

RIOT PO WiSe 17/18



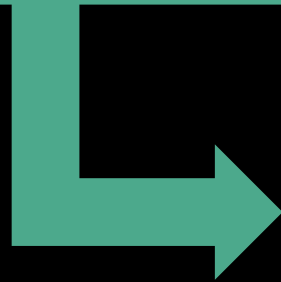
The friendly Operating System for the Internet of Things

Peter Kietzmann and Cenk Gündogan
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

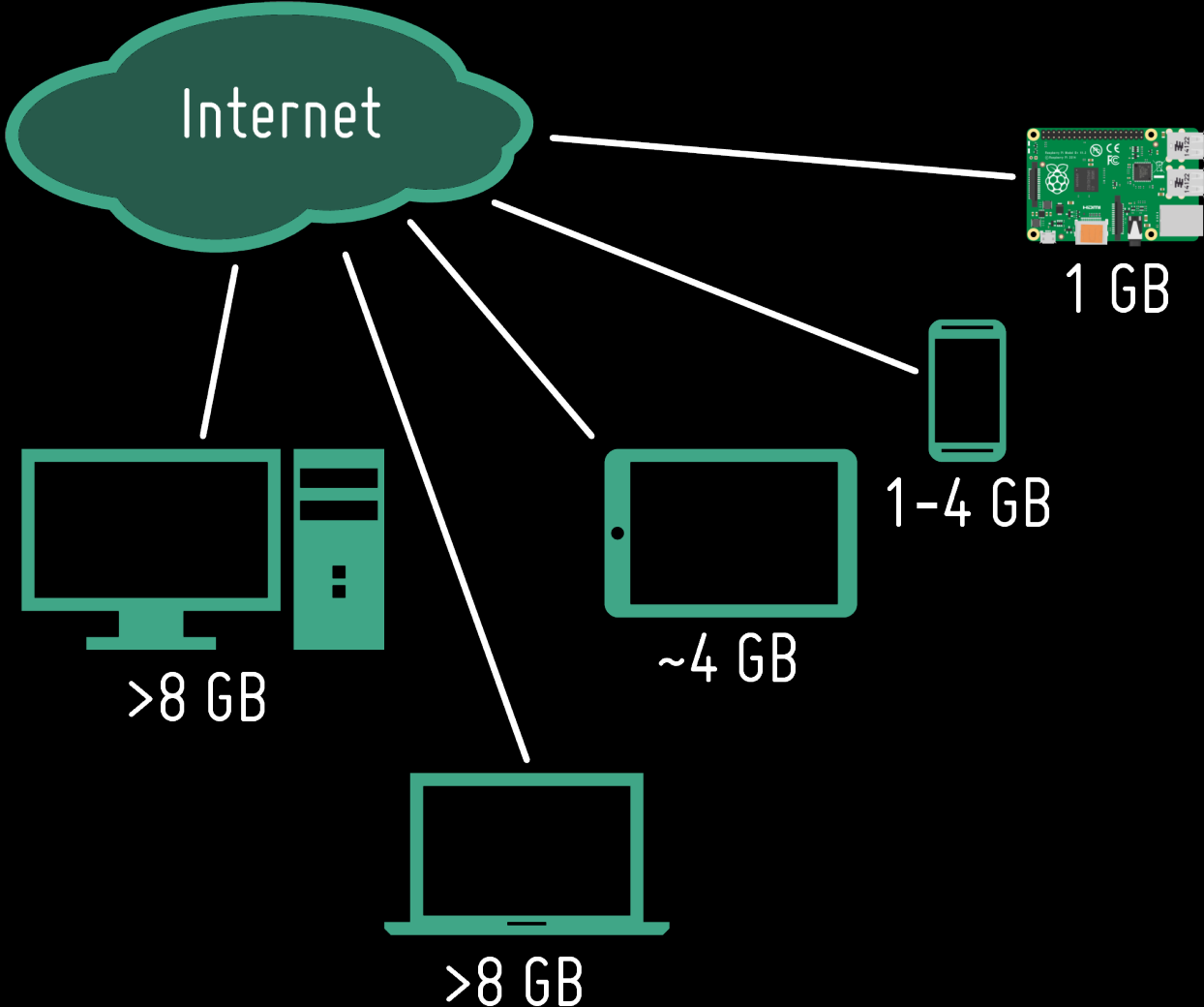
If your IoT device cannot
run Linux, then run

