

# RIOT PO WiSe 18/19



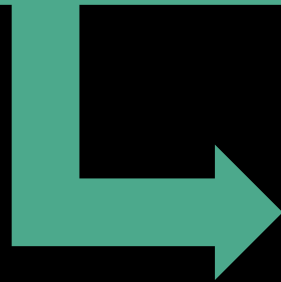
The friendly Operating System for the Internet of Things

Cenk Gündogan, Peter Kietzmann and Michel Rottleuthner  
RIOT developers and maintainers

# Why are we here ?

Experience (e.g. with Linux) shows we are likely to succeed with a platform that is:

- open source
- free
- driven by a grassroots community



RIOT

If your IoT device cannot  
run Linux, then run

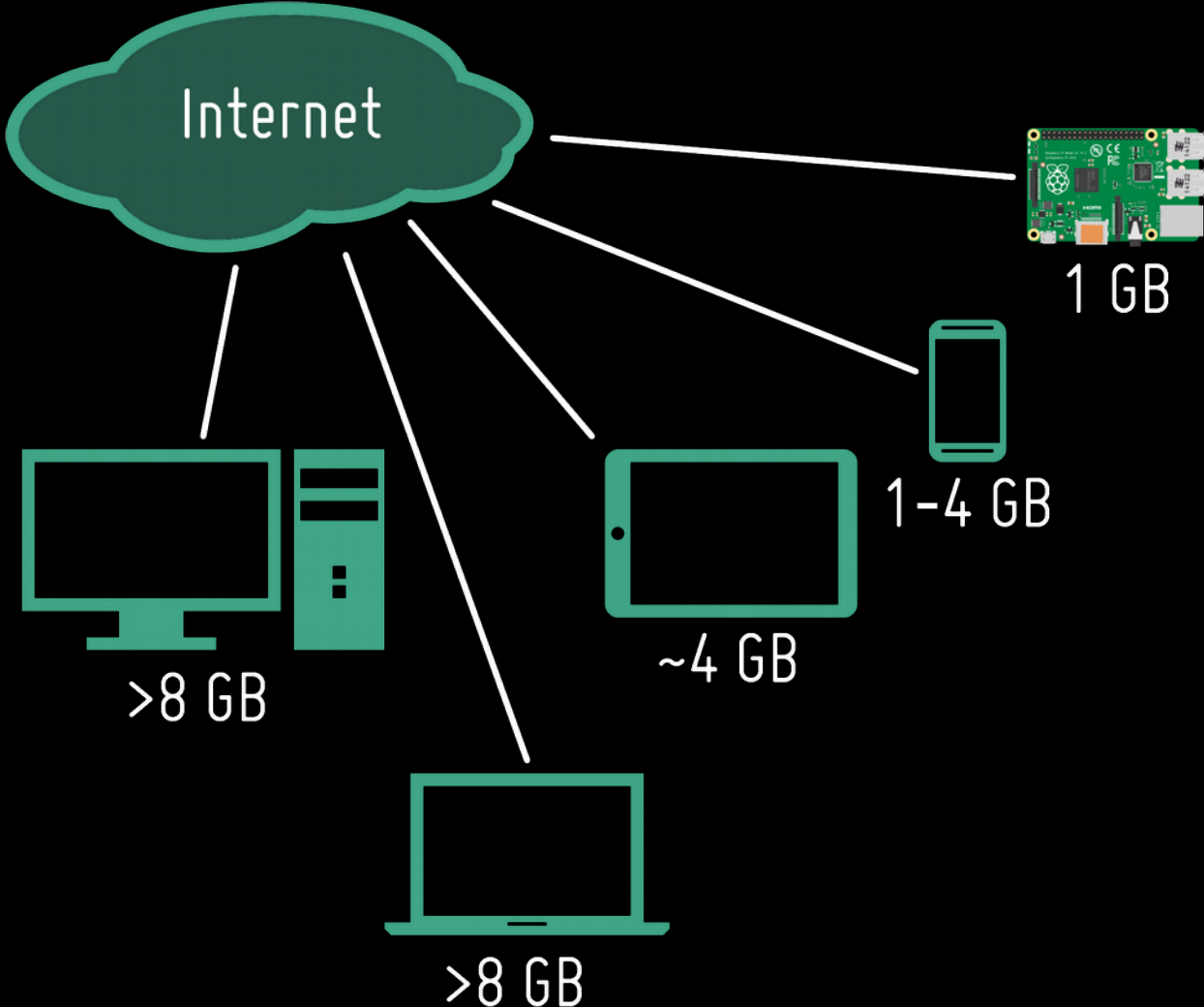


R.IOT

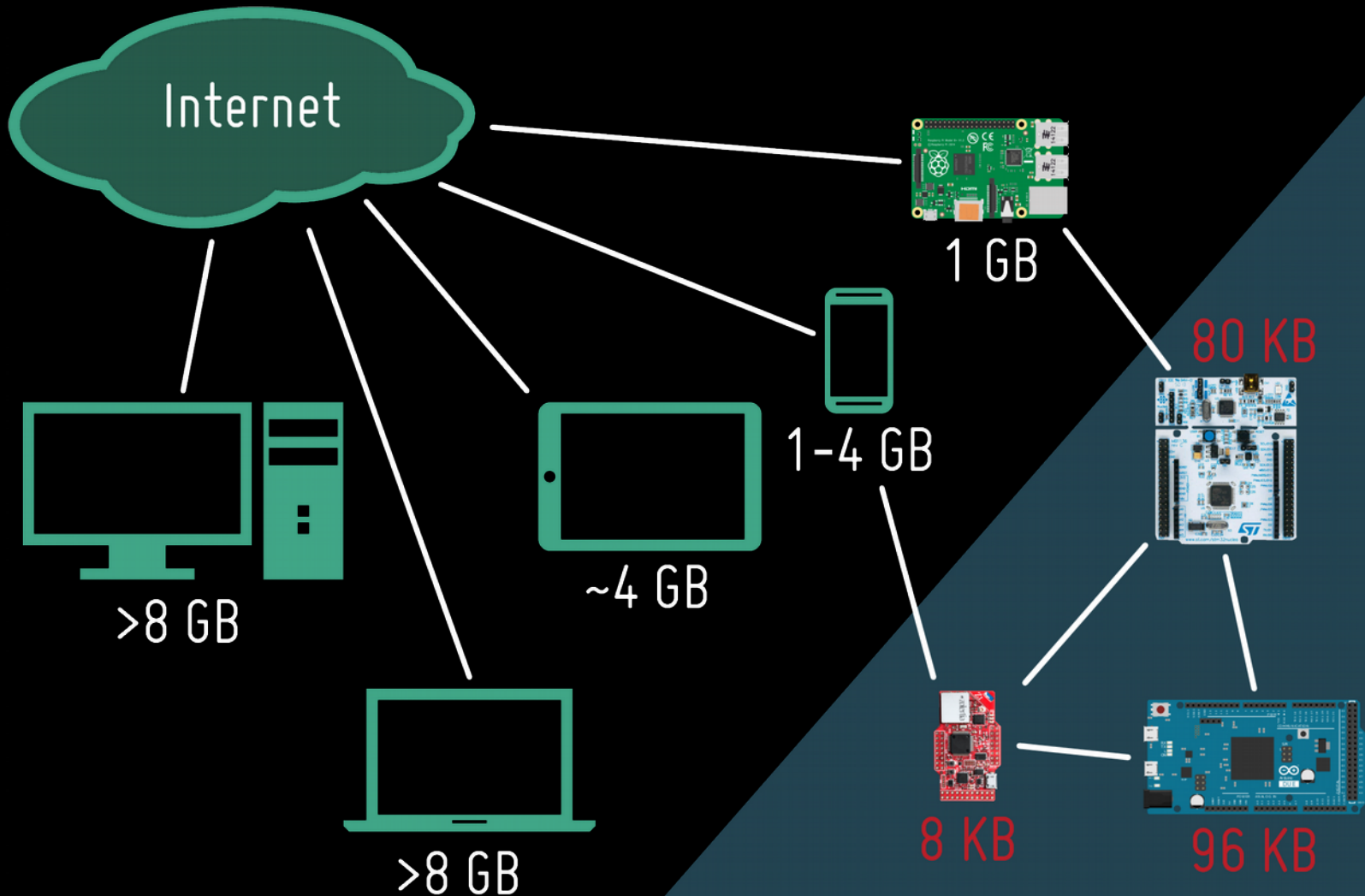
# AGENDA

- Internet of Things: Which OS?
- Requirements for an IoT OS
- RIOT in an Nutshell
- RIOT user and developer evolution
- Roadmap

