



# Zephyr: Creating a Best-of-Breed, Secure RTOS for IoT

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# What is Zephyr™ Project?

## Small Footprint RTOS for IoT

- As small as 8KB
- Enables application code to scale
- Configurable
- Modular

## Truly Open Source

- Hosted by Linux Foundation
- Transparent development
- Apache 2.0 License

## Cross Architecture

- ARM
- x86
- ARC
- RISC-V
- Tensilica
- Nios II

# Why Does the Industry Need RTOS Consolidation?



High NRE hindering  
Mass adoption



Fragmentation  
with large number of choices



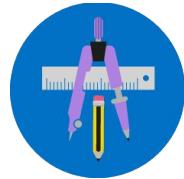
No single RTOS for  
IoT use cases x-platforms



OEMs and Devs need a  
solution they can influence



Limited options that include security  
for connected, constrained devices



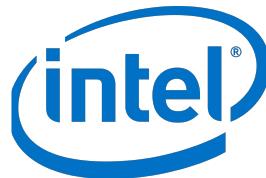
Roll your own demands  
high level of maintenance

**...and collaborate on security and safety with others**



# Who are Project Members?

## Platinum Members



## Silver Members



and others...

## Associate Members





# Which Architectures Are Supported by Zephyr Today?

**ARM**

**ARC**  
Synopsys

**intel**<sup>®</sup>

**RISC-V**

**Nios® II**  
*Processor*

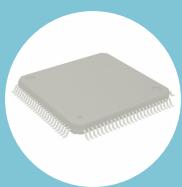
**tensilica**



# How Do We Help Our Community Grow?



Transition of code to GitHub for easier contributions



Continuously broadening architecture and board support



More transparency with an open TSC & community interaction via JIRA





# Status: Gaining Community Momentum

## Repositories

- 2016/02: 5
  - 2017/06: 10

## Authors

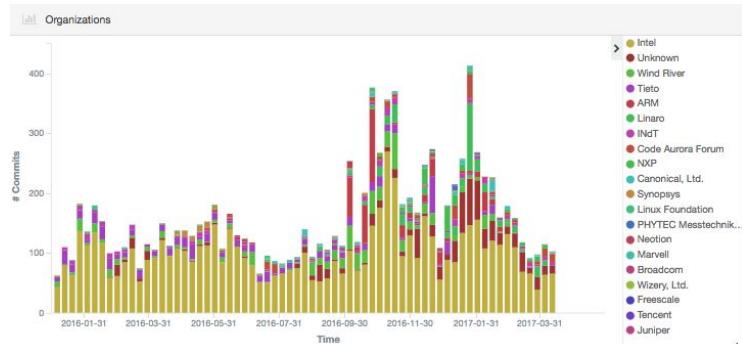
- 2016/02: 80
  - 2017/06: 189

## Commits

- 2016/02: 2,806
  - 2017/06: 13,319

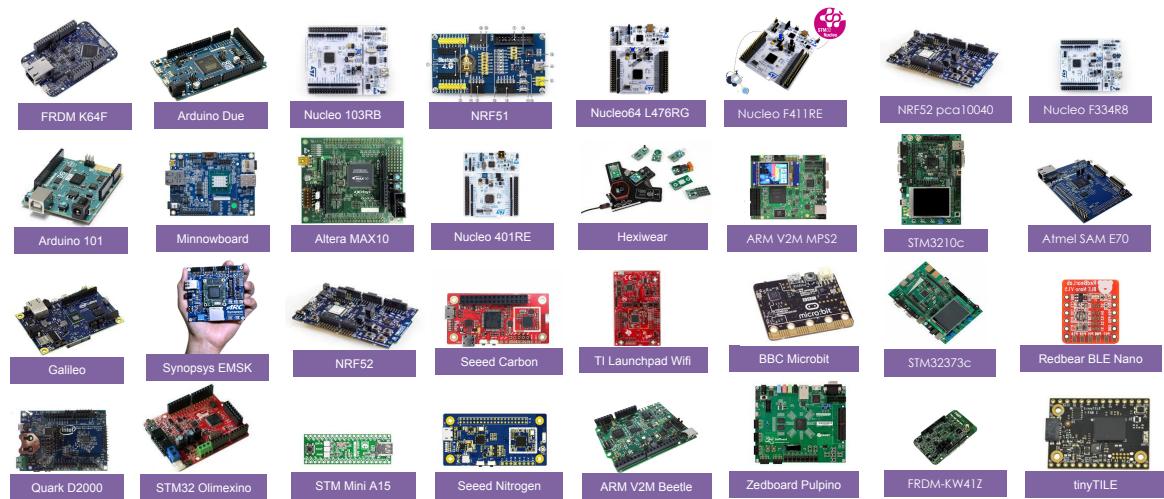
## Boards

- 2016/02: 4
  - 2017/06: 57+



# Status:

## Sample of Boards Supported



Currently 57 boards supported today with more on way

# Status: Eco-System Emerging

## 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

Application Services  
OS Services  
Kernel / HAL

## 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



# Zephyr Project Roadmap

2016						2017										
Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
	◆ 1.5			◆ 1.6			◆ 1.7			◆ 1.8		◆ 1.9			◆ 1.10	