 IoT

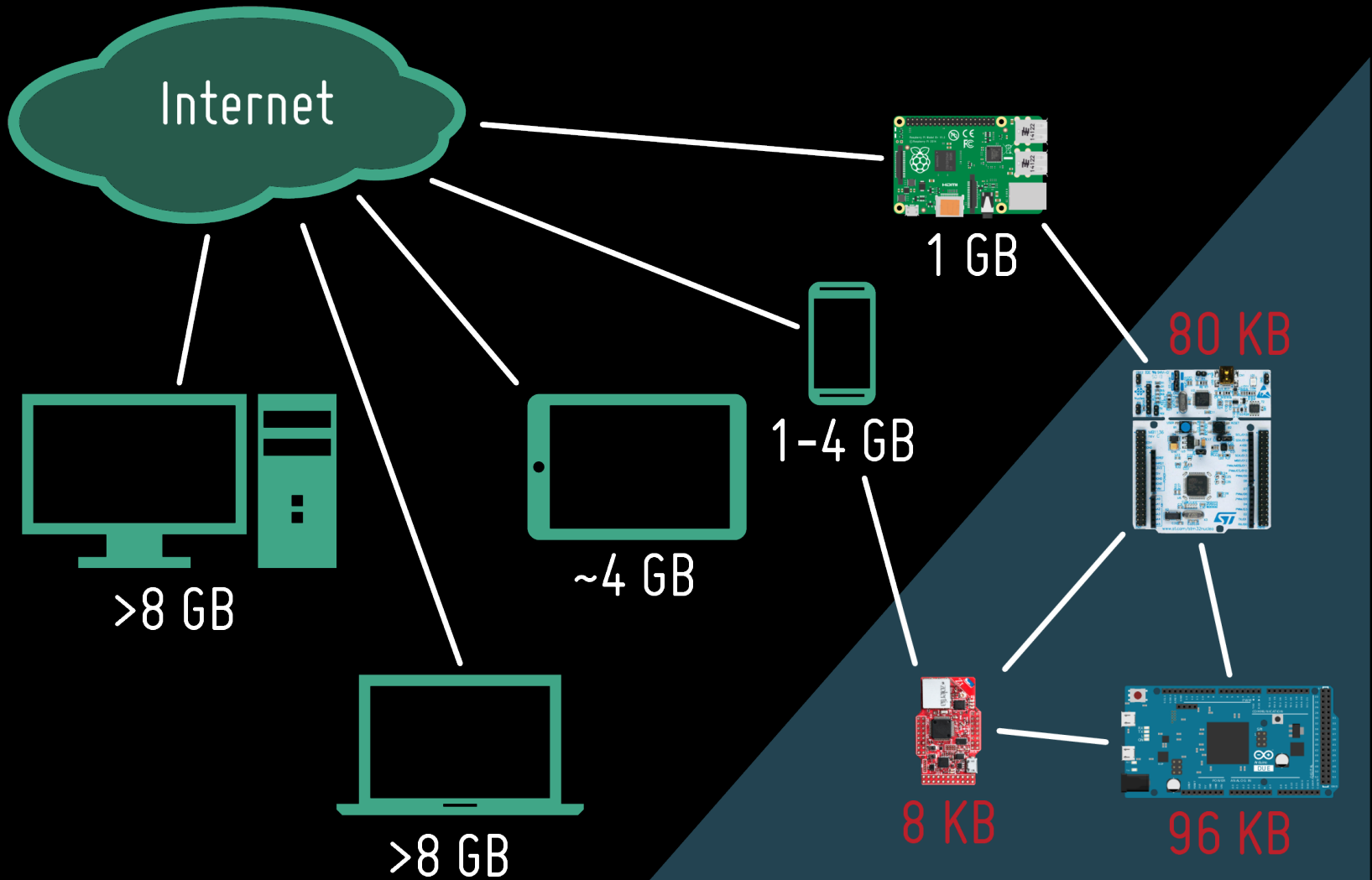
AGENDA

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

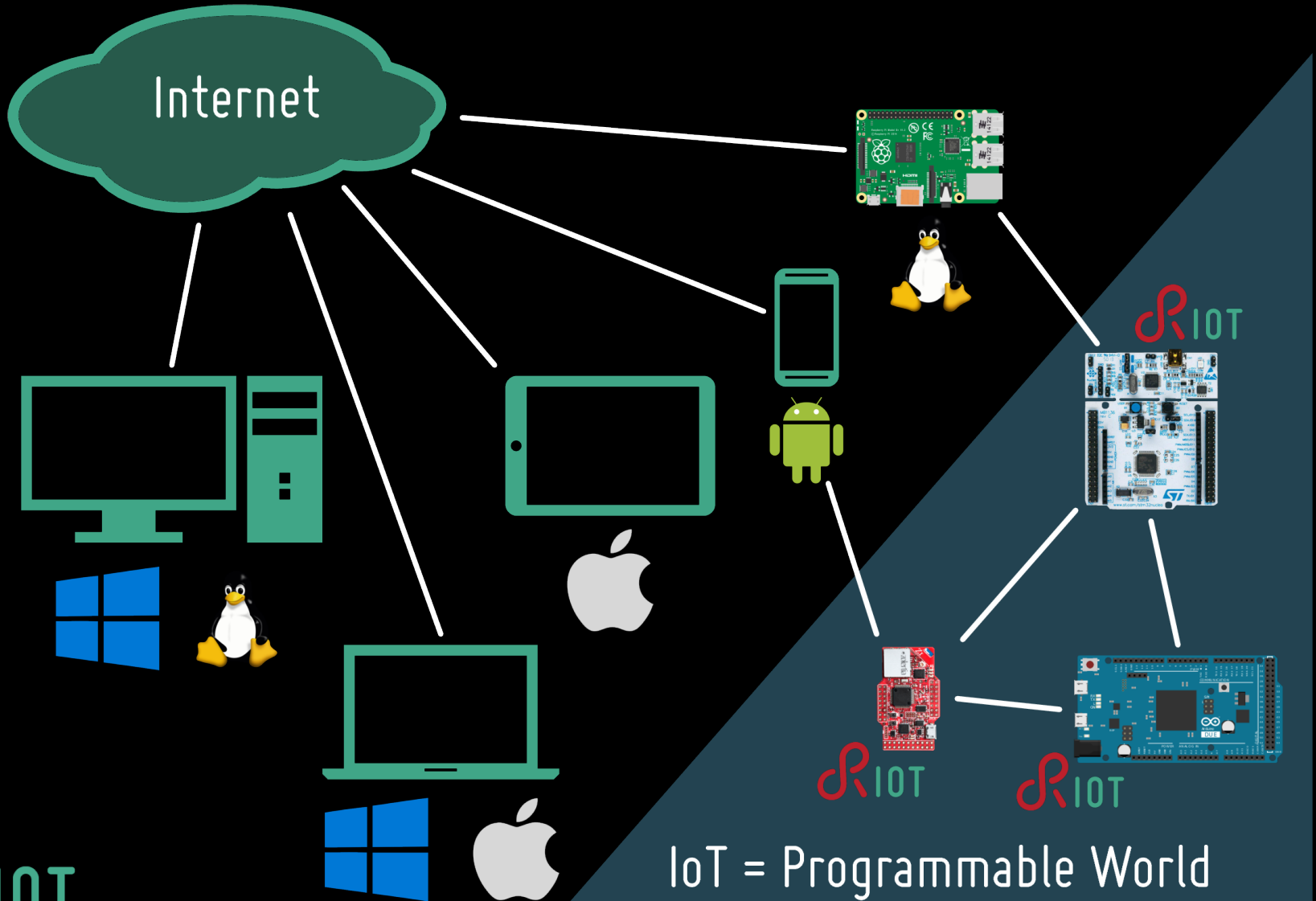
The Internet



The Internet of Things