# The Internet

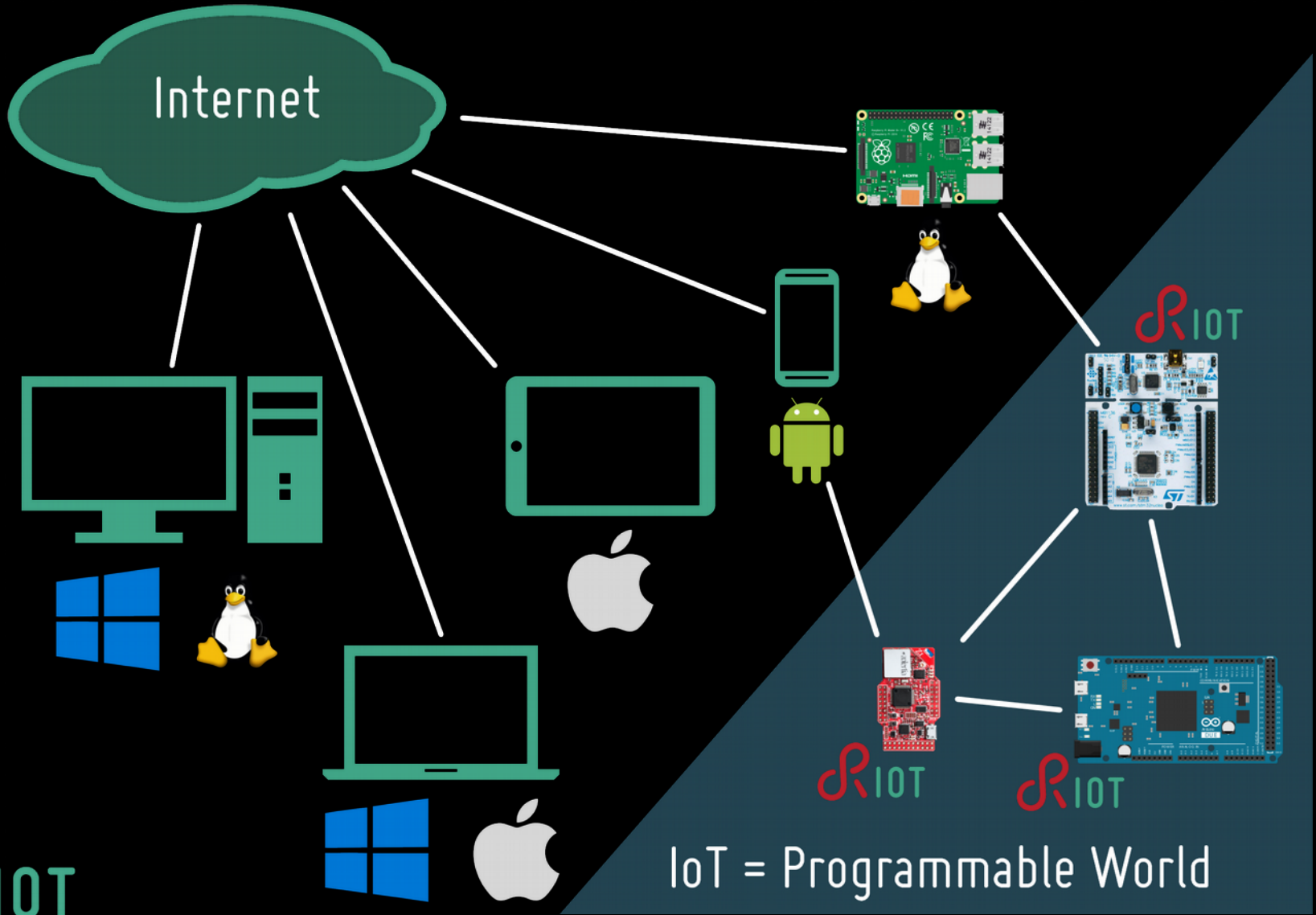


# The Internet of Things



IoT = Programmable World

# A Software Platform for the IoT?



# IoT Challenge: Constrained Devices

## ENERGY

Milliwatt instead of Watt

## CPU

Megahertz instead of Gigahertz

## MEMORY

Kilobytes instead of Gigabytes



**R**IOT





# Why a Software Platform for IoT ?

- As IoT software is evolves...
  - more complex pieces, e.g. an IP network stack
  - evolution of application logic
- ... non-portable IoT software slows innovation
  - 90% of IoT soft. should be hardware-independent
  - this is achievable with a good software platform (but not if you develop bare-metal)

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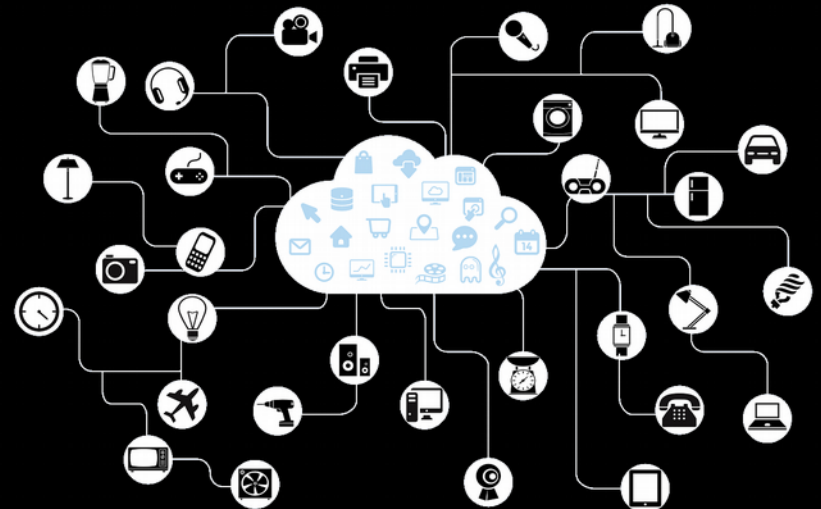
# Requirements for an IoT OS I

- Hardware abstraction
  - Re-usability of complex software
  - Heterogeneous hardware
- Resource efficiency
  - Memory
  - Energy
- Real-time
  - Determinism & dependability



# Requirements for an IoT OS II

- Network support
  - Internet Standards
  - Adaptation Layers
- Standard programming interfaces
- Security and modifiability
  - Updates
  - Open Source



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# RIOT Origins

## History

- **2008 – Project roots:**  
The kernel was started as part of a research project
- **2010 – Towards the IoT:**  
Implementation of 6LoWPAN and RPL was initiated
- **2013 – RIOT goes public:**  
Branding of RIOT started, source code moved to GitHub

## Founding institutions



# RIOT Positioning

- Licensed under LGPLv2
- Word wide, active community
- RIOT is a combination of
  - Memory & energy efficient design
  - Functionalities of a full-fledged operating system

