Zephyr Project: Unlocking IoT Innovation with an Open Source RTOS

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24 Jun 2019 | Oslo, Norway

简体

Customer | nRF52832 | Bluetooth LE | Lighting

Phantom's ELDA system uses two devices employing Nordic's nRF52832 SoC for mesh networking between wall switch and LED drivers

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Source: https://www.nordicsemi.com/News/2019/06/Phantom-ELDA-system-uses-two-devices-employing-nRF52832-SoC-for-mesh-networking

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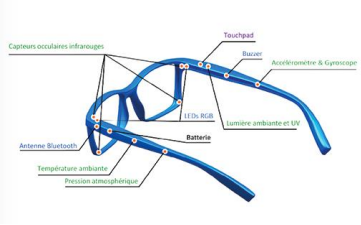
"Because we required multi-tasking, the Nordic SoC's Zephyr RTOS [real-time operating system] support was also important." - Wu Tianji, CTO at Phantom

Source: https://www.nordicsemi.com/News/2019/06/Phantom-ELDA-system-uses-two-devices-employing-nRF52832-SoC-for-mesh-networking

Products Running Zephyr Today



Ellcie-Healthy Smart Connected Eyewear

Grush Gaming Toothbrush

hereO Smartwatch

Rigado IoTGateway

Blocks Modular Smartwatch

ProGlove Scanning Gloves

Intellinium Safety Shoes

Adero tracking devices

GNARBOX 2.0 SSD

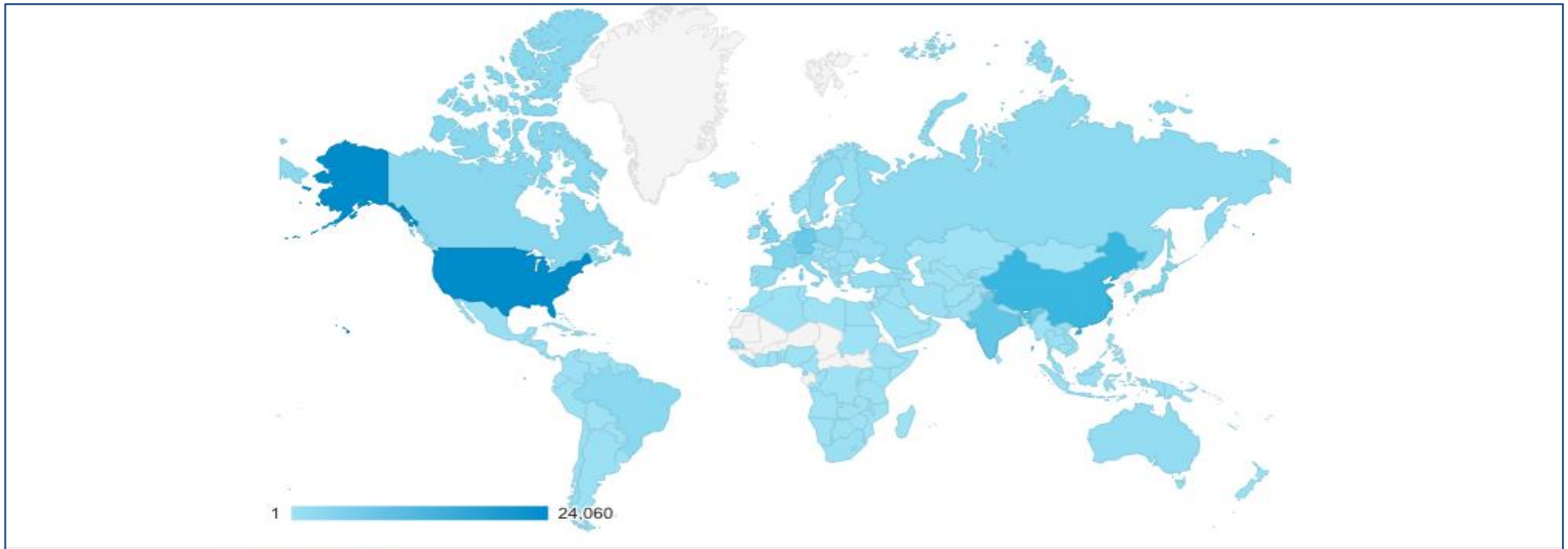
RUUVI node

GEPS

Point Home Alarm

Anicare reindeer tracker

HereO Core Box

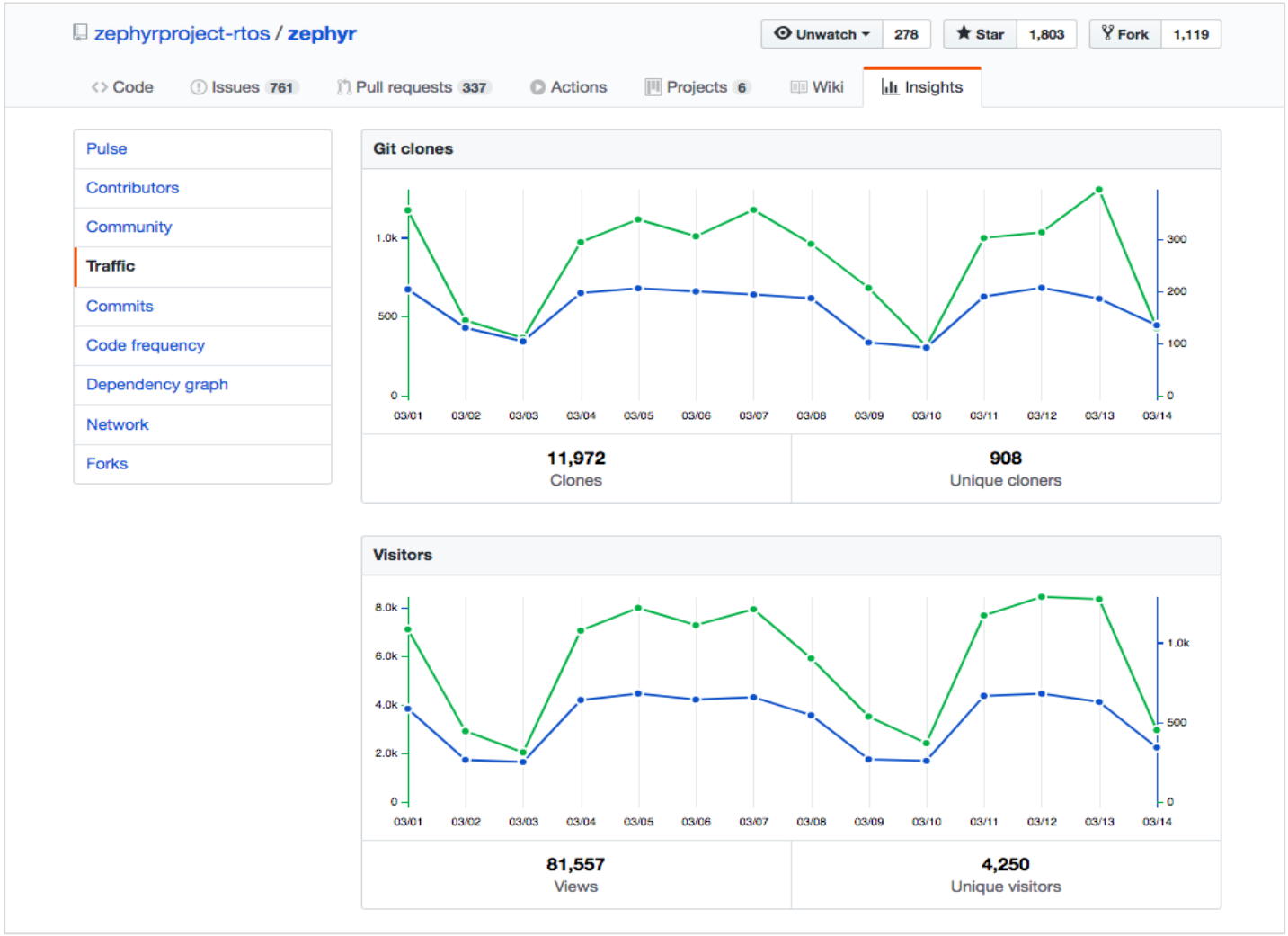


Primary Dimension: **Country** City Continent Sub Continent

Secondary dimension | advanced

Country	Users	Sessions	Pages / Session	Avg. Session Duration	% New Sessions	Bounce Rate
	107,341 % of Total: 100.00% (107,341)	219,112 % of Total: 100.00% (219,112)	2.85 Avg for View: 2.85 (0.00%)	00:03:15 Avg for View: 00:03:15 (0.00%)	48.61% Avg for View: 48.52% (0.20%)	56.43% Avg for View: 56.43% (0.00%)