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



RIOT



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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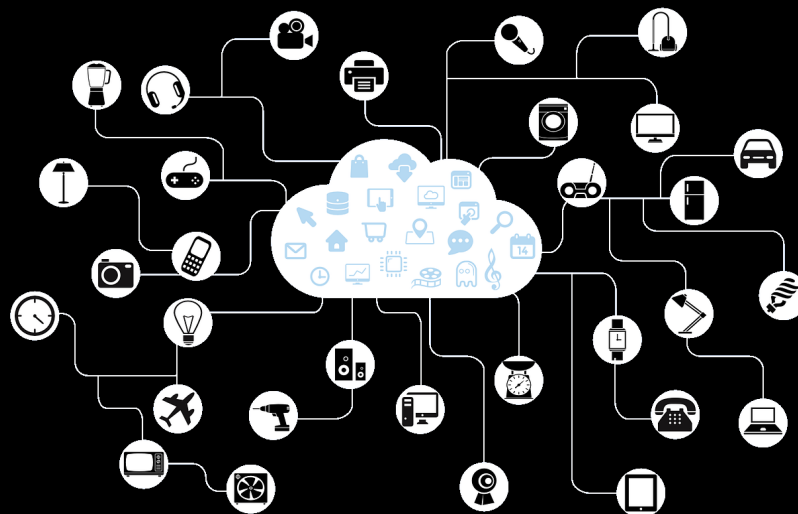
Requirements for an IoT OS I