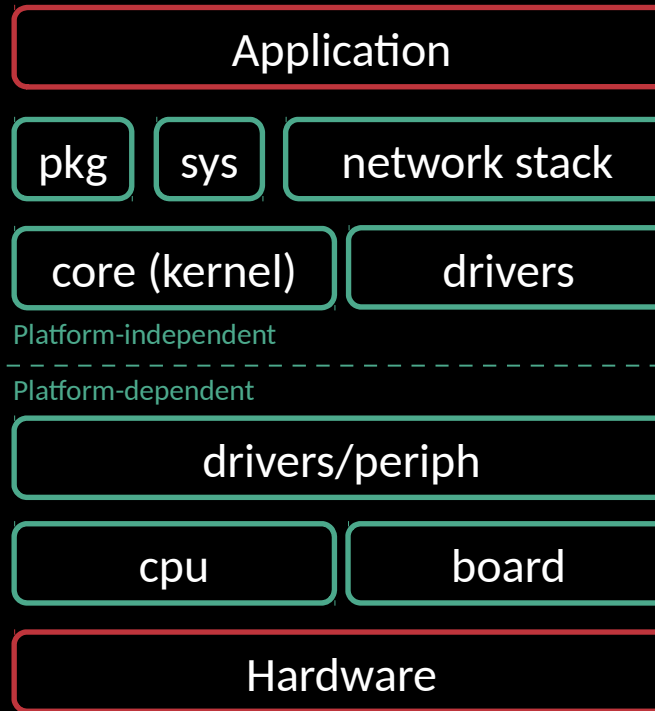


# RIOT: Fact sheet

- $\mu$ -kernel-like architecture (robustness)
- Modular design (adaptivity)
- Tickless scheduler (energy efficiency)
- Deterministic O(1) scheduling (real-time)
- Low latency interrupt handling (reactivity)
- Preemptive multi-threading & IPC
- Hardware abstraction
- Full featured, expendable network-stacks

