ZEPHYR PROJECT OVERVIEW

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Zephyr™

Why RTOS Consolidation is Needed

- **High NRE** hindering mass adoption

- **Fragmentation** with large number of choices

- No single RTOS for IoT support **cross-platforms**

- OEMs and Devs need a solution they can **influence**

- Limited options where **safety & security** for connected, constrained devices are needed

- Roll your own demands high level of **maintenance**
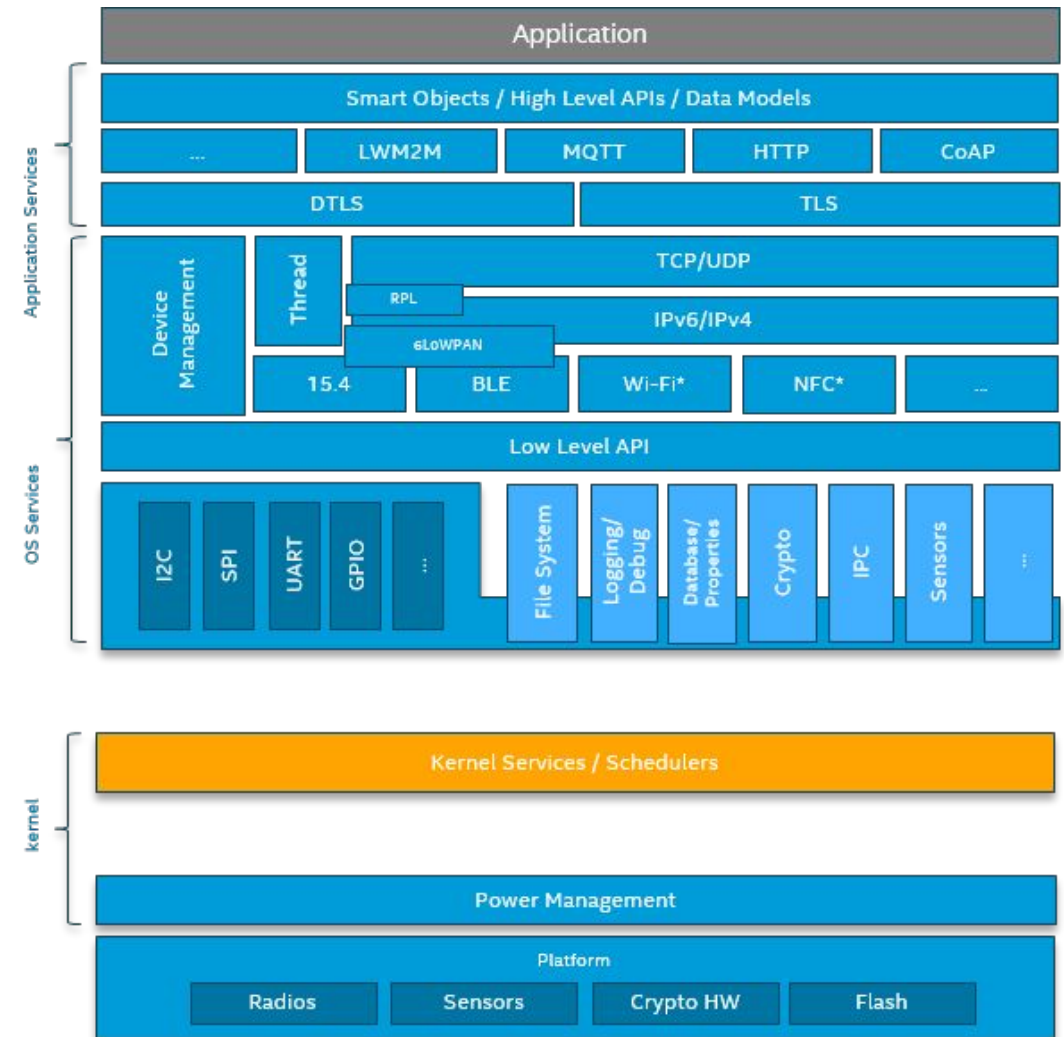
Zephyr Project: beyond the kernel

