

openwifi

AN OPEN-SOURCE WI-FI CHIP? WHAT, WHY AND HOW --THOUGHTS FORM THE OPENWIFI PROJECT

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BACKGROUND

open-source IEEE 802.11 Wi-Fi FPGA/chip and Linux driver (Internal start 2017)

<https://github.com/open-sdr/> (online at end of 2019) AGPLv3

(Currently) digital **BaseBand**:

Antenna – RF -- ADC/DAC -- **BB** -- Linux

openwifi repo : Linux (driver/etc)

openwifi-hw repo : Verilog

openwifi-hw-img repo : FPGA bitstream

BACKGROUND

European H2020 ORCA

Orchestration and Reconfiguration Control Architecture (2016~2020)

2017: start internal openwifi in **ORCA**

2019: on github

2019 Dec 18, v1.0.0. release Ghent, Initial 802.11a.

2020: FOSDEM in Brussels

2020 Mar 05, v1.1.0. release Taiyuan. Major improvement.

2020 Dec 18, v1.2.0. release Leuven. 802.11n -- **Thanks to NLNET!**

2022 Apr 01, v1.3.0. release Wilsele. AMPDU and RF optimization

2022 May 16, v1.3.1. release Wilsele. Dynamic FPGA/Driver reloading in seconds.

2023 Jan 28, v1.4.0. release Notter. OS upgraded to the same as Raspberry Pi.

Trying hard to get resources to for long term road map ...

BACKGROUND

- Overall readme: <https://github.com/open-sdr/openwifi/blob/master/README.md>
- Tech description: <https://github.com/open-sdr/openwifi/blob/master/doc/README.md>
- App notes: https://github.com/open-sdr/openwifi/blob/master/doc/app_notes/README.md
- Publications: <https://github.com/open-sdr/openwifi/blob/master/doc/publications.md>
- FPGA how to: <https://github.com/open-sdr/openwifi-hw/blob/master/README.md>

| board_name | Description | Vivado license |
|---------------|---|----------------|
| zc706_fmcs2 | Xilinx ZC706 board + FMCOMMS2/3/4 | Need |
| zed_fmcs2 | Xilinx zed board + FMCOMMS2/3/4 | NO need |
| adrv9364z7020 | ADRV9364-Z7020 + ADRV1CRR-BOB | NO need |
| adrv9361z7035 | ADRV9361-Z7035 + ADRV1CRR-BOB/FMC | Need |
| zc702_fmcs2 | Xilinx ZC702 board + FMCOMMS2/3/4 | NO need |

| board_name | Description | Vivado license |
|--------------|---|----------------|
| antsdr | MicroPhase enhanced ADALM-PLUTO Notes | NO need |
| e310v2 | MicroPhase new antsdr Notes | NO need |
| antsdr_e200 | MicroPhase enhanced ADALM-PLUTO (smaller/cheaper) Notes | NO need |
| sdrpi | HexSDR SDR in Raspberry Pi size Notes | NO need |
| zcu102_fmcs2 | Xilinx ZCU102 board + FMCOMMS2/3/4 | Need |
| neptunesdr | Low cost Zynq 7020 + AD9361 board | NO need |

BACKGROUND



Dec 10th, 2019



May 12th, 2021

Just search: **openwifi**

WHAT, **WHY**, HOW



Just for fun!

A poll

Why is an open-source Wi-Fi chip needed? Do I miss your reason?

Then comment on it!

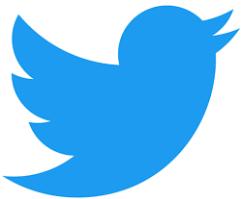
You can see how people vote. [Learn more](#)

Just for fun and sharing

Better security & privacy

Help customize and optimize it

Education and Research





Why is an open-source Wi-Fi chip needed? Do I miss your reason? Then comment on it!

Just for fun and sharing

3.1%

Better security & privacy

32.3%

Customize and optimize it

23.1%

Education and Research

41.5%

65 votes · Final results



Why is an open-source Wi-Fi chip needed? Do I miss your reason?

Then comment on it!

You can see how people vote. [Learn more](#)

Just for fun and sharing ✓

0%

Better security & privacy ✓

29%

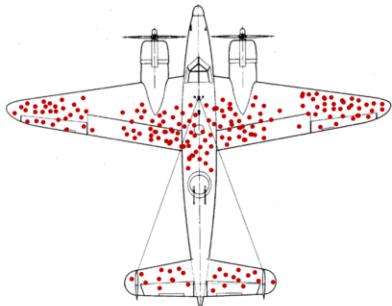
Help customize and optimize it ✓

29%

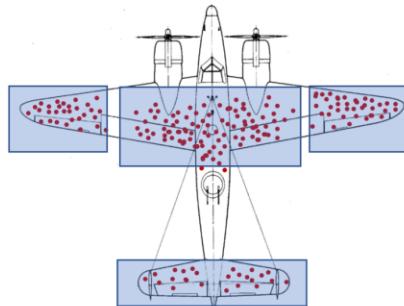
Education and Research ✓

41%

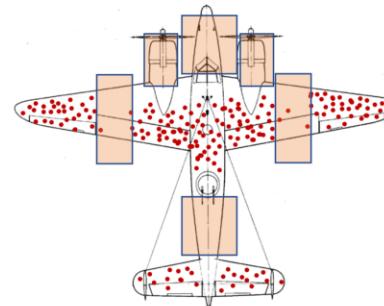
34 votes • 5d left • [Hide results](#)



Our data is only from returning flights. Here we see a visualization of the places that bullet holes were observed.

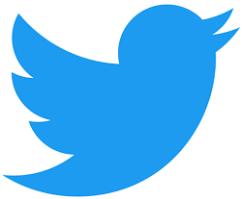


And initial guess at how to fix this might be to apply additional armor plating to the parts of the plane with