1. United States	**24,060** (21.78%)	43,255 (19.74%)	2.80	00:02:59	53.86%	57.70%
2. China	**11,898** (10.77%)	30,959 (14.13%)	3.19	00:04:20	36.51%	49.15%
3. India	**7,497** (6.79%)	14,760 (6.74%)	2.56	00:03:09	49.99%	58.70%
4. Germany	**6,737** (6.10%)	12,192 (5.56%)	2.86	00:03:06	52.57%	58.11%
5. United Kingdom	**3,905** (3.53%)	6,459 (2.95%)	2.62	00:02:31	58.28%	58.38%

1 year of traffic to zephyr.org website



2 weeks of traffic to github.com/zephyr code repository

Zephyr Project:

- **Open source** real time operating system
- **Vibrant Community** participation
- Built with **safety and security** in mind
- **Cross-architecture** with growing developer tool support
- **Vendor Neutral** governance
- **Permissively** licensed - Apache 2.0
- **Complete**, fully integrated, highly configurable, **modular** for **flexibility**, better than roll-your-own
- **Product** development ready using LTS includes security updates
- **Certification** ready with Auditable

THE LINUX FOUNDATION PROJECTS

Zephyr Supported Hardware Architectures

ARC Synopsys

arm

intel

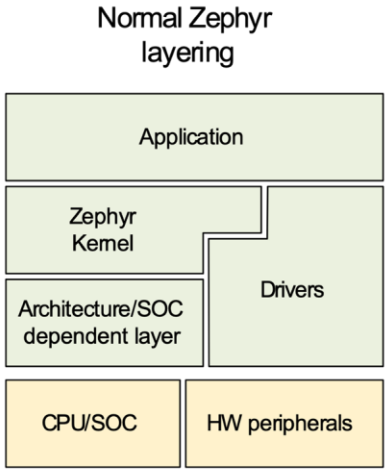
Nios® II Processor

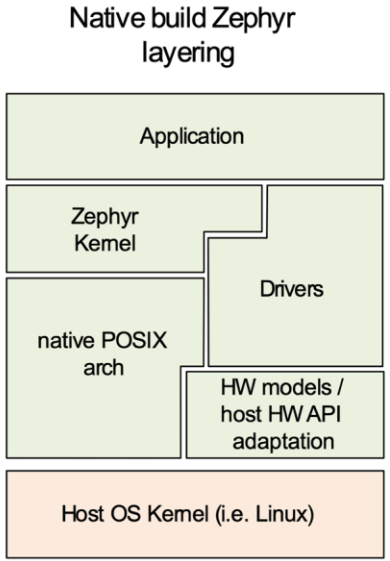
RISC-V

tensilica

Native execution on a POSIX-compliant OS

- Build Zephyr as native Linux application
- Enable large scale simulation of network or BLE tests without involving HW
- Improve test coverage of application layers
- Use any native tools available for debugging and profiling
- Develop GUI applications entirely on the desktop
- Optionally connect to real devices with TCP/IP and BLE
- Reduce requirements for HW test platforms during development