- **Neutral** governance and **active community** participation
- Built with **safety and security** in mind
- **Cross-architecture** with growing developer tool support
- **Complete**, fully integrated, highly configurable, **modular** for **flexibility**, better than roll-your-own
- **Product** development ready
- **Permissively** licensed

Open Source, RTOS, **Connected**, Embedded
Fits where Linux is too big

Zephyr OS

3rd Party Libraries

Application Services

Middleware/Networking

OS Services

Kernel

HAL

THE LINUX FOUNDATION PROJECTS

Zephyr Project: Key Features

- 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 5.0) with both controller and host, BLE Mesh
- Native, Fully featured and optimized networking stack
- Cross architecture: ARC, ARM, Nios II, RISC-V, Tensilica, x86
- Permissively licensed – Apache 2.0

Application

Application Services

Smart Objects / High Level APIs / Data Models

... | LWM2M | MQTT | HTTP | CoAP

DTLS | TLS

Device Management | Thread | RPL | TCP/UDP | IPv6/IPv4 | 6LoWPAN | 15.4 | BLE | Wi-Fi* | NFC* | ...

Low Level API

OS Services

I2C | SPI | UART | GPIO | ... | File System | Logging/Debug | Database/Properties | Crypto | IPC | Sensors | ...

kernel

Kernel Services / Schedulers

Power Management

Platform

Radios | Sensors | Crypto HW | Flash

4

Zephyr Project: Architectures

February 2016

2018

Initial Platforms in 2016

ARC EM
Starter Kit

Arduino* 101

Arduino Due

Intel® Quark™
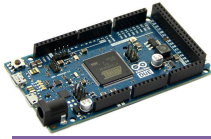D2000 CRB

2nd Generation
Intel® Galileo

NXP FRDM-K64F

ST Nucleo F103RB

Sample of Board Support: today
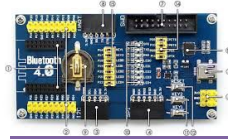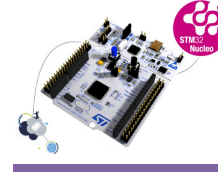
Zephyr™

Synopsys EMSK | Arduino Due | Nucleo 103RB | NRF51 | Nucleo64 L476RG | Nucleo F411RE | NRF52 pca10040 | Nucleo F334R8

Arduino 101 | Minnowboard | Altera MAX10 | Nucleo 401RE | Hexiwear | ARM V2M MPS2 | STM3210c | Atmel SAM E70

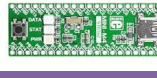Galileo | NXP FRDM K64F | NRF52 | Seeed Carbon | TI Launchpad Wifi | BBC Microbit | STM32373c | Redbear BLE Nano

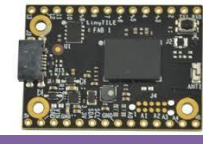Quark D2000 | STM32 Olimexino | STM Mini A15 | Seeed Nitrogen | ARM V2M Beetle | Zedboard Pulpino | NXP FRDM-KW41Z | tinyTILE
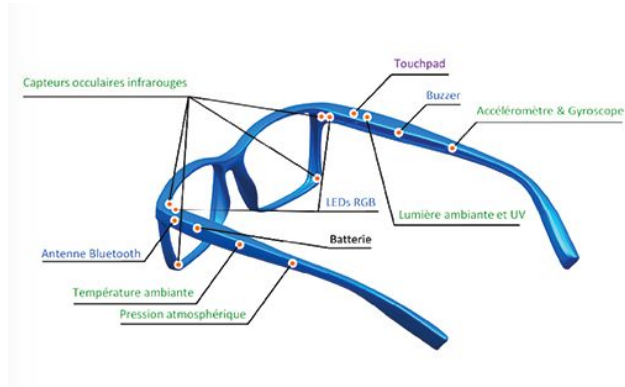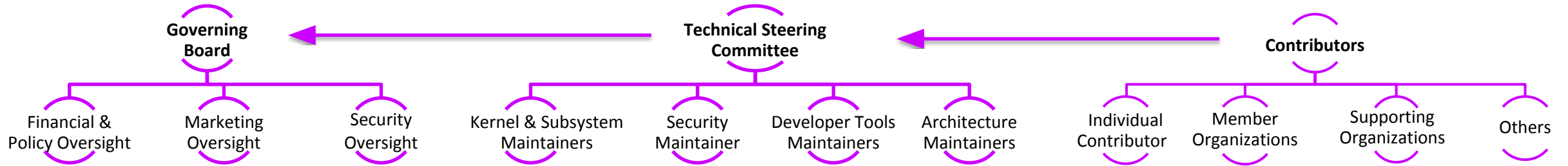
82 BOARDS TODAY WITH MORE ON WAY…

