Zephyr OS:
Industrial IoT support

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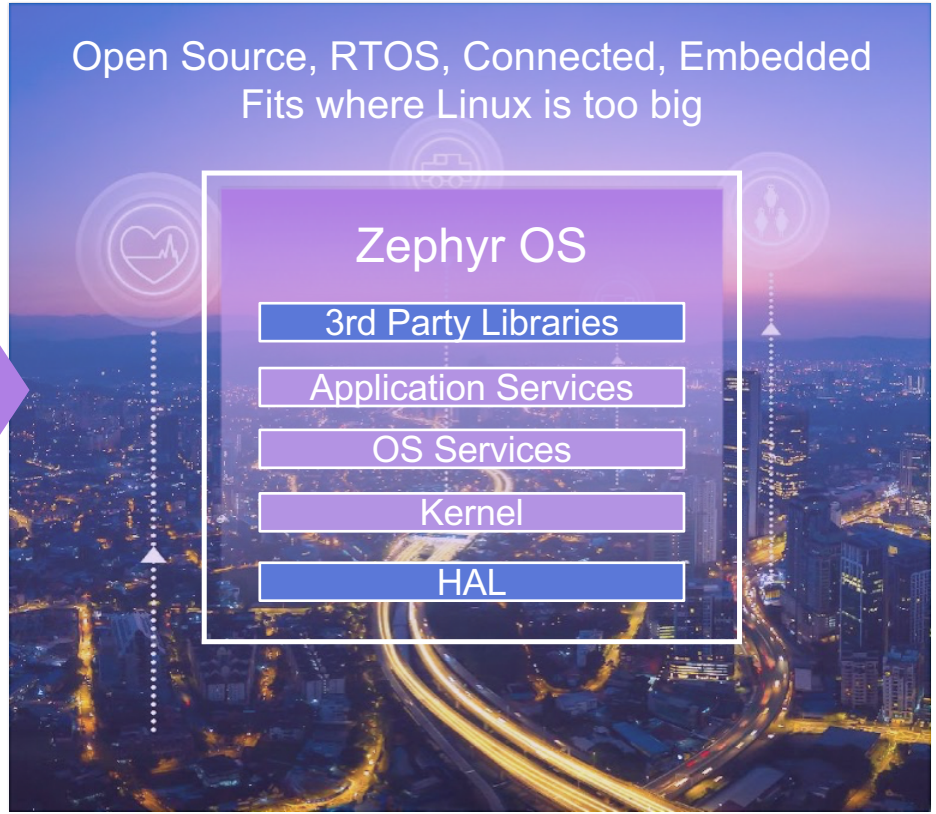
Zephyr Project

- **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 Supported Hardware Architectures

Cortex-M & Cortex-R

X86 & x86_64

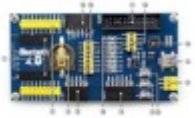
32 & 64 bit

Xtensa

Coming soon:

Board Support – 200+ and growing

Zephyr™

 Arduino Due	 Nucleo 103RB	 NRF51	 Nucleo64 L476RG	 Nucleo F411RE	 NRF52 pca10040	 Nucleo F334R8	 Synopsys EMSK
 Minnowboard	 Altera MAX10	 Nucleo 401RE	 Vega Board	 ARM V2M MPS2	 STM3210c	 Atmel SAM E70	 Adafruit Feather
 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

Zephyr Project Members

and more...

Zephyr in RTOS Landscape 2019/12/26

#1

Total GitHub Contributors

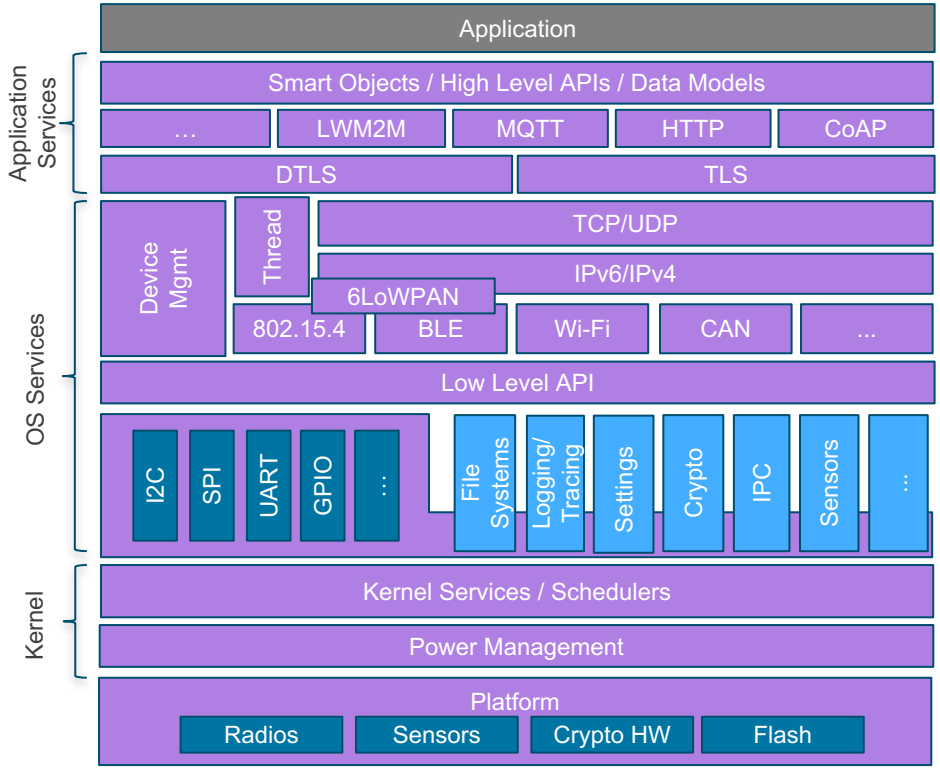
Rank	RTOS	#
1	**Zephyr**	**589**
2	mbed OS	563
3	nuttX	359