- 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

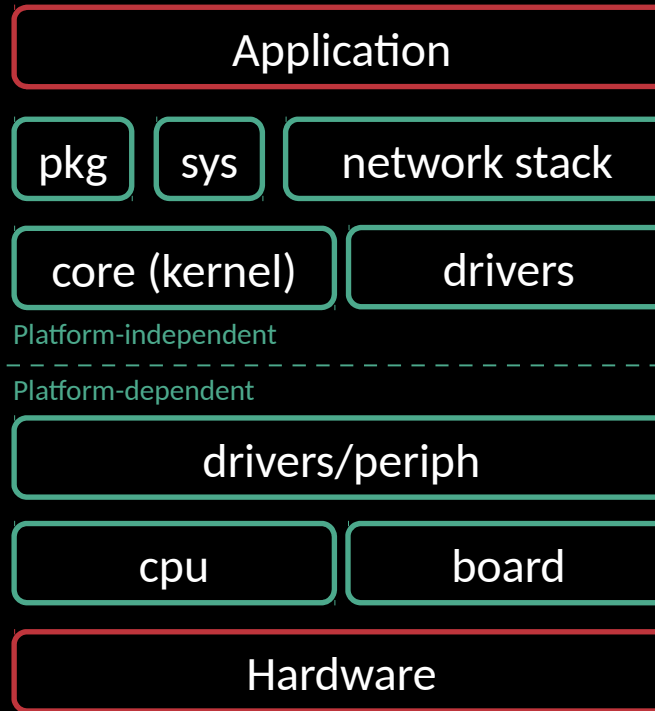
- Licensed under LGPLv2
- Word wide, active community
- RIOT is a combination of
 - Memory & energy efficient design
 - Functionalities of a full-fledged operating system



RIOT: Fact sheet

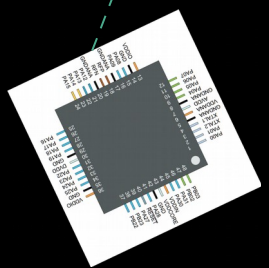
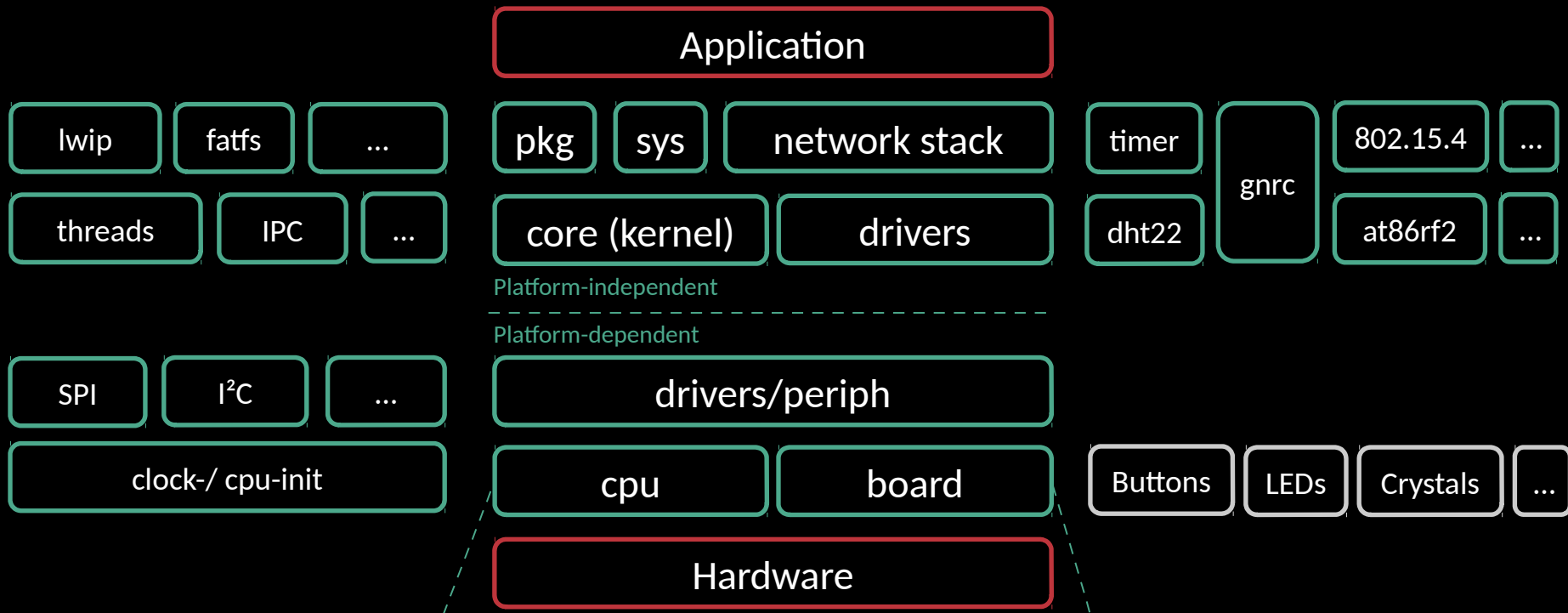
- μ -kernel-like architecture (robustness)
- Modular design (adaptivity)
- Tickless scheduler (energy efficiency)
- Deterministic O(1) scheduling (real-time)
- Low latency interrupt handling (reactivity)
- Preemptive multi-threading & IPC
- Hardware abstraction
- Full featured, expendable network-stacks

RIOT Software Components I



■ SW-module
■ non-OS

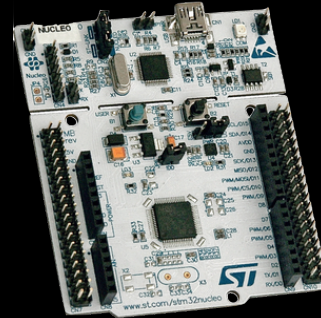
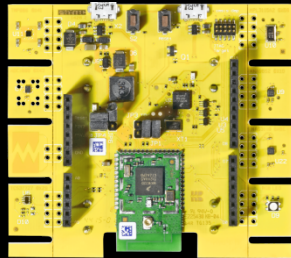
RIOT Software Components II



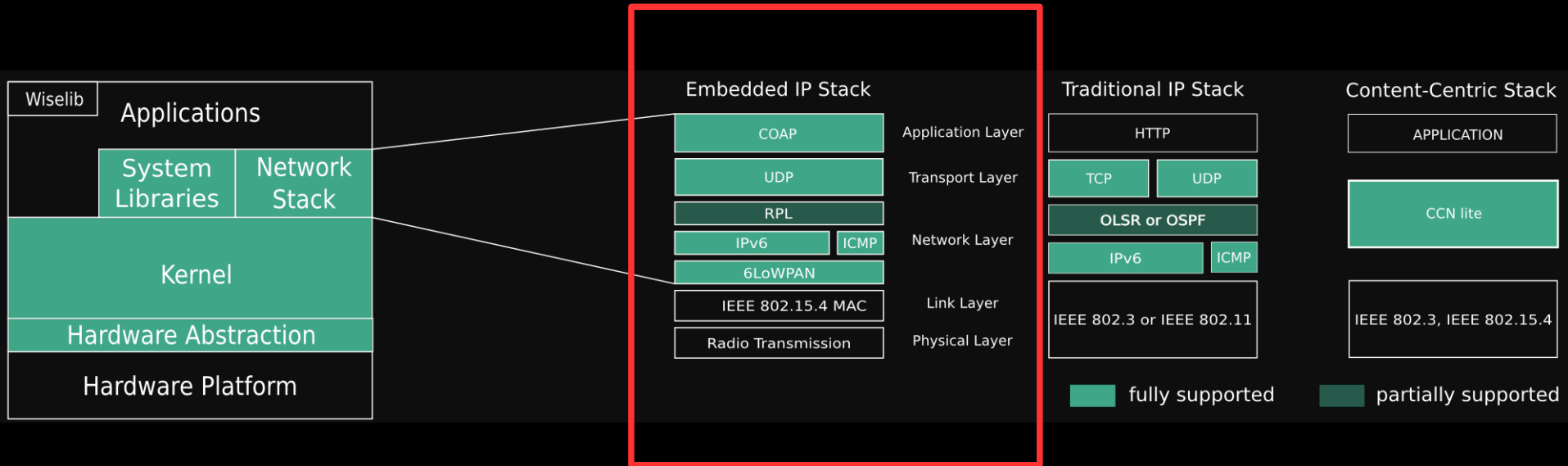
- SW-module
- non-OS
- config

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

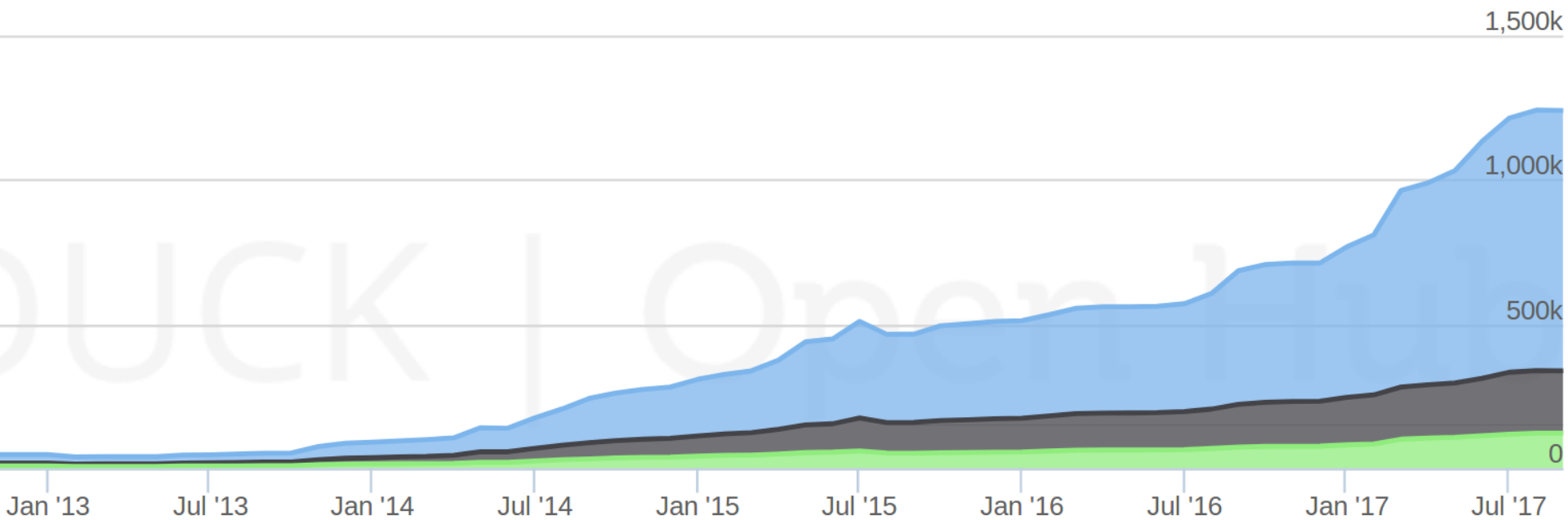


GDB
The GNU Project
Debugger

RIOT

RIOT stats

215 contributors, 86 active in last 12 months from industry, academia and makers scene

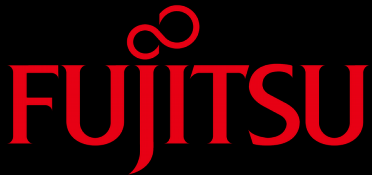


Estimated cost: \$13.9M, 253 person-years [1]



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

Some Active Supporters



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Roadmap

- Network stack developments
 - BLE & BLE over IPv6
 - CoAP resource directory
- Deployment tools
 - Over-the-air application and OS update...
- Continuous integration
 - Automated hardware tests
- System Extensions
 - Enhance energy management system
 - Extend hardware support

Join the RIOT

- ~ 822 forks on GitHub
<https://github.com/RIOT-OS/RIOT>
- Hundreds on the developer mailing list
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)

github
SOCIAL CODING



IETF



Meet us

Hack'n'ACK



EmbWo



Dagstuhl



FGSN



RIOT Summit

September 25 - 26, 2017

<http://summit.riot-os.org>

- ✓ bringing together RIOTers, beginners & experts
- ✓ gathering people interested in the IoT in general
- ✓ plenary talks, hands-on tutorials & demos



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