Products Running Zephyr: today

Zephyr Project Governance

Goal: Separate business decisions from meritocracy, technical decisions

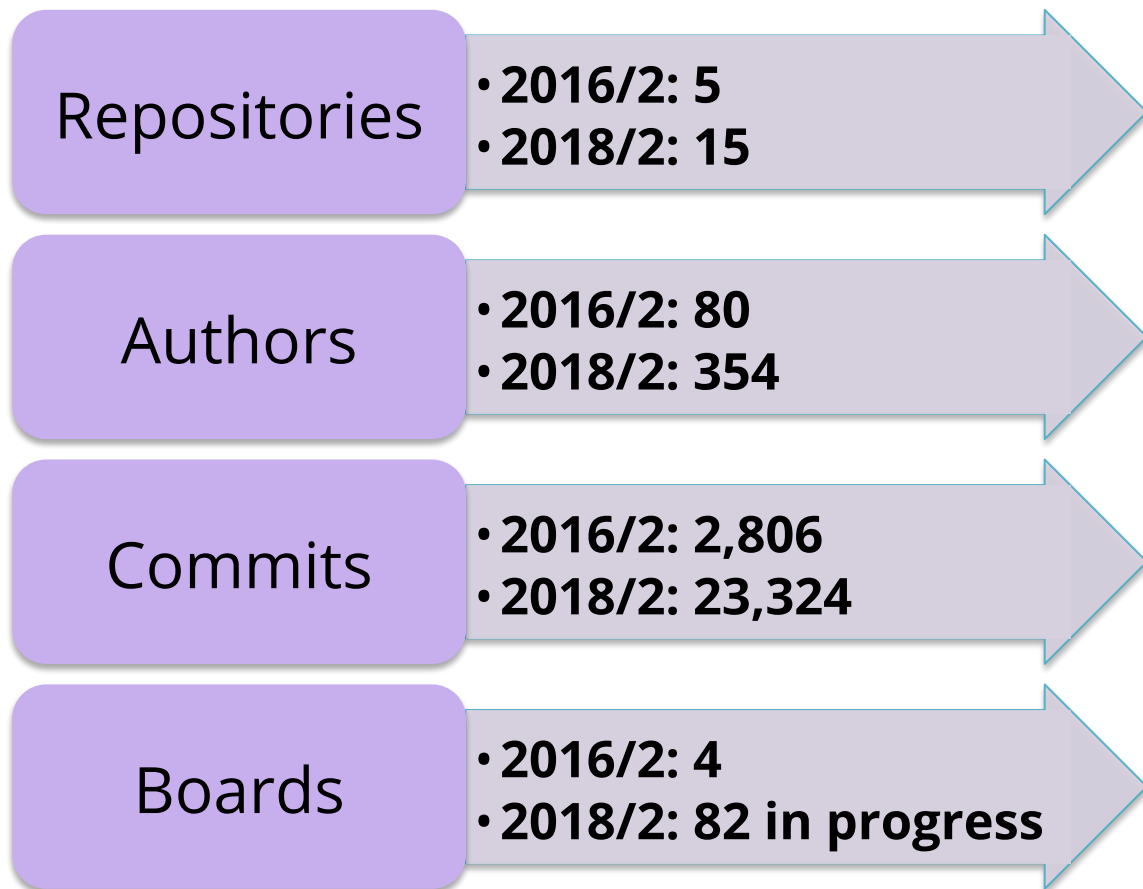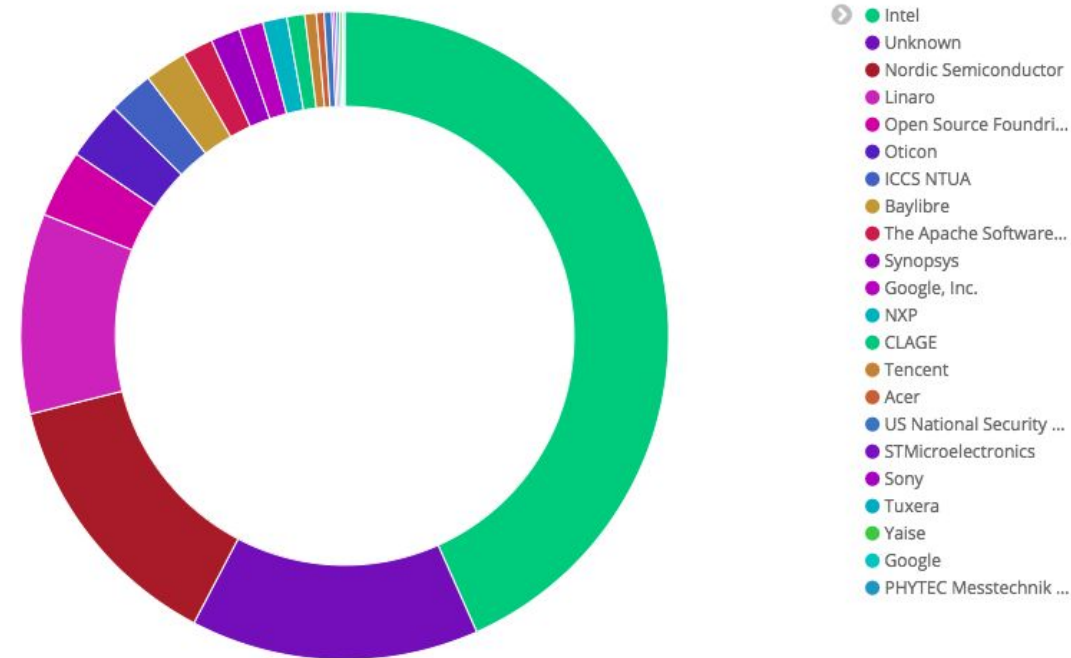| Governing Board	Technical Steering Committee	Community