Sample of Board Support

Zephyr™


SiFive HiFive1


Arduino Due


Nucleo 103RB


NRF51


Nucleo64 L476RG


Nucleo F411RE


NRF52 pca10040


Nucleo F334R8


Synopsys EMSK


Arduino 101


Minnowboard


Altera MAX10


Nucleo 401RE


Hexiwear


ARM V2M MPS2


STM3210c


Atmel SAM E70


Adafruit Feather


Galileo


NXP FRDM K64F


NRF52


Seeed Carbon


TI Launchpad Wifi


BBC Microbit


STM32373c


Redbear BLE Nano


96b Neon Key


Quark D2000


STM32 Olimexino


STM Mini A15


Seeed Nitrogen


ARM V2M Beetle


Zedboard Pulpino


NXP FRDM-KW41Z


tinyTILE

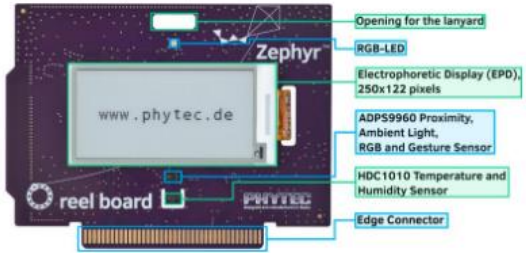

NXP i.MX RT1050

170 BOARDS TODAY WITH MORE ON WAY…

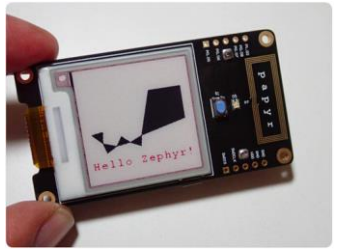
http://docs.zephyrproject.org/boards/boards.html

Boards Shipping with Zephyr Today

Antmicro Badge

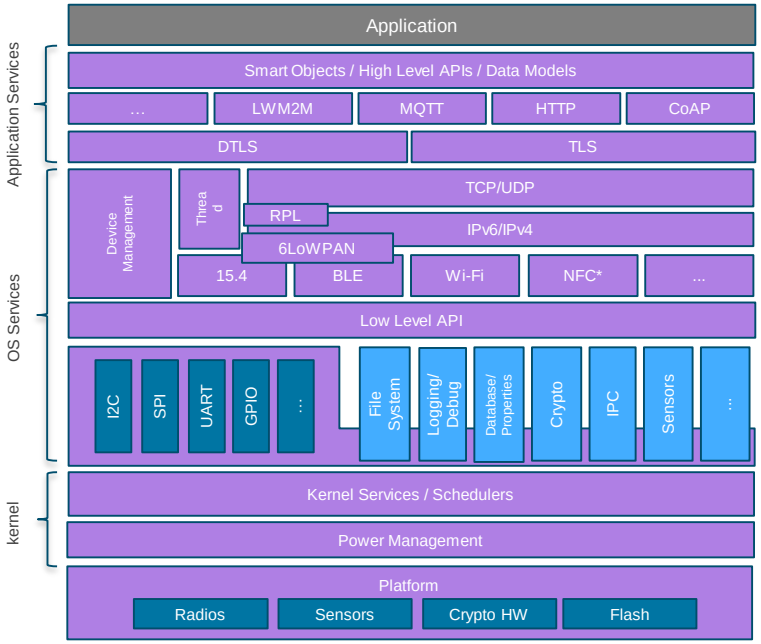


Phytec Reel Board



Electronuts Papyr

Architecture



- Highly Configurable, Highly Modular
- Cooperative and Pre-emptive 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 4.2, 5.0) with both controller and host, BLE Mesh
- Native, fully featured and optimized networking stack

Fully featured OS allows developers to focus on the application

Growing a Diverse Community!

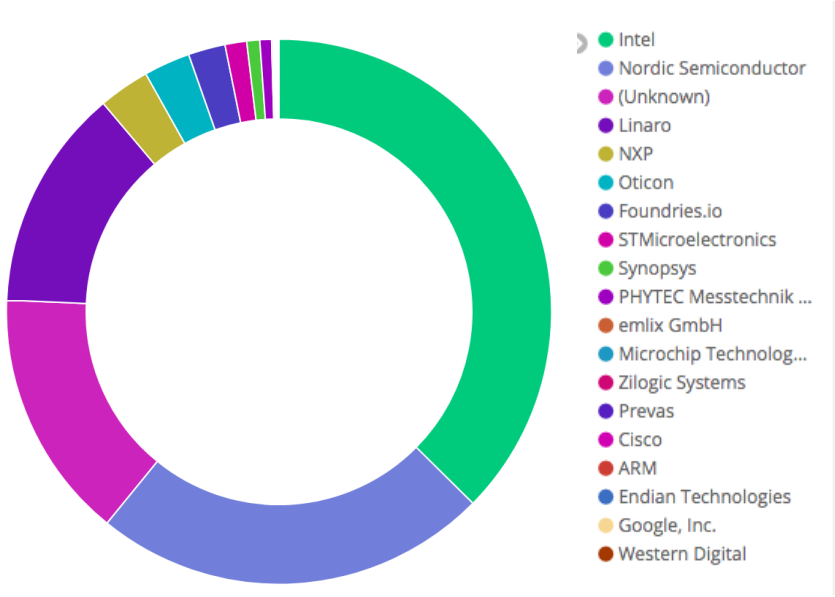
Lifetime project participation

Authors
- 2016/2: 80
- 2019/6: 499

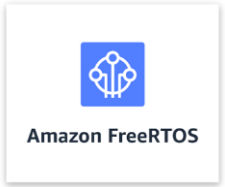
Commits
- 2016/2: 2,806
- 2019/6: 31,274