## Zephyr OS Releases

### Zephyr OS 1.7

- Unified Kernel continued
- Direct Interrupt handling
- CMSIS support
- Native IP Stack
  - New Net and L2 APIs
  - Native protocols: MQTT, HTTP Library, CoAP (Zoap), NATS
- Iotivity/OCF
- Device Tree
- Bootloader Support
- Openocd support
- RISC V Port
- Xtensa Port

### Zephyr OS 1.8

- Tickless Kernel
- BT 5.0 Features
- Eco System: Tracing, debugging support through 3rd party tools
- Improved Build and Debug
- 3rd Party Compilers Support
- Xtensa GCC support
- Improved Build on Mac/Windows
- MMU/MPU: Initial support (WIP)
- Expand device support

### Zephyr OS 1.9

- POSIX API Layer
- BSD Socket Support
- Expand Device Tree support to more architectures
- BLE Mesh
- Full Bluetooth 5.0 Support
- LWM2M ([→](#))
- Thread Protocol (initial drop) ([→](#))
- Expand LLVM Support to more architectures
- MMU/MPU (Cont.): Thread Isolation, Paging ([→](#))
- Revamp Testsuite, Increase Coverage
- Build and Configuration System (CMake) ([→](#))
- Zephyr SDK NG
- Eco System: Tracing, debugging support through 3rd party tools

### Zephyr OS 1.10

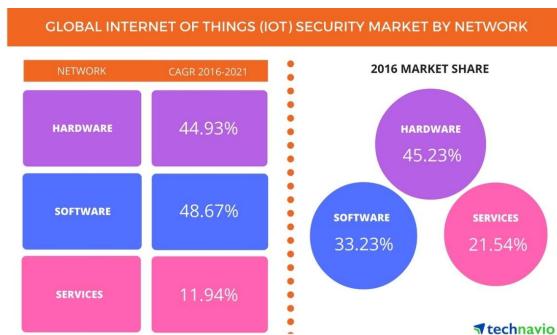
- SMP Support
- AMP Support
- FOTA Updates, Integration with Bootloader ([←](#))
- IDE Integration
- MMU/MPU (Cont.)

([←](#)) potentially pull in  
([→](#)) potentially push out

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

## Zephyr Project & Securing IoT

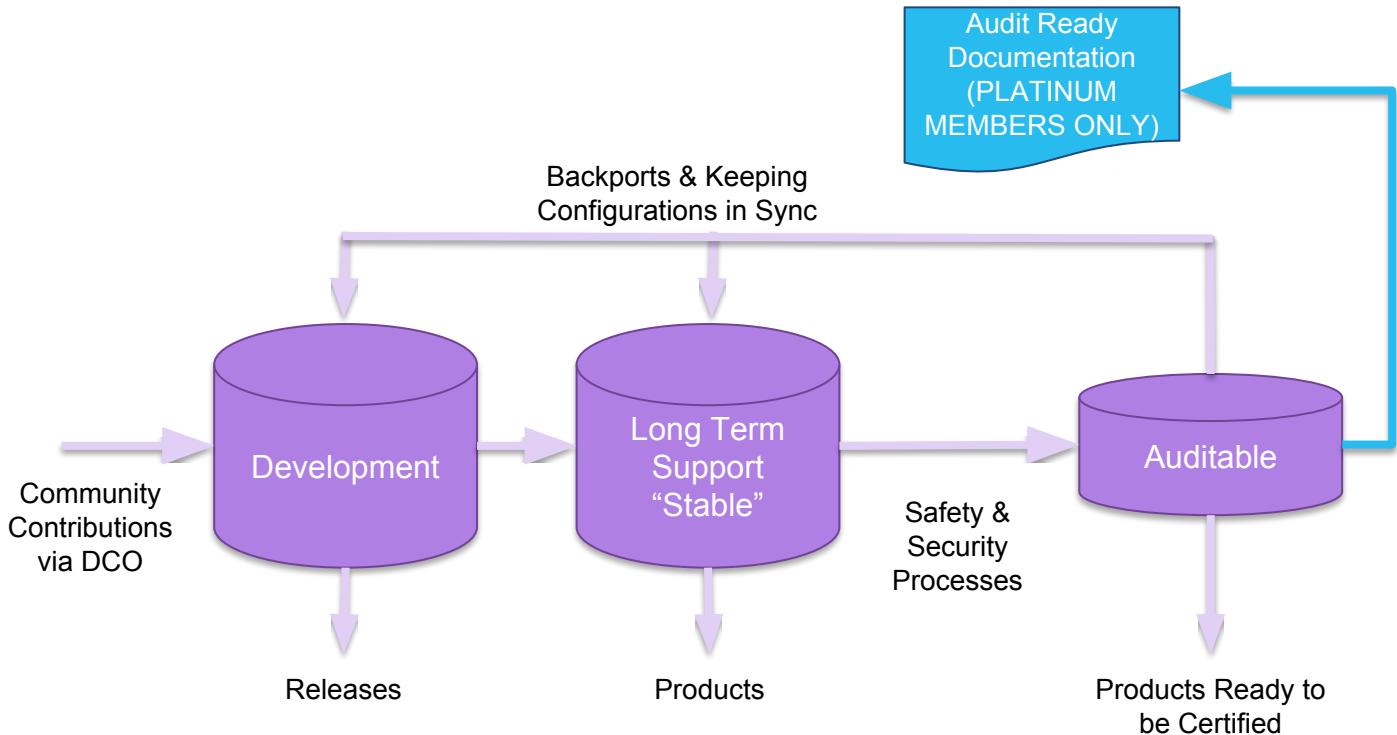
Focus on addressing security needs of connected, resource constrained devices

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

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

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

# Code Repositories



# Zephyr OS: Auditable Code Base

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.

# Zephyr Project Governance



**Goal:** Separate business decisions from meritocracy, technical decisions

Governing Board	Technical Steering Committee	Community
<ul style="list-style-type: none"> <li>Decides project goals</li> <li>Sets business, marketing and legal decisions</li> <li>Prioritizes investments and oversees budget</li> <li>Oversees marketing such as PR/AR, branding, others</li> <li>Identifies member requirements</li> </ul>	<ul style="list-style-type: none"> <li>Sets direction and serves as the highest technical decision body consisting of project maintainers and voting members</li> <li>Coordinates across community collaboration</li> <li>Sets up new projects</li> <li>Coordinates releases</li> <li>Enforces development processes</li> <li>Moderates working groups</li> <li>Oversees relationships with other relevant projects</li> </ul>	<ul style="list-style-type: none"> <li>Code base open to all contributors, need not be a member to contribute.</li> <li>Path to committer and maintainer status through peer assessed merit of contributions and code reviews</li> <li>Ecosystem enablement</li> </ul>

# Experience: The Zephyr Project

## Synopsys

Wayne Ren

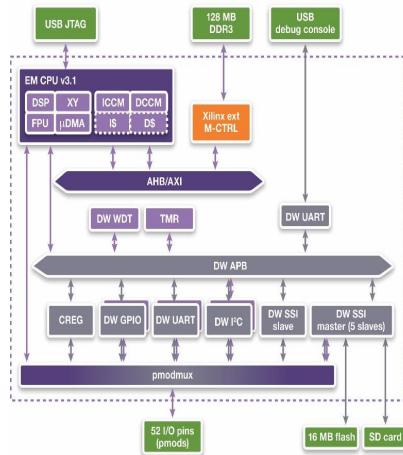
2017.06.19

# Why Synopsys joined in Zephyr

- Best-Of-Breed RTOS
  - High quality code, networking stack, Bluetooth stack, utilities
- Open and Free
  - Multi architecture support - ARC, ARM, x86
- License
  - Apache 2.0 License, commercial friendly
- Strategic Founding Members
  - Intel, NXP, Synopsys
- Rapidly Growing Community
  - Mailing list, web site, Github
- Re-use of familiar Linux build & configuration system
  - Kbuild, Kconfig, Device tree

# ARC EM Starter Kit (EMSK)

Low-cost and versatile software development system for rapid application development and debugging for ARC EM processors



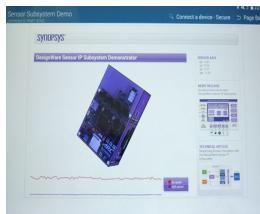
## Highlights:

- Selectable ARC EM core configurations
- Timers, Watchdog Timer
- UARTs, SPI, I<sup>2</sup>C, micro USB
- SD Card slot, 20-pin JTAG
- 6 Pmod™ Extension connectors
- 5 buttons, 4 switches, 9 LEDs
- Over 50 application examples

# Zephyr-based 9D Motion Sensor on ARC EMSK

Efficient smart sensor data fusion using Zephyr on an ultra-low power ARC EM processor

- Extension Pmods
  - Gyroscope
  - Accelerometer
  - Magnetometer
  - Bluetooth



## Highlights:

- Microkernel on ARC
  - I2C bus, SPI sensor interfaces
- Bluetooth module via UART
- Interrupt driven
- Sensor processing: 3x 3D input to Yaw/Pitch/Roll
- Bluetooth link to host application

# Working and Contributing with Zephyr Project

- To use Zephyr
  - Seamless switch for developers with embedded Linux experience
  - A lot of web docs and demos & examples available for new developers
- Contribute in Zephyr - Now simpler with GitHub!
  - Fork and clone GitHub repo
  - Submit changes via Pull Requests
  - Raise issues for bugs, enhancement and features as issues on GitHub
    - Participate in discussions on developer mailing list
- Challenges
  - Build system not supported well in Windows
  - Minimal IDE support

# Thank You



Solution Department  
SANECHIPS Technology Co., Ltd



# SANECHIPS & Zephyr



## Requirement for IoT OS

- Tiny memory overhead
- Stable IP Stack
- Rich device drivers
- Open ecosystem
- Stable, efficient IDE

## Cooperation with Zephyr

- Using Zephyr OS
- Join Linaro LITE group
- Support NB-IoT
- Chip level security

## Contribution to Zephyr

- **[TCP/IP]** 8 JIRA activities
  - 3 accepted
  - 3 closed
  - 2 patches upstreamed
- **[OS]** 3 JIRA activities
  - being reviewed

# SANECHIPS SDE (IoT Application Develop Platform)



Requirement

Debug requirement for IoT chips

- Memory constrained, print log is not available
- Zephyr OS, visible debug of kernel/driver/net/etc for our client



Solution

SDE satisfy these features

- Hardware JTAG debug, instead of gdb\_server/kgdb, debug on memory constrained device
- Deeply optimized UI and exception management, effective and stable method
- Support Zephyr OS and TCP/IP visible debug
- Support 3<sup>rd</sup> component visible debug



Schedule

6.30

7.30

8.30

M0 Basic version

M0 Stable version

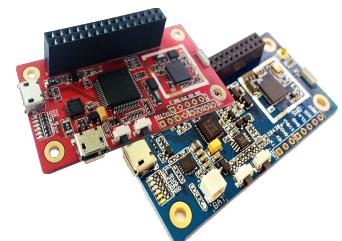
Zephyr Supported

**THANK YOU**



# The Linaro IoT & Embedded Group (LITE)

- Collaboration on software and standards for ARM in IoT
- Zephyr
  - Open source and open governance
  - Cross architecture
  - Commercial friendly license
  - Clean design to meet growing IoT complex needs



# Linaro enables Zephyr on ARM



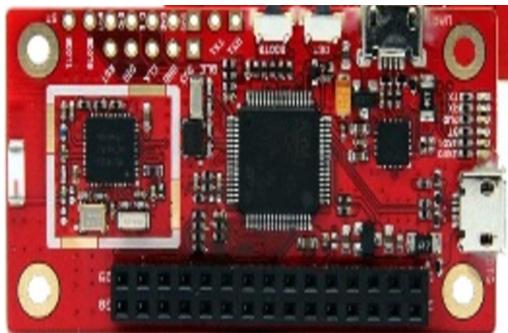
\* Please see the list at <https://www.zephyrproject.org/doc/boards/boards.html>

# Linaro unifies Zephyr on ARMs

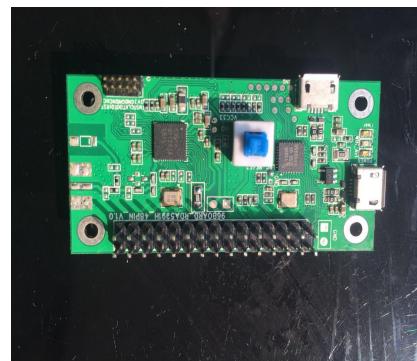
96Board facilitates the delivery of

- Single Zephyr software base
- Single APP/Solution
- Across all SoCs/Boards
- Your focus on differentiation

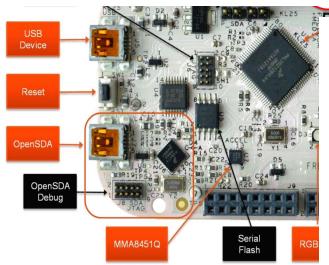
# Single Zephyr supports different BLE



# Single Zephyr supports different WiFi



# Single Zephyr supports other usages (To add more...)



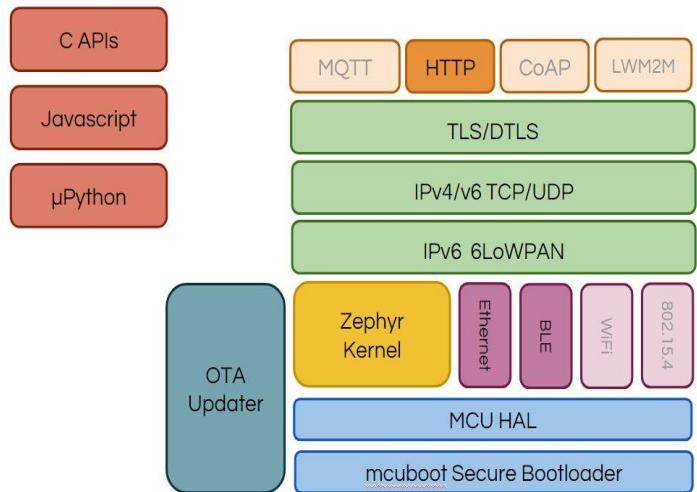
# IoT needs more around Zephyr

IoT problems to solve:

- Security
- Cloud connection
- Developer
- Portable
- Driver

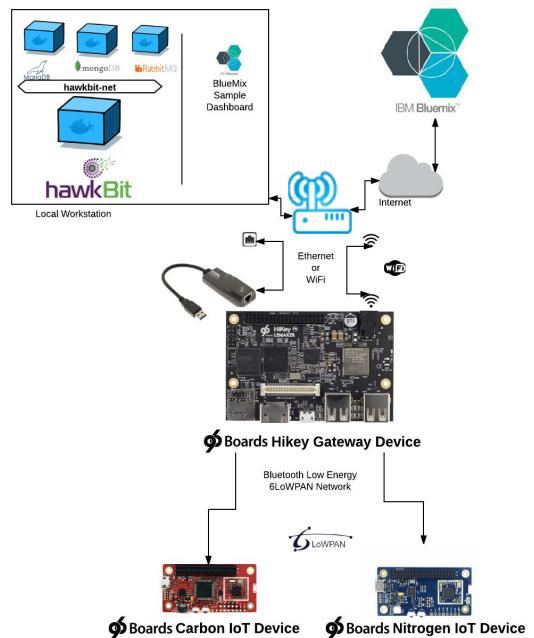
All in an unified SW solution

Zephyr™ + MCUBoot + FOTA



# Linaro develops full IoT end-to-end solution

- Unified SW stack across all ARM MCUs  
Due to 96Board
- Zephyr is the RTOS
- All the technologies built enable Sensor data to the cloud  
Signed FOTA image to device  
6LoWPAN over BLE  
etc... more to see a real demo



# Welcome to join Linaro

Set SW standards and implement  
Build unified SW ecosystem on ARM

Thank you



# Summary:

## Benefits of Adopting Zephyr Project

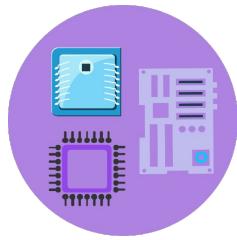
- Roll your own is expensive & difficult to develop & maintain
- Permissively licensed corresponds to ease of adoption
- Multiple corporate sponsorships assures long term commitment and longevity
- Long standing reputation of open source investment among current membership
- Community innovation has proven faster for progression
- Project development is a collaboration of industry experts



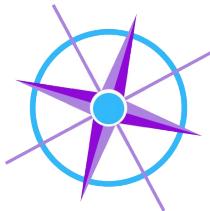
# Join us!

- Explore the project
  - Download the code  
<https://github.com/zephyrproject-rtos/zephyr>
- We welcome community contributions
  - Engage via GitHub, Mailing List, IRC
- Consider the possibility of becoming a sponsoring member of Zephyr project to shape the future direction of the project

# Participate!



Impact architecture



Direction



Marketing / Advocacy



Decision making

Examine the code  
[\(https://github.com/zephyrproject-rtos/\)](https://github.com/zephyrproject-rtos/)  
contribute and join us!



[www.zephyrproject.org](http://www.zephyrproject.org)