• Decides project goals
• Sets business , marketing and legal decisions
• Prioritizes investments and oversees budget
• Oversees marketing such as PR/AR, branding, others
• Identifies member requirements
	• Serves as the highest technical decision body consisting of project maintainers and voting members
	• Sets technical direction for the project
	• Coordinates X-community collaboration
	   • Sets up new projects
	   • Coordinates releases
	   • Enforces development processes
	   • Moderates working groups
	• Oversees relationships with other relevant projects
		• Code base open to all contributors, need not be a member to contribute.
		• Path to committer and maintainer status through peer assessed merit of contributions and code reviews
		• Ecosystem enablement

Growing a Diverse Community!

Repositories
- **2016/2: 5**
- **2018/2: 15**

Authors
- **2016/2: 80**
- **2018/2: 354**

Commits
- **2016/2: 2,806**
- **2018/2: 23,324**

Boards
- **2016/2: 4**
- **2018/2: 82 in progress**

LAST 90 days: 9 repositories, 94 authors, 1572 commits

Organizations

- Intel
- Unknown
- Nordic Semiconductor
- Linaro
- Open Source Foundri...
- Oticon
- ICCS NTUA
- Baylibre
- The Apache Software...
- Synopsys
- Google, Inc.
- NXP
- CLAGE
- Tencent
- Acer
- US National Security ...
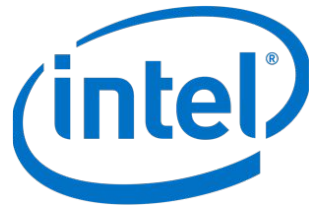- STMicroelectronics
- Sony
- Tuxera
- Yaise
- Google
- PHYTEC Messtechnik ...

Zephyr Project: Membership Momentum

February 2016

February 2018

Platinum Members

Silver Members

and others….