Boards
- 2016/2: 4
- 2019/6: 167 in progress

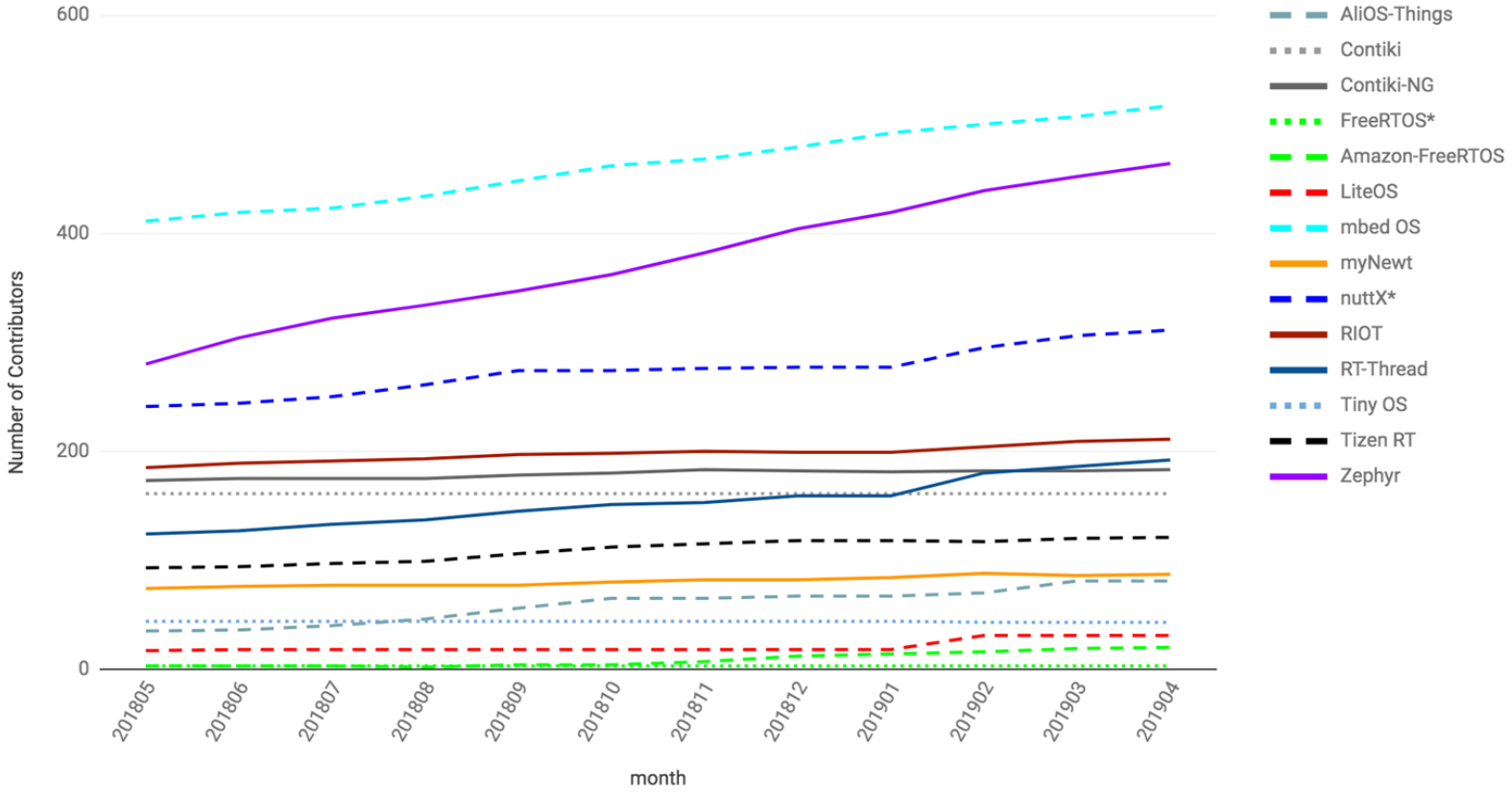
1.14 (LTS) release participation



Open Source OS/RTOS Options Today

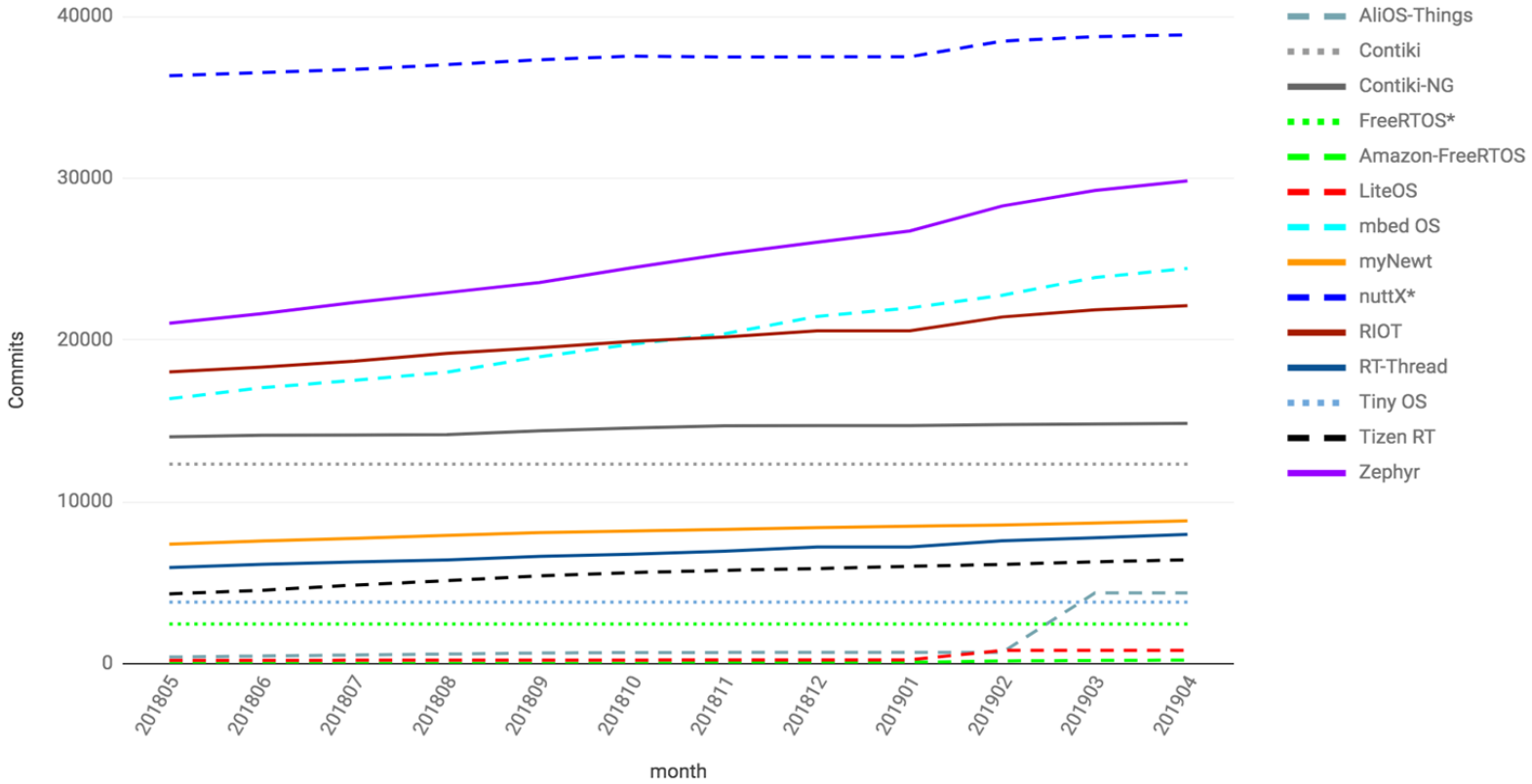


Operating System Contributors



Source: Data as of 2019-4-25 from github (* from openhub.net)

Total Commits by Operating System



Source: Data extracted on 2019-4-25 from github (* from openhub.net)

Operating System	First Commit	Controls Commits	Copyright Treatment	Declared License	Total Contribs	Total Commits	Commits in last month
AliOS-Things	2017/09	Alibaba	Assign	Apache-2.0	81	4,374	**0**
Contiki	2006/06	community		BSD-3-Clause	161	12,327	0
Contiki-NG	2017/10	community	Retain	BSD-3-Clause	184	14963	8
FreeRTOS*	2004/07	Richard Barry	Assign	GPL-2.0 w/ FreeRTOS exception	3	2,441	0
Amazon-FreeRTOS	2017/11	Amazon	Assign	MIT	35	1529	**328**
LiteOS	2016/09	Huawei	Assign	BSD-3-Clause	31	816	0
mbed OS	2013/02	ARM	Assign → Retain	Apache-2.0 or BSD-3-Clause	**525**	**25,153**	**207**
myNewt	2015/06	community	Aggregate	Apache-2.0	87	8,829	139
nuttX*	2007/?	Gregory Nutt	Assign	BSD-variant	**315**	**39,013**	158
