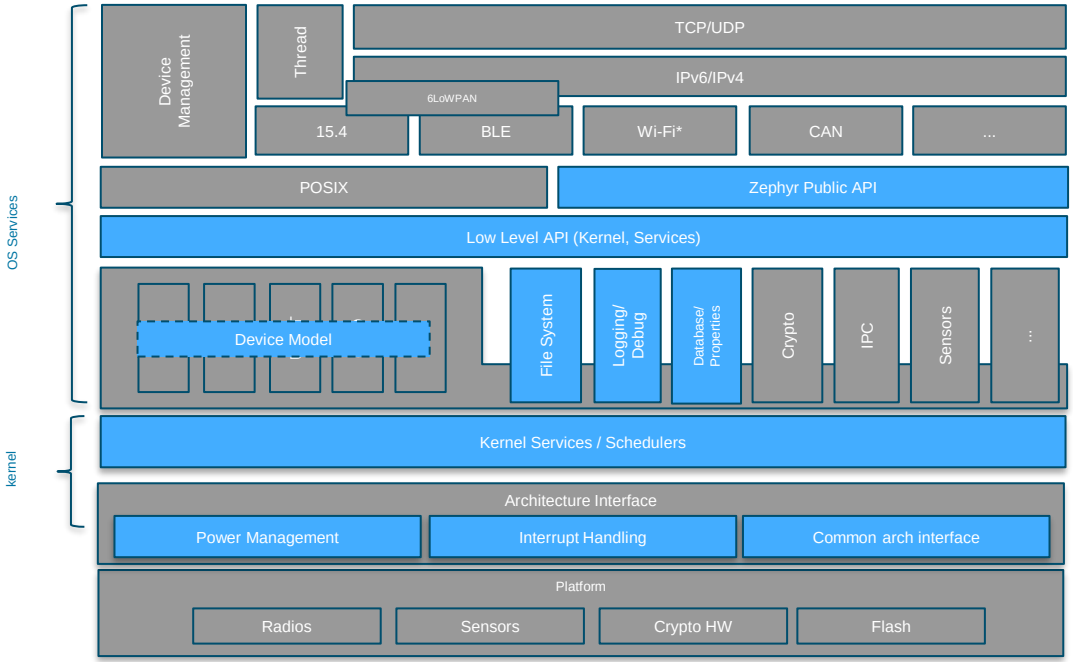
Zephyr OS: Initial Certification Focus

In scope

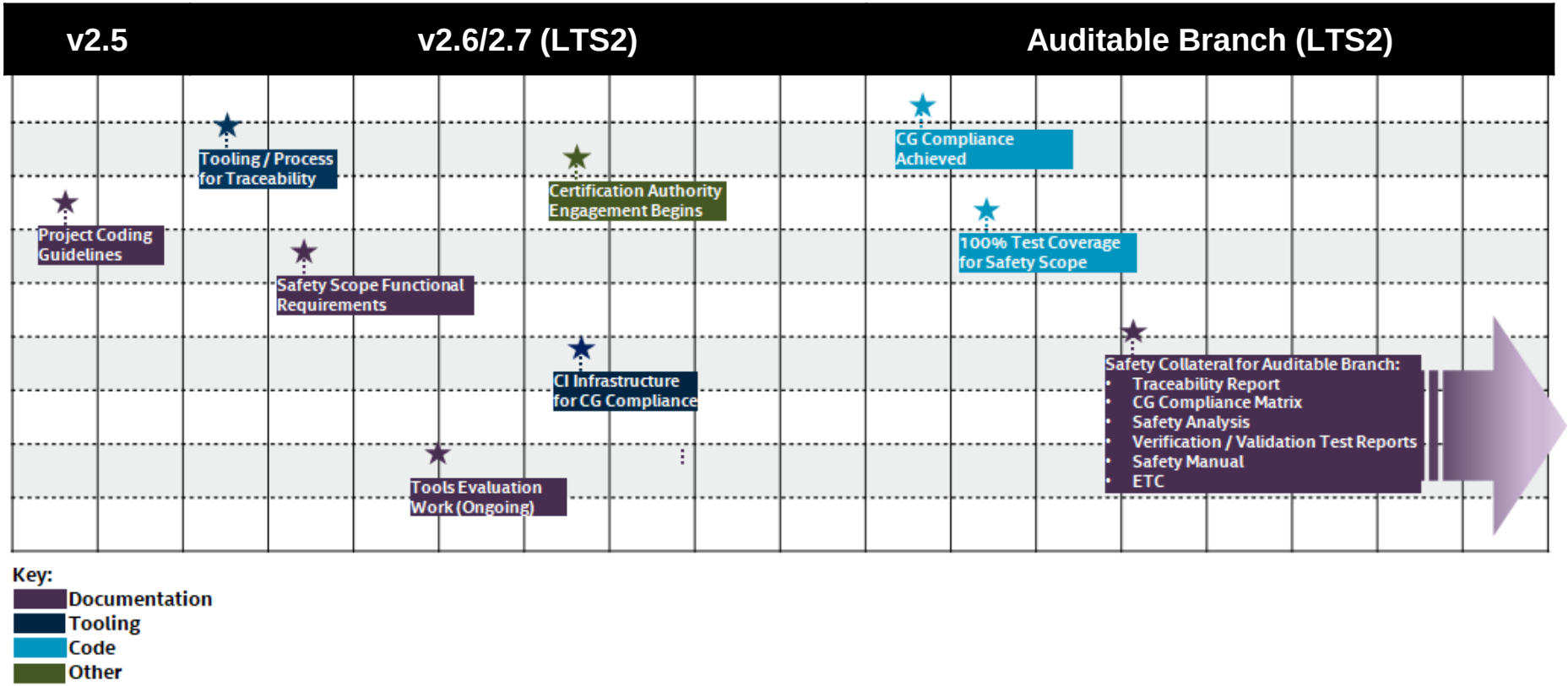
Out of scope

Scope will be **extended** to include **additional components** as determined by the safety committee

Some of the modules under consideration for the next iteration include: Crypto, IPC, Flash, etc.



Zephyr OS: Certification Roadmap



Safety Collateral

Zephyr™

Draft (pending approval by Certification Authority)

Phase	Assumed Collateral	Type of Doc	Owner	Sharing Model
Safety Concept	Safety Plan and Safety Assessment Plan	Plan/Process	FSM	Platinum
	Verification / Validation / Integration Test Plans	Plan/Process	Testing WG	Public
	Software Development Plan	Plan/Process	TSC	Public
	Configuration and Change Management Plans	Plan/Process	TSC	Public
	Software Architecture and Module Design Specification	Plan/Process	TSC	Public
	Coding Guideline	Plan/Process	TSC	Public
	Tools Documentation	Plan/Process	TSC	Public
	Software Requirements	Code	TSC	Public
	Software Safety Requirements Specification	Result Artifact	Safety WG	Platinum
Detailed Test Phase	Tests (Integration, Arch / Module, Validation)	Code	TSC	Public
	Code Review Report	Result Artifact	Safety WG	Platinum
	Verification / Validation / Integration Test Reports	Result Artifact	Testing WG	Platinum
	Fault Injection Test Report	Result Artifact	Testing WG	Platinum
	Tools Classification	Result Artifact	Safety WG	Platinum
	Tools Validation	Result Artifact	Safety WG	Platinum
	Traceability Report	Result Artifact	Testing WG/FSM	Platinum
	Test Coverage Report	Result Artifact	Testing WG/FSM	Platinum
	Coding Guideline Compliance Report	Result Artifact	Safety WG	Platinum
	Safety Analysis (e.g., FMEA)	Result Artifact	FSM	Platinum
	Source Code	Code	TSC	Public
	Software User Manual	Result Artifact	TSC	Platinum
	Safety Manual	Result Artifact	FSM	Platinum

Silver members have limited access, restricted use to Platinum artifacts based on participation