Zephyr Roadmap 2018

2018											
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec

Zephyr Releases											
		◆ 1.11		◆ 1.12			◆ 1.13			◆ 1.14	

Zephyr 1.11	Zephyr 1.12	Zephyr 1.13/2.0 (LTS)	Future
• OpenThread support • Native POSIX Port • POSIX API Layer (PSE52) • FOTA Updates (LWM2M, BLE) • SMP Support • Lightweight Flash Storage • Support the kernel (scheduler + objects) as a separate module	• QM level qualification • AMP Support • LLVM Support • IDE Integration • MIPS support • Improved Logging Support • Source Code modularisation: Support external modules, boards, SoCs • Eco-System: Tracing, Profiling, debugging support through 3rd party tools	• MISRA-C 2012: Kernel • Precision Time Protocol (PTP) Support • Time Sensitive Networking (TSN) Support • 802.1Q - Virtual LANs	• Safety and Security Pre-Certification • LoRa Support • CanBUS, SocketCAN • Paging Support • Dynamic Module Loading • Enhanced Sensor support (support HW FIFOs)

NOTE: Features aligned to releases are subject to change per guidance from the TSC

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

Zephyr "Community"

Zephyr Project

Zephyr OS

Kernel / HAL

OS Services

Application Services
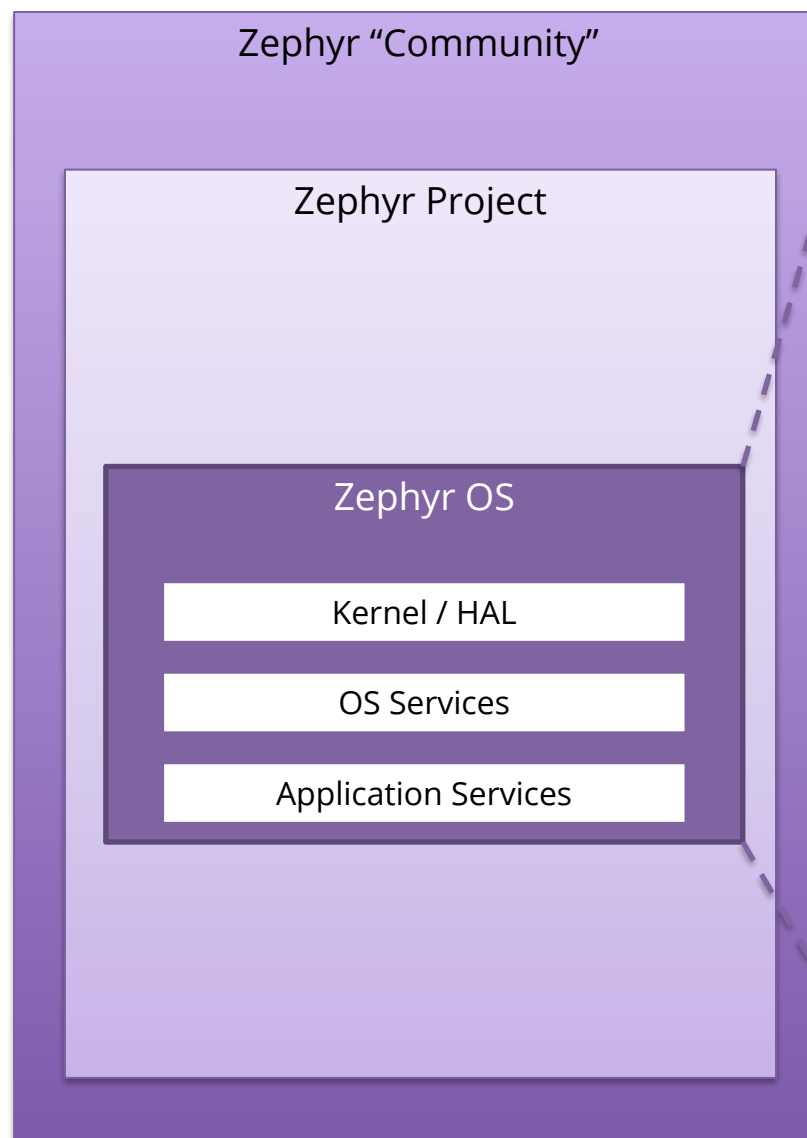
Kernel / HAL

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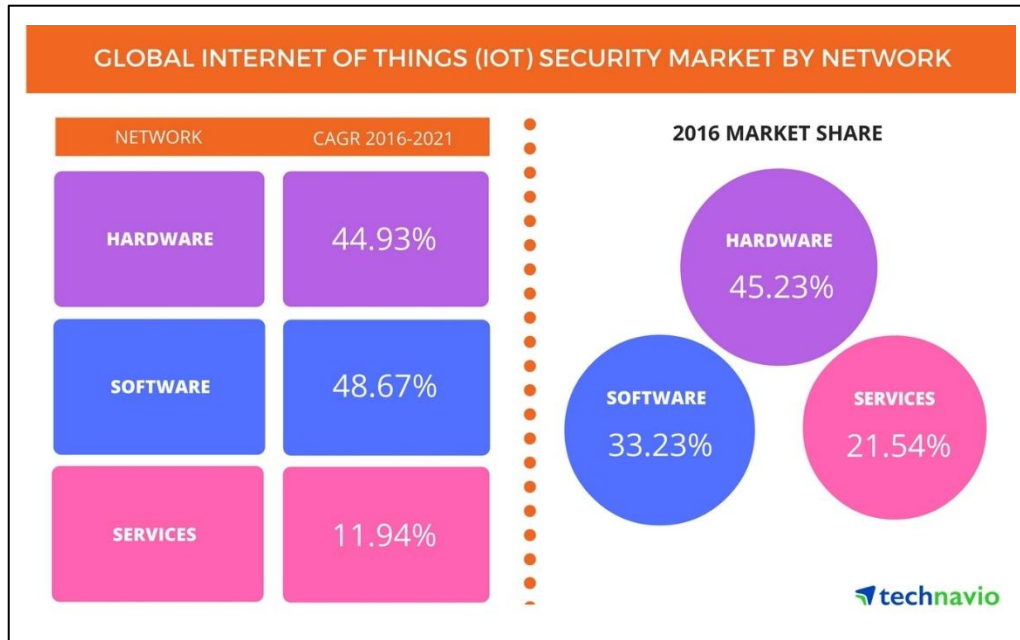- Access to standardized data models
- High Level networking protocols

Sample of Developer Tools…

Zephyr Project: Safety & Security Vision

Security and Global IoT

"... to maintain and address all security concerns in the sector, both software and hardware security chips should be used." – Technavio, January 2017