RIOT	2010/09	community	Retain	LGPL-2.1	215	22,393	158
RT-Thread	2009/06	community	Aggregate	?? GPL-2.0 → Apache-2.0	198	8,175	107
Tiny OS	2004/10	community		BSD-3-Clause	43	3,809	21
Tizen RT	2015/04	Samsung	Assign	?? BSD-variant → Apache-2.0	128	6,839	129
Zephyr	2014/11	community	Retain	Apache-2.0	**499**	**31,229**	**645**

Data extracted on 2019-6-23 from github (* from openhub.net)

Zephyr in RTOS Landscape 2019/6/23

Total Contributors

Rank	RTOS	#
1	mbed OS	525
2	**Zephyr**	**499**
3	nuttX	315

Total Commits

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1	nuttX	39,013
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Commits to Master (last 30 days)

Rank	RTOS	#
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2	Amazon FreeRTOS	328
3	mbed OS	207

Zephyr Ecosystem

Zephyr OS

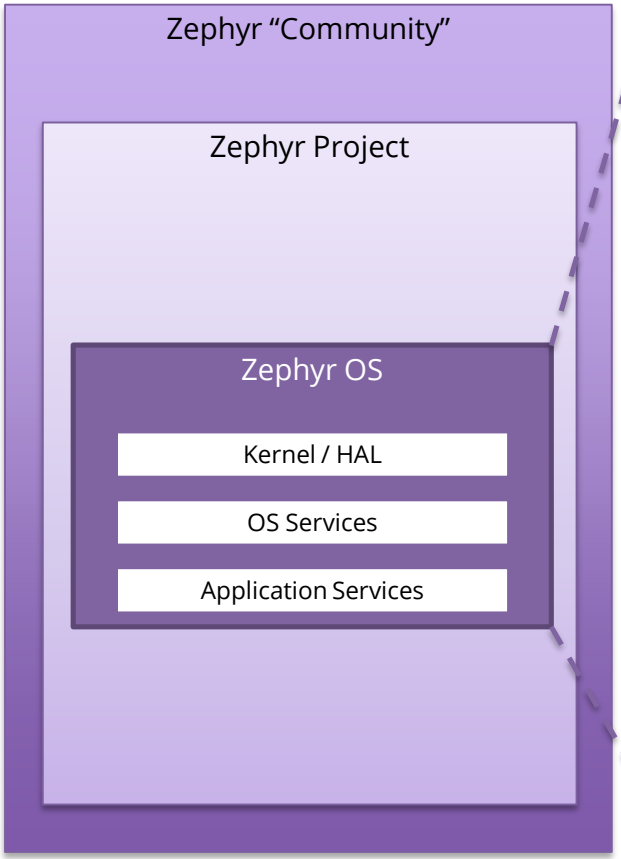
- The kernel and HAL
- OS Services such as IPC, Logging, file systems, crypto

Zephyr Project

- SDK, 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: Jerryscript, Micropython, Iotivity



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

Developer Tools...

RENODE™

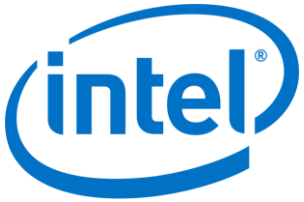
by: antmicro

SEGGER

LAUTERBACH
DEVELOPMENT TOOLS

Synopsys
DesignWare
ARC Development
Tools

Zephyr Supported Hardware Architectures



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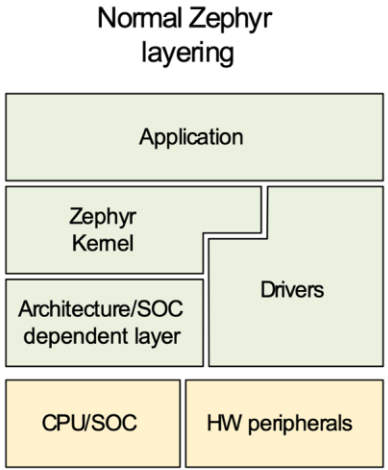
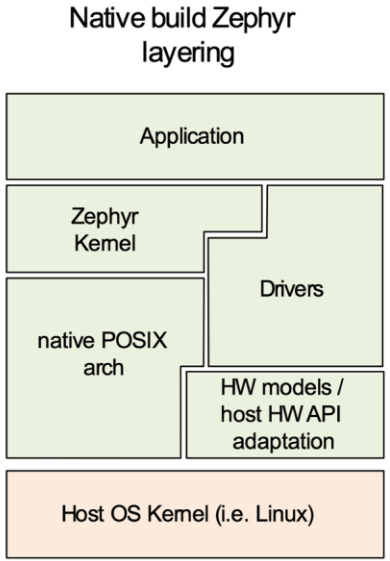
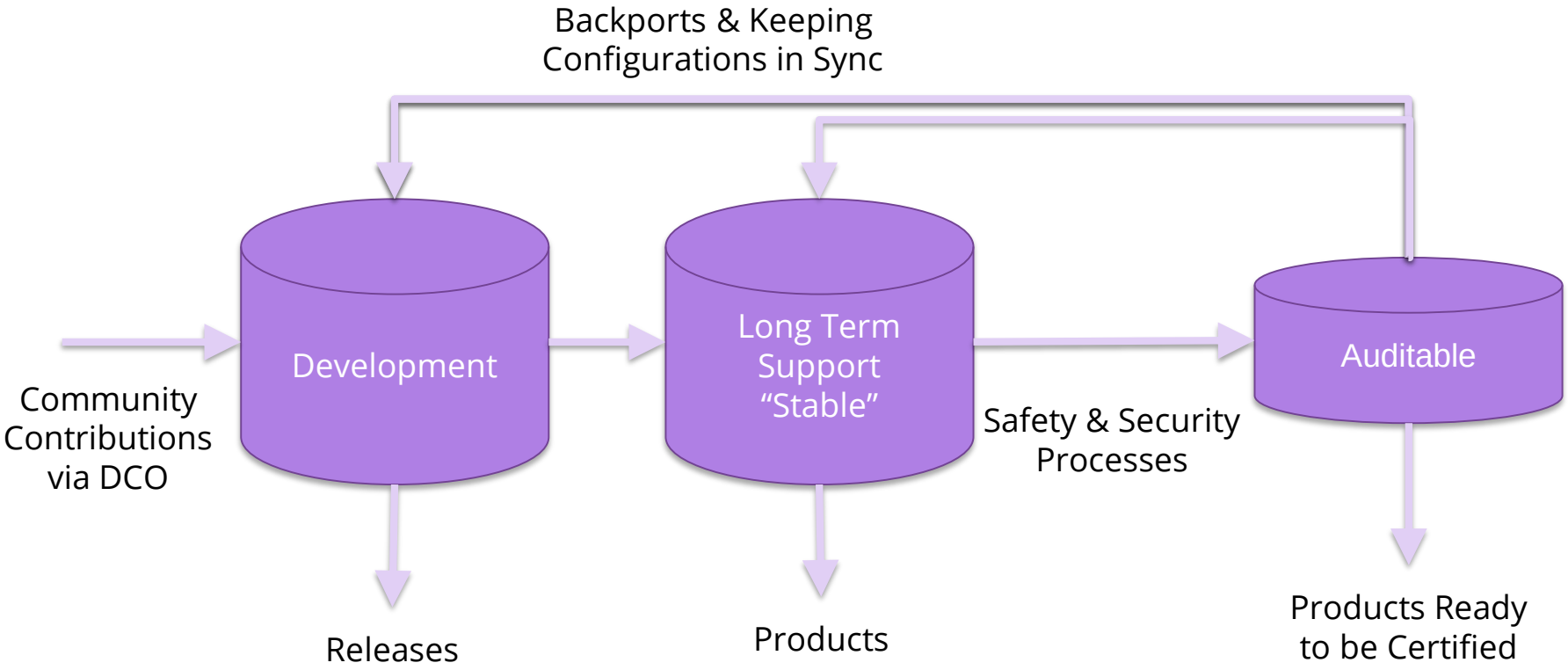




What is next for Zephyr?

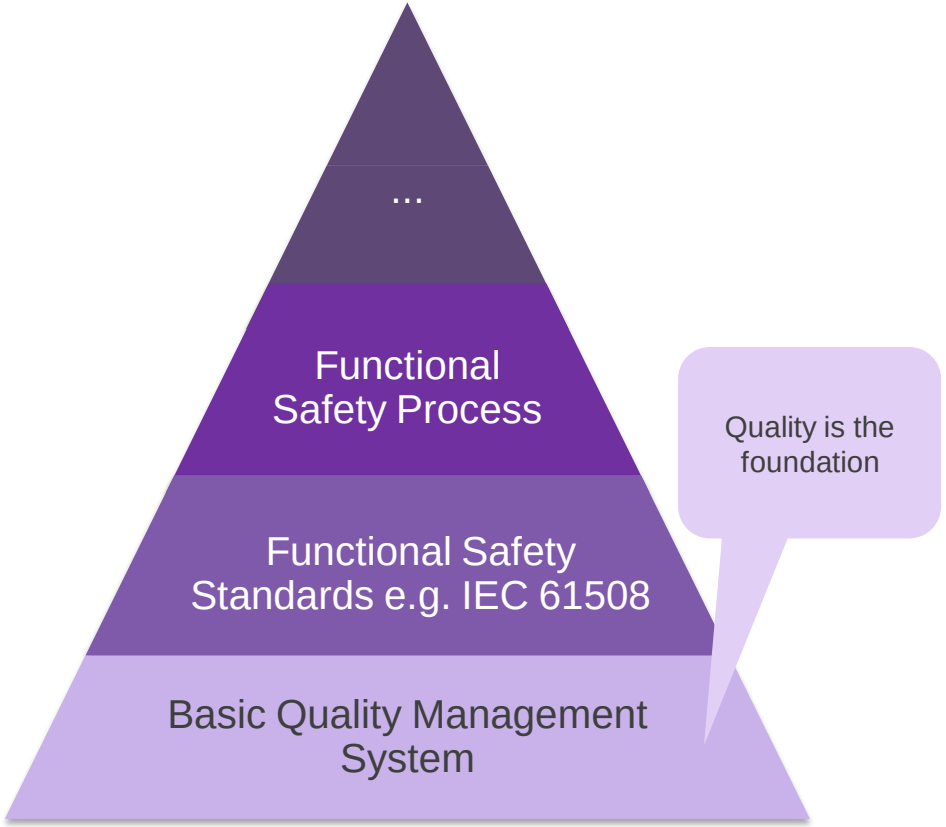
Security & Safety Certifications!

Code Repositories



Zephyr OS: Development

- Quality is a **mandatory expectation** for software across the industry.
- Assumptions:
  - Software Quality is enforced across Zephyr project members
  - Compliance to internal quality processes is expected.
- Software Quality is not an additional requirement caused by functional safety standards.
- Functional safety considers Quality as an existing pre-condition.



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.
- **More Tested**: Shorten the development window and extend the Beta cycle to allow for more testing and bug fixing

It is *not*:

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

Building in Security for LTS & Auditable

- Established **Security Committee**, 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
- Passing 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.

Zephyr OS: Auditable Considered Standards

Coding for Safety, Security, Portability and Reliability in Embedded Systems:

- MISRA C:2012, with Amendment 1, following MISRA C Compliance:2016 guidance

Safety:

- IEC 61508: 2010 (SIL 3 initially, eventually though like to get to SIL 4)
  - broadest for robotics and autonomous vehicle engineering companies. Reference for other standards in Robotics domain.
  - Sampled Certifications derived from IEC 61508: Medical: IEC 62304; Auto: ISO 26262; Railway: EN 50128

Security:

- PSA (Level 1+), Common Criteria (EAL4+), FIPS(140-2)

Others:

- Medical: FDA 510(K), ISO 14971, IEC 60601; Industrial: UL 1998, ??

Zephyr OS: Auditable

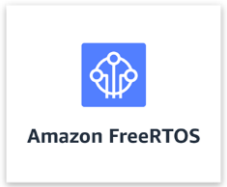
- Initial target was decided by Governing Board to be **61508** (it is a common basis for others standards that the members care about)
- An auditable code base will be established from a subset of the **Zephyr OS LTS**.
  - Code bases will be kept in sync.
  - More rigorous processes (necessary for certification) will be applied to the auditable code base.

Processes to achieve selected certification to be determined by **Safety** Committee and **Security** Committee and coordinated with **Technical Steering** Committee.

Options for Safety Certification?

Zephyr™

Explicit Path



Proprietary

LTS

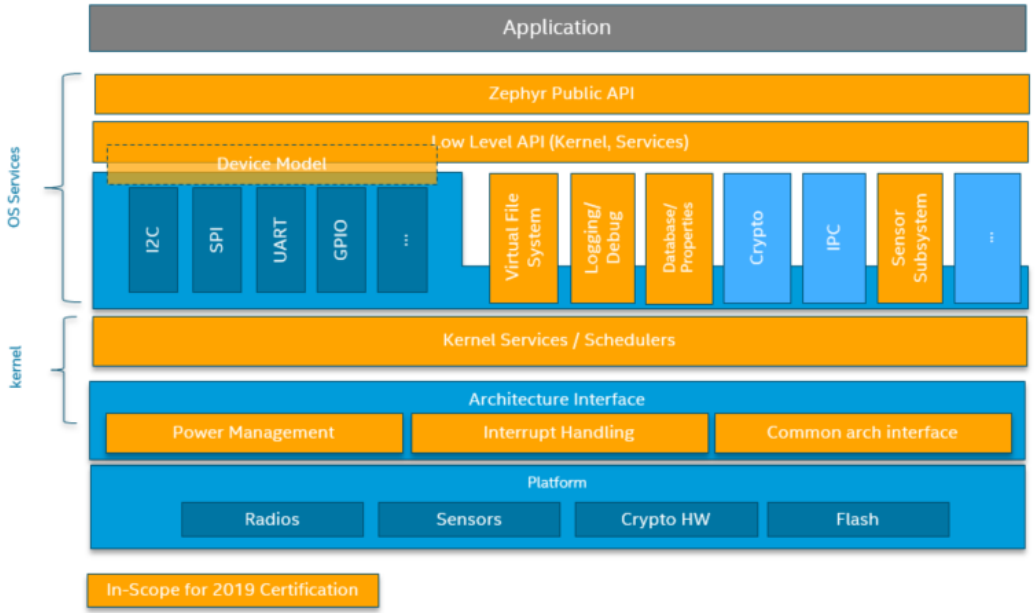
Auditable

?

2019 Auditable Scope (in orange)

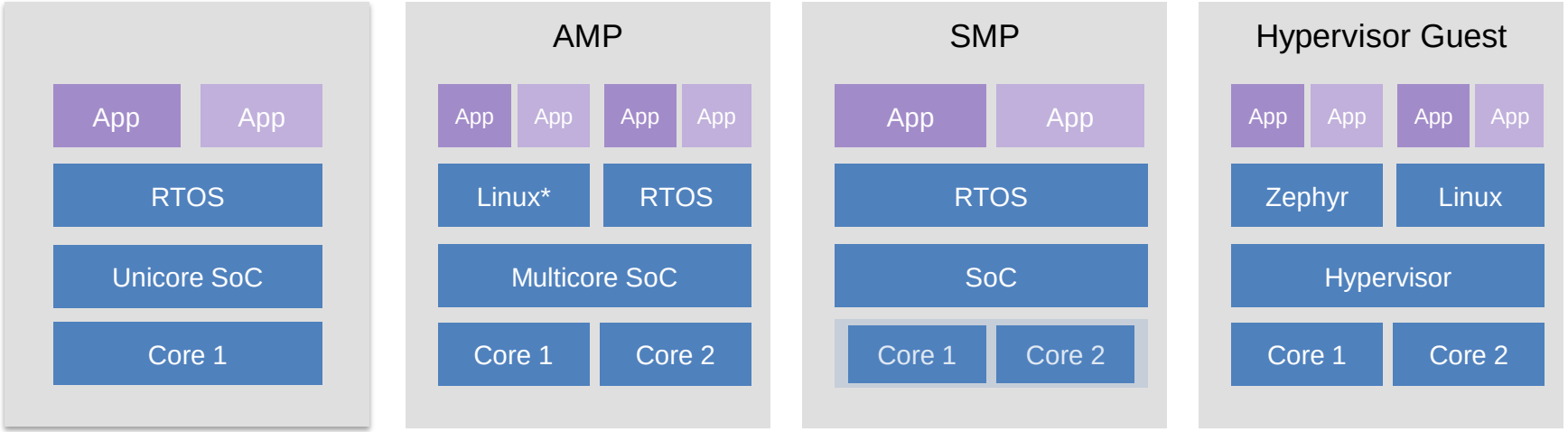
Not in scope:

- Platform drivers or BSPs
- No platform specific power management implementation, only device and kernel part of power-management
- No filesystem or sensor driver implementation, only interface and infrastructure to support those on top of existing APIs



See: https://www.zephyrproject.org/zephyr-project-rtos-first-functional-safety-certification-submission-for-an-open-source-real-time-operating-system/ for more details

Zephyr Use Cases



Single Core MCU

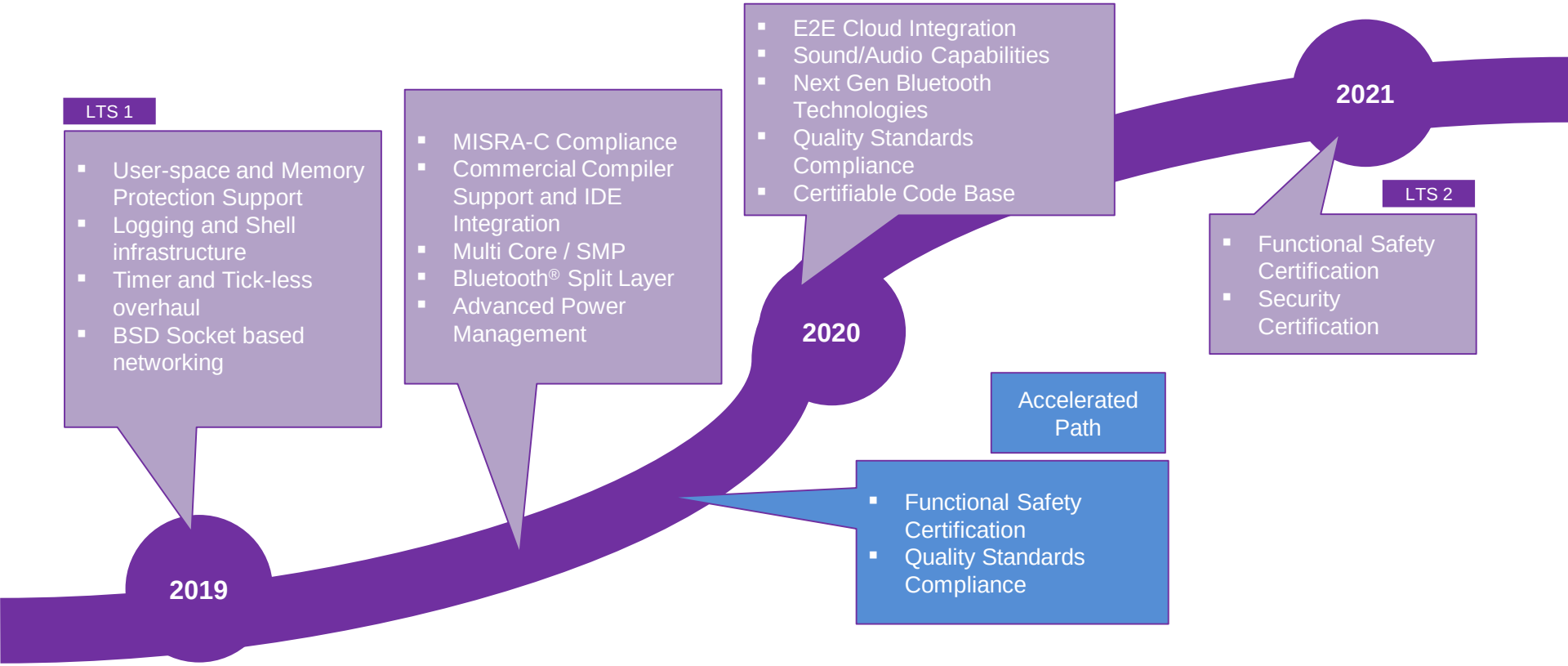
Supported with OpenAMP

Supported on Xtensa* and x86_64

Supported with OpenAMP

Safety and security requirements grow with complexity of use cases

Zephyr Project Roadmap



Zephyr Participation Information

Orientation:

- https://www.zephyrproject.org/community/how-to-contribute
- https://www.zephyrproject.org/doc/contribute/index.html

Github:

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

Mail Lists:

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

Slack:

- https://zephyrproject.slack.com (get invite from github page)

www.zephyrproject.org