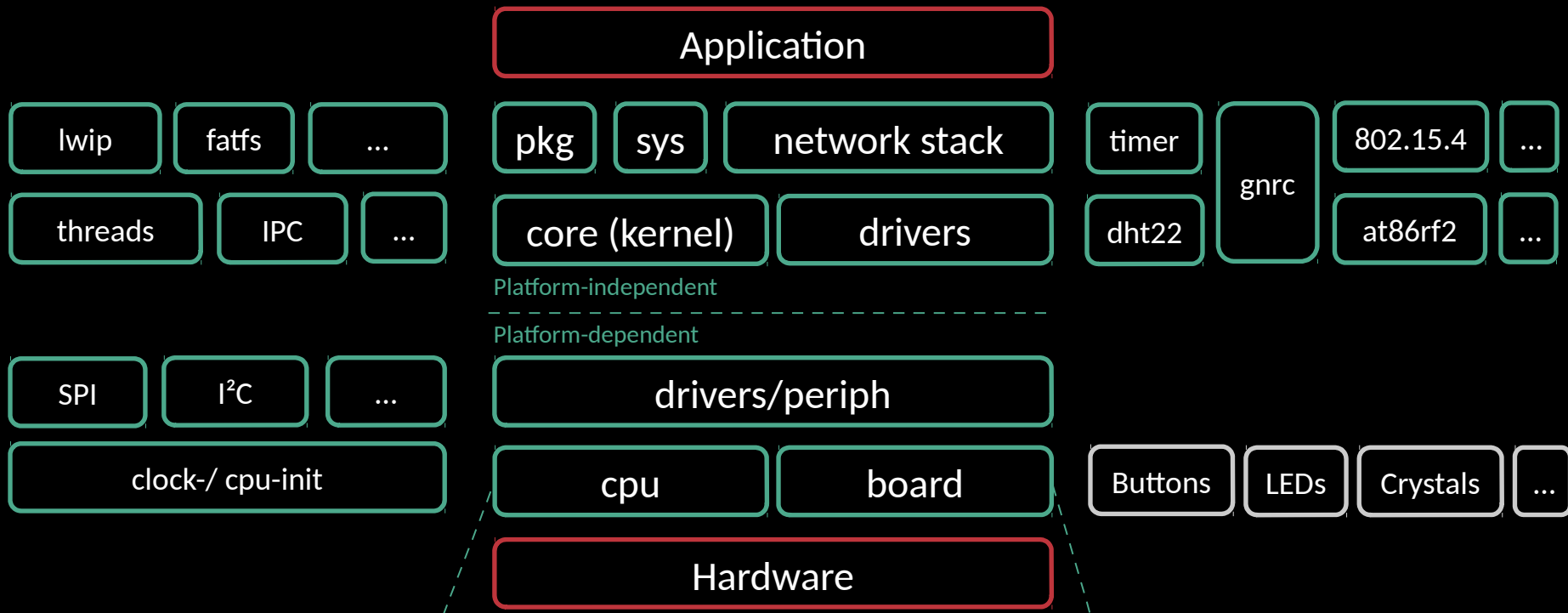


# RIOT Software Components I



■ SW-module  
■ non-OS

# RIOT Software Components II

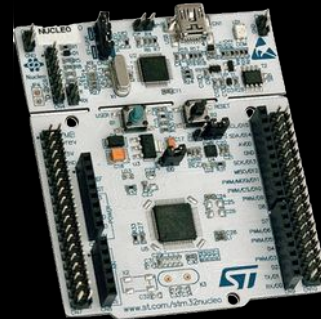
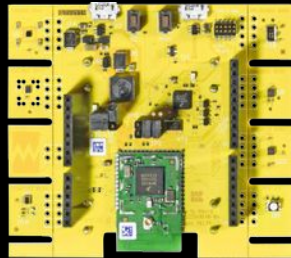


- SW-module
- non-OS
- config

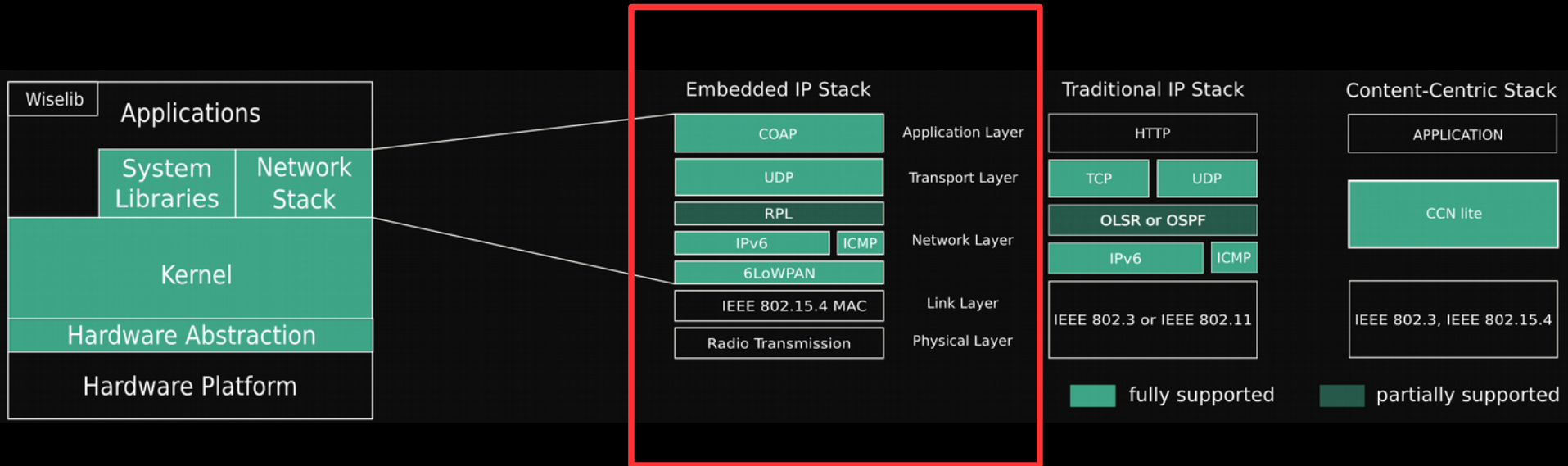


# RIOT already runs on a wide range of IoT hardware

Support for > 70 boards, various CPUs, different architectures, radios, sensors, actuators, SD-cards, ...



# RIOT: Built to connect



- Open-access protocols
  - e.g. 6LoWPAN, IPv6, CoAP, ...
- RIOT supports several network stacks (GNRC, LWIP, EMP6, CCN-lite, ...)