GLOBAL INTERNET OF THINGS (IOT) SECURITY MARKET BY NETWORK

NETWORK	CAGR 2016-2021
HARDWARE	44.93%
SOFTWARE	48.67%
SERVICES	11.94%

2016 MARKET SHARE

HARDWARE 45.23%
SOFTWARE 33.23%
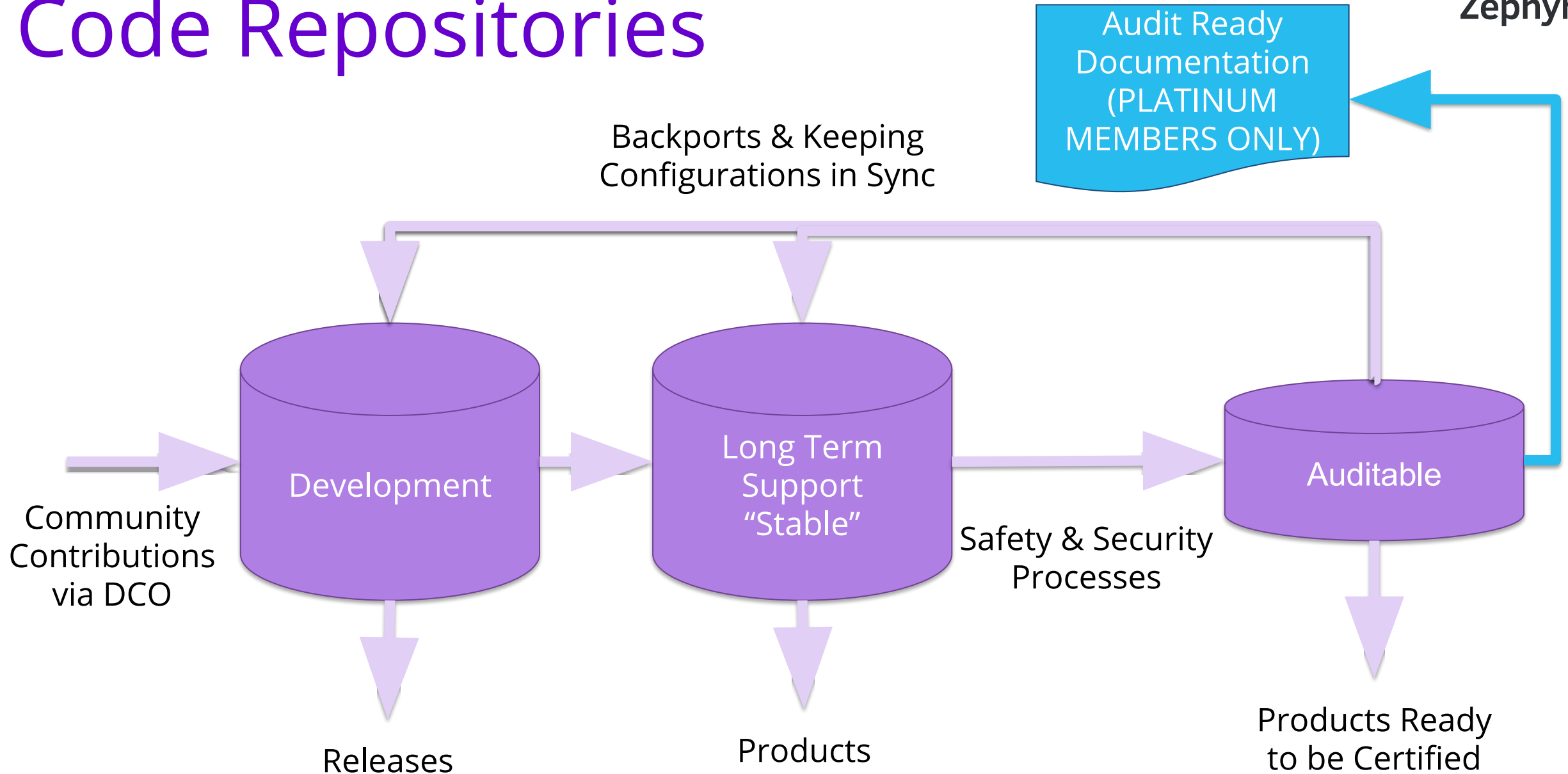SERVICES 21.54%

technavio

Safety & Security

- Focus on addressing security needs of connected, resource constrained devices

- Work group focused on defining the safety & security strategy and development plans

- Membership marries HW & SW functional safety & security expertise and investment through open source development

- The goal of working group to develop a safety & security auditable version of the OS

Global internet of things security market is expected to grow at a CAGR of nearly 48% during the period 2017-2021 – Technavio, January 2017

Code Repositories

Zephyr™

Audit Ready Documentation (PLATINUM MEMBERS ONLY)

Backports & Keeping Configurations in Sync

Community Contributions via DCO

Development

Long Term Support "Stable"

Safety & Security Processes

Auditable

Releases

Products

Products Ready to be Certified

Zephyr OS: Readying Auditable

- Established Security Working Group, 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 weakness determined by a researcher 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 Code Base

- Initial and subsequent certification targets to be decided by Governing Board.

- An auditable code base will be established from a subset of Zephyr OS.

  - Code bases will be kept in sync from that point forward.

  - More rigorous processes (necessary for certification) will be applied before new features move into the auditable code base.

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

Participation Information

Developer Participation Orientation:
- https://www.zephyrproject.org/community/how-to-contribute
- https://www.zephyrproject.org/doc/contribute/contribute_guidelines.html

TSC:
- weekly on Wednesdays

Security Committee:
- bi-weekly on Wednesdays (members only)

Governing Board:
- monthly (members only)

www.zephyrproject.org