Zephyr Ecosystem

Zephyr OS

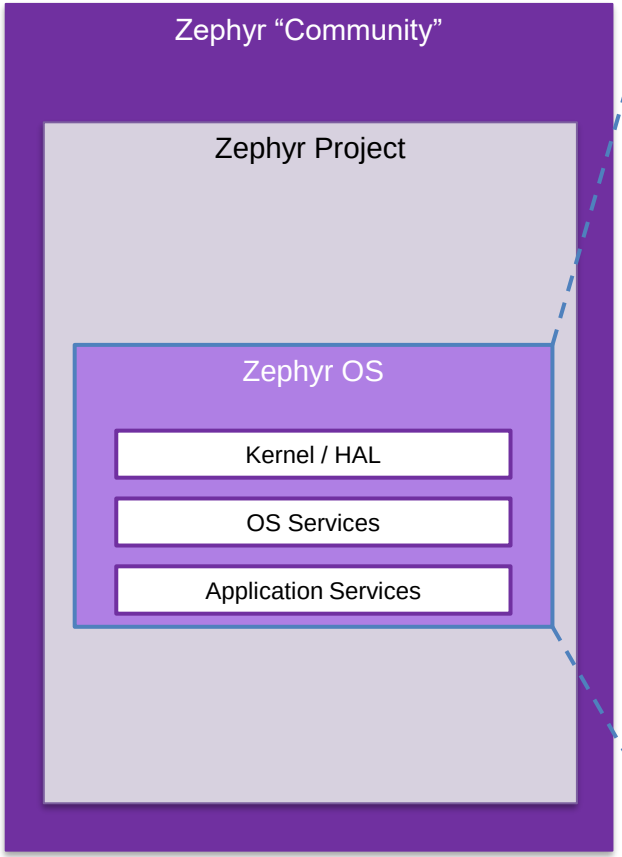
- The kernel and HAL
- OS Services such as IPC, Logging, file systems, crypto

Zephyr Project

- SDK, west, tools and development environment
- Additional middleware and features
- Device Management and Bootloader

Zephyr Community

- 3rd Party modules and libraries
- Support for Zephyr in 3rd party projects, for example: micro-ROS, Tensorflow LITE, Micropython, Jerryscript



Kernel / HAL

- Scheduler
- Kernel objects and services
- low-level architecture and board support
- power management hooks and low level interfaces to hardware

OS Services and Low level APIs

- Platform specific drivers
- Generic implementation of I/O APIs
- File systems, Logging, Debugging and IPC
- Cryptography Services
- Networking and Connectivity
- Device Management

Application Services

- High Level APIs
- Access to standardized data models
- High Level networking protocols

Development Tools For Zephyr OS

Zephyr™

GNU Compilers / Debug Tools

IDE / Debug Tools

Debug Tools

Simulation / Testing

Tracing

Cloud Debugging

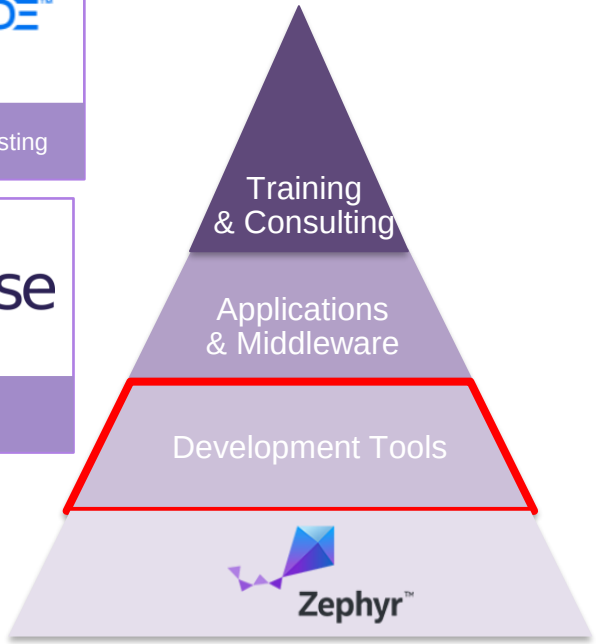
Platform.io IDE

IDE

SDK

DesignWare ARC Metaware DT

NXP MCUpresso



Firmware/Middleware/Apps For Zephyr OS

Zephyr™

TensorFlow Lite
AI/ML Library

MicroPython
Python

Javascript

Memfault
Firmware/
IoT monitoring

Intel ZephyrJS
Javascript

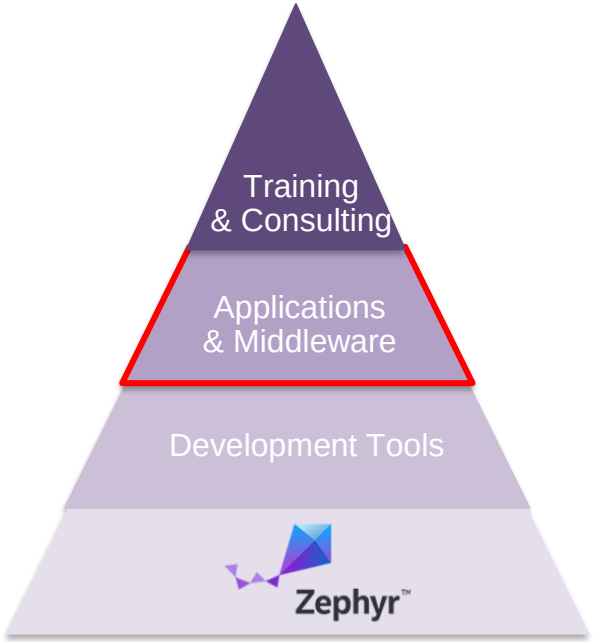
MCUboot
Firmware

FOUNDRIES.IO
IoT

Mbed TLS

TinyCrypt
Crypto Libraries

wolfSSL
SSL/TLS



Zephyr OS Training and Consulting

Zephyr™

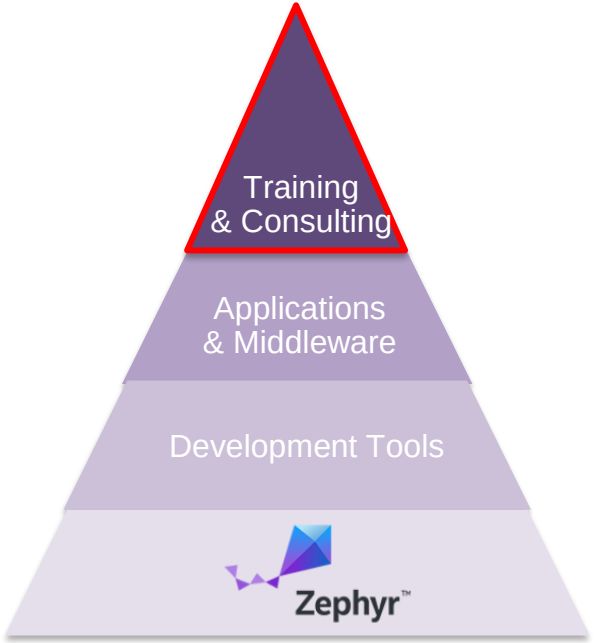
antmicro
Services

Baylibre
Consulting

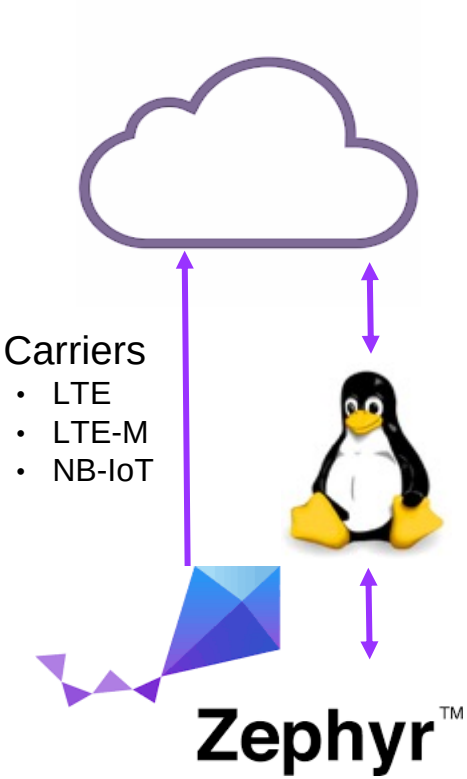
Konsulko Group
Consulting

THE LINUX FOUNDATION
Training

FOUNDRIES.IO
Services



Zephyr & the Edge/Cloud Ecosystem



Data Analytics & Control
Data Management
Device Management

Edge Gateways/Interfaces
Fog/Mesh

Sensors & Controllers
Smart Devices
(Industrial & Consumer)

RISC-V support history in Zephyr

1st commit

commit cd83e85edc5d741f6b52c6b5995303c30bda443a
Author: Jean-Paul Etienne <fractalclone@gmail.com>
Date: Wed Jan 11 00:24:30 2017 +0100
arch: added support for the riscv32 architecture

SiFive Joins Zephyr

Date: August 17, 2018
https://www.linux.com/news/zephyr-project-embraces-risc-v-new-members-and-expanded-board-support/

riscv64 support

commit 1f4b5ddd0fa84f828213fe1200917bad480bce7b
Author: Nicolas Pitre <npitre@baylibre.com>
Date: Wed Jul 17 13:17:05 2019 -0400
riscv32: rename to riscv

userspace support

commit 542a7fa25d0e135132b212ffe5ec07e98cffba36
Author: Alexandre Mergnat <amergnat@baylibre.com>
Date: Tue Jul 21 16:00:39 2020 +0200
arch: riscv: add memory protection support

riscv support status

- RISC-V international: associate member of Zephyr
- 13 boards, 9 SoCs riscv32 & riscv64, user space
- Todo: smp, MMU, more boards, more SoCs

Want riscv maintainers and contributors!!

Add support GigaDevice GD32V

https://github.com/zephyrproject-rtos/zephyr/pull/34970
Author: TOKITA Hiroshi <tokita.hiroshi@gmail.com>
Date: 8 May 2021
This PR adds support for GigaDevice GD32V SoC

riscv smp support

https://github.com/zephyrproject-rtos/zephyr/pull/29105
Author: Katsuhiro Suzuki <katsuhiro@katsuster.net>
Date: 11 Oct 2020
This patch adds support of SMP for RISC-V privilege systems.

latest commit

commit 7b09d031fae3969fbe8647a57190f1fa21fabd8e
Author: Felipe Neves <felipe.neves@espressif.com>
Date: Mon Jun 14 11:10:47 2021 -0300
Plus added implementation for esp32c3 SoC.

1st Zephyr Developer Summit

700 people registered, **3** tracks, **5** mini-conferences, **28** sessions and **51** speakers

Zephyr RTOS Virtualization and Memory Isolation

- Integrating RISC-V PMP Support in Zephyr
- Securing MCUBoot in 5 minutes or less
- ACRN Hypervisor and Zephyr RTOS for Industrial IoT Applications
- Trusted Firmware M in Zephyr

Zephyr's Ecosystem Support

- Machine Learning with TensorFlow Lite Micro on Zephyr
- Micropython Binding to LVGL in Zephyr OS
- Coredump: A Brief Introduction and Demo
- Logging Subsystem Overview
- Real Time in the Real World, Scheduler Details for Practical Problems

Zephyr RTOS for Industrial

- Using Zephyr for hard real-time applications: motor control
- Software Defined Power Electronics: Leveraging Zephyr to unleash the Arduino of Energy
- IoT-enabled Solar Power Converters with Zephyr
- Power Electronics for Zephyr Roadmap
- Using OPC UA with Zephyr

Device & Boards

- A deep dive into the Zephyr 2.5 device model
- USB support in Zephyr
- Zephyr Power Management 101
- Demand Paging: when software is bigger than available memory
- The ESP32 Status on Zephyr

More details are in https://www.zephyrproject.org/

Zephyr Participation Information

Orientation:

- https://www.zephyrproject.org/community/

Github:

- https://github.com/zephyrproject-rtos/zephyr

Mail Lists:

- https://lists.zephyrproject.org/g/main

Slack:

- https://tinyurl.com/y5glwylp

我来带你入群

www.zephyrproject.org