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Introduction to Linux-wpan and Potential Collaboration

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Agenda

- Relationship to RIOT
- Linux-wpan Project
- Current Collaboration
- Future

Relationship to RIOT

Relationship

- Over the air protocol interoperation
  - IEEE 802.15.4 and 6LoWPAN
  - Independent implementations
  - Interoperability testing
- RIOT native on Linux

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Linux-wpan Project

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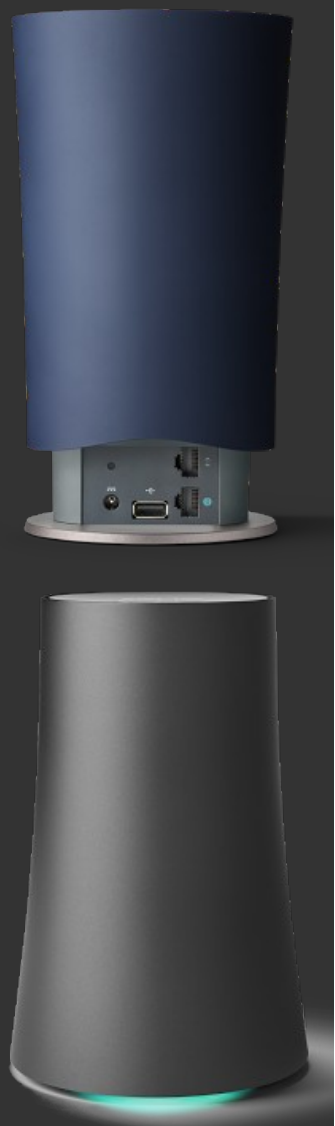
Motivation

- Platforms already running Linux could benefit from native 15.4 and 6LoWPAN subsystems
- 15.4 transceivers could easily be added to existing designs
- Battery powered sensors on the other hand are more likely to run a OS like RIOT
- Example: Google OneHub AP which already comes with, de-activated, 15.4 hardware
- Example: Ci40 Creator board as home IoT hub



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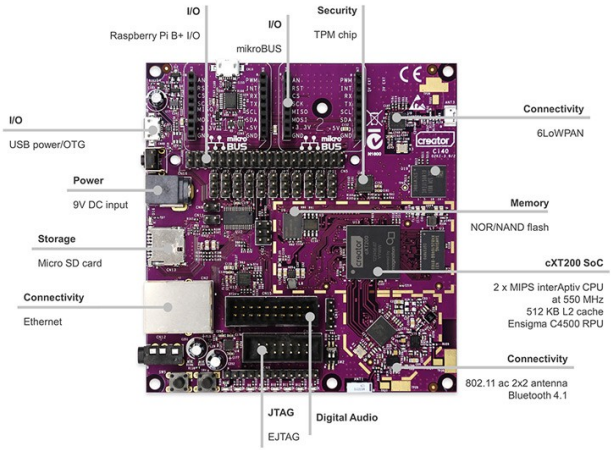
Development Boards

- Development boards with 15.4 hardware
- Ci40 Creator (Keno should have mentioned the 6LoWPAN clickers)
- ARTIK 5/10
- Raspberry Pi with openlabs shield
- Various transceivers hooked up via SPI
- EOL atusb USB transceiver



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Linux-wpan Project

- IEEE 802.15.4 and 6LoWPAN support in the mainline Linux kernel
- Started in 2008 as linux-zigbee project on SourceForge
- First steps of mainlining in 2012
- New project name to avoid confusion: linux-wpan
- New maintainer: Alexander Aring, Pengutronix
- Normal kernel development model
- Patches are posted and reviewed on the mailing list
- Accepted patches find their way through bluetooth-next towards Linus tree

Linux-wpan Community

- Small community: 1-2 core devs and ~4 additional people for specific drivers
- #linux-wpan on Freenode (~25 people)
- http://vger.kernel.org/vger-lists.html#linux-wpan (~85 people)
- https://github.com/linux-wpan (no PR model)
- http://wpan.cakelab.org used for wpan-tools releases and docs

Current Status

- ieee802154 layer with driver for various transceivers (at86rf2xx, mrf24j40, cc2520, atusb, adf7242)
- Link Layer Security
- 6LoWPAN with fragmentation and reassembly (RFC 4944)
- LOWPAN_IPHC and NHC for UDP (RFC 6282)
- Testing between Linux, RIOT and Contiki

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Current Collaboration

Development

- Developer discussions about protocol interpretations
- Test counterpart for new developments e.g. neighbour discovery
- RIOT native on Linux

Testing

- Linux-wpan on the Raspberry Pi to test as boarder router for RIOT nodes
- Part of tests run before every RIOT release
- Packet sniffing

Future

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raw802154

- PR #5582, currently reviewed
- With RIOT native on Linux this can be used for virtual testing on the 15.4 level
- RIOT will use a fake loop-back interface of the Linux-wpan subsystem through the raw802154 driver
- Virtual 15.4 communication between RIOT,

  Linux and maybe later OpenThread

raw802154 Details

- The RIOT driver will use raw packets over AF_PACKET
- The Linux loop-back interface will be used in promiscuous mode to avoid address filter problems
- Acknowledgements are not handled
- Several virtual interfaces can be created with RIOT and Linux
- Could also be used to run on a real transceiver interface, not recommended :-)

Comparison

Feature	Linux	RIOT
IEEE 802.15.4: data and ACK frames	✔	✔
IEEE 802.15.4: beacon and MAC command frames	✘	✘
IEEE 802.15.4: coordinator scenario: scanning, joining, PAN coordinator	✘	✘
IEEE 802.15.4: link layer security	✔	✘
6LoWPAN: frame encapsulation, fragmentation, addressing (RFC 4944)	✔	✔
6LoWPAN: IP header compression (RFC 6282)	✔	✔
6LoWPAN: next header compression, UDP only (RFC 6282)	✔	✔
6LoWPAN: generic header compression (RFC 7400)	Partial	✘
6LoWPAN: neighbour discovery optimizations (RFC 6775)	Partial	✔
Mesh link establishment draft	✘	✘

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Linux-wpan Future

- Implement missing parts of the 15.4 specification
  - Beacon and MAC command frame support
  - Coordinator support in MAC layer and wpan-tools
  - Scanning
- Improve existing drivers and add support for new hardware
- Neighbour Discovery Optimizations (RFC 6775), started
- Evaluate running OpenThread on top of linux-wpan

RIOT Future

- Only suggestions from my side :-)
- Link Layer Security implementation
- Beacon and MAC command frame support
- PAN scanning and joining
- Support more transceivers
- Simply hook them up to a board over SPI
- Learn from what we had to figure out e.g. mrf24j40 problems with security enabled frames

Together

- Automate RIOT vs. Linux testing with the raw802154 driver in RIOT
- Compatible short address handling
- The mesh link establishment draft might be interesting to implement (OpenThread, ZigBee IP)

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Thank you!

6LoWPAN

- Physical and MAC layer defined by IEEE 802.15.4 from 2003 onwards
- Series of IETF specifications from 2007 onwards (RFCs 4944, 6282, 7400, etc)

L5 Application Layer	Application	Application
L4 Transport Layer	TCP | UDP | ICMP	UDP | ICMPv6
L3 Network Layer	IP	IPv6
		6LoWPAN
L2 Data Link Layer	Ethernet MAC	IEEE 802.15.4 MAC
L1 Physical Layer	Ethernet PHY	IEEE 802.15.4 PHY

Architecture

- ieee802154 and mac802154 handle the driver and MAC layer (wpan0 interface)
- 6LoWPAN sits on top of the wpan devices and acts as an adaptation layer to be used by the normal IPv6 kernel stack (lowpan0 interface)
- The 6LoWPAN subsystem transparently handles fragmentation and reassembly between the different MTUs as well as compression