#2

Total Git Commits

Rank	RTOS	#
1	nuttX	40,332
2	**Zephyr**	**35,993**
3	mbed OS	27,925

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

Aspects Of Industrial Use

Zephyr™

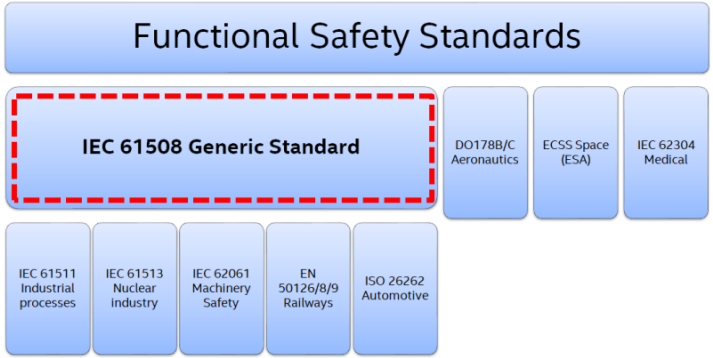
Functional aspects (“What”)

- **Industrial networking**
- Real-time scheduling

Non-functional aspects (“How”)

- **Safety**
- Security

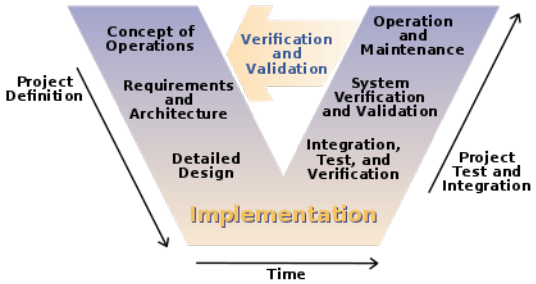
Zephyr: Functional Safety



Ongoing activity to make Zephyr certifiable for Functional Safety using IEC 61508

This requires tailored development process and special artefacts.
These will be deployed to special branch ‘auditable’

- Auditable branch based on Zephyr Long-Term Support release (2 year cadence)
- Supports V-model requirement by FuSa standards



Zephyr Networking Features

High-Level Protocols

- CoAP v1
- MQTT Client v3.1.1
- HTTP
  - As of Zephyr 2.0 server is implemented using CivetWEB library
  - Native HTTP client
  - Websocket client
- SOCKS5
- LWM2M
- Thread
  - Supported by OpenThread project

Supported technologies

- Ethernet
- Ethernet over USB
- WiFi with IP offload
- IEEE 802.15.4 with 6Lo
- Bluetooth LE with 6Lo
- CANbus with 6Lo
- PPP

Introducing Time Sensitive Networking

TSN is a set of IEEE 802.1 standards for the time-sensitive transmission of data over deterministic Ethernet networks.

They define

- Time synchronization
- Scheduling and traffic shaping
- Selection of communication paths and fault-tolerance

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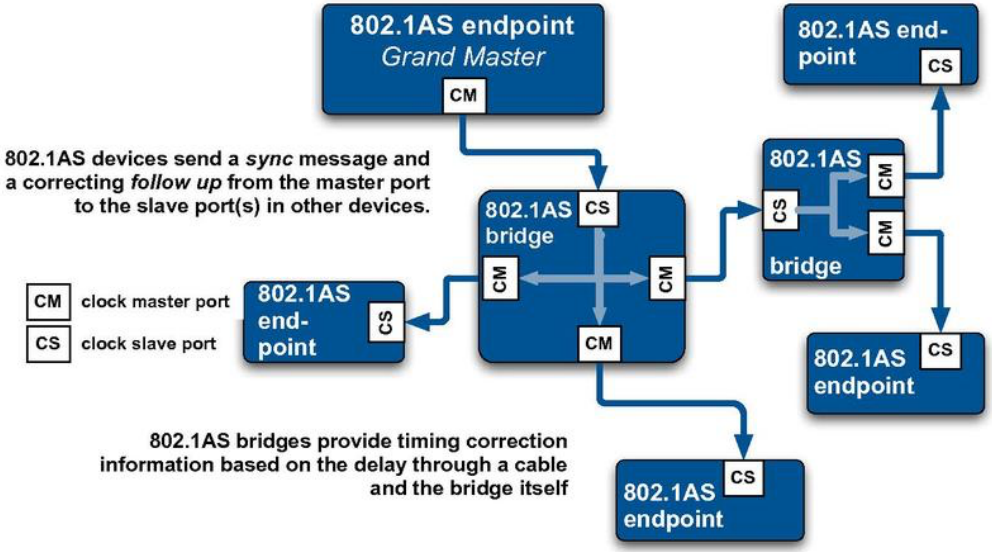
Sample uses

- Synchronizing time between different parts of assembly robot
- Transfer multimedia content inside car multimedia system

TSN: Time Synchronization

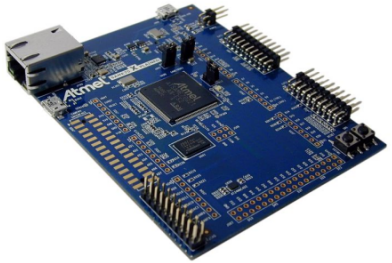
IEEE 802.1AS-2011 defines the Generic Precision Time Protocol (gPTP). It uses gPTP messages to establish a hierarchy of clocks and synchronize time between them



TSN: Traffic Scheduling and Shaping

- **Traffic scheduling for TSN** - defined by a group of standards extending IEEE 802.1Q to guarantee end-to-end latencies for the various traffic classes
- TSN scheduling standards include 802.1Qav, Qbu, Qbv
- **Traffic shaping** is a method of distributing traffic in time to allow consistent bandwidth usage

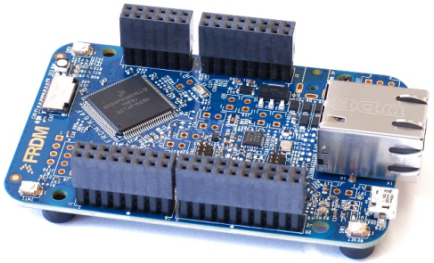
Zephyr TSN Support: Supported Features



Zephyr supports 802.1AS-2011 gPTP protocol

- It can act as a grand master or a slave

Supported hardware needs to have Ethernet packet timestamping implemented:



- Atmel SAM-E70 Xplained (gPTP and Qav supported)
- NXP FRDM-K64F (only gPTP supported)

See samples/net/gptp application for details

https://docs.zephyrproject.org/latest/reference/networking/tsn.html

Introducing CAN Bus

Controller Area Network bus is a serial bus developed by Bosh in 1983.
Family of ISO standards 11898, since 1993

Commonly used to interconnect Electronic Control Units in car:

- Engine,
- Power steering
- ABS
- Wipers
- etc

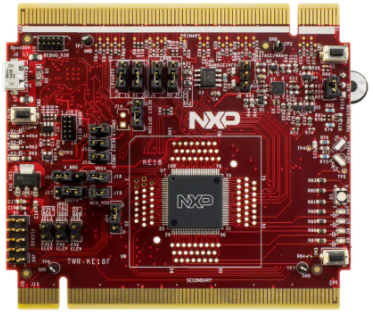
Used for OBD II in your car

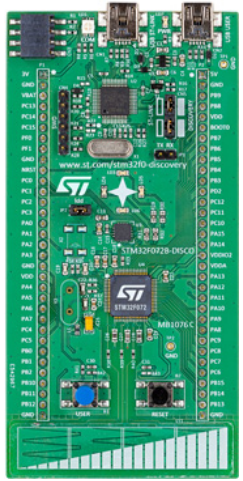
Thanks to the low cost of equipment, used as a common fieldbus in automation solutions

Zephyr CAN bus support

Hardware support:

- NXP TWR-KE18F
- STM32-based chips: F0, F7,...





Protocols:

- direct/raw CAN access
- SocketCAN (using Socket API to access CAN)
- CANOpen (protocol over CAN)

6LoCAN

- IPv6 over CAN bus, IETF draft (Oct 2019)

https://docs.zephyrproject.org/latest/reference/networking/can.html

Closing Thoughts

Open Source operating systems can be a good fit for industrial IOT, if

- They have right technologies enabled
- They have right license
- They enable safety/security certification

Zephyr Project has a unique combination of advantages that can make it a viable alternative to closed source platforms in IIOT

You are welcome to try it at www.zephyrproject.org !

www.zephyrproject.org