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# RIOT: IoT development made easy

- Open source, community-driven
- Write your code in **ANSI-C** or **C++**
- Compliant to the most widely used **POSIX** features such as **threads** and **sockets**
- Well known development tools
- No IoT hardware needed for debugging  
→ Run & debug RIOT as native process in Linux

 WIRESHARK

Valgrind

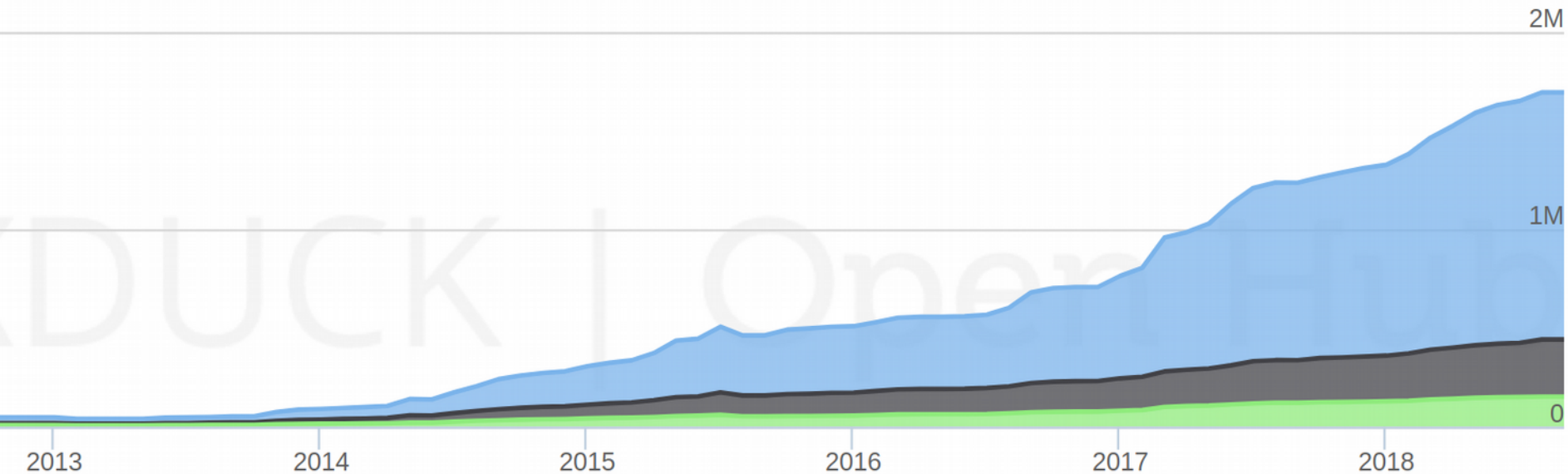


**GDB**  
The GNU Project  
Debugger

 RIOT

# RIOT stats

283 contributors, 119 active in last 12 months from industry, academia and makers scene



Estimated cost: \$19.7M, 358 person-years [1]

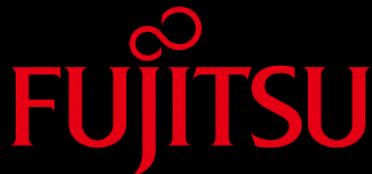


[1] source: [www.openhub.net/p/RIOT-OS](http://www.openhub.net/p/RIOT-OS) estimate using the basic COCOMO Model

# Some Active Supporters



life.augmented





# Join the RIOT

- ~ 822 forks on GitHub  
<https://github.com/RIOT-OS/RIOT>
- Hundreds on the developer mailing list  
[devel@riot-os.org](mailto:devel@riot-os.org)
- Support & discussions on IRC:  
[irc.freenode.org #riot-os](https://irc.freenode.org/#riot-os)
- ~1700 followers on Twitter  
[@RIOT\\_OS](https://twitter.com/RIOT_OS)



# Meet us @ Hack'n'ACK







RIOT

The friendly Operating System for IoT



<https://github.com/RIOT-OS/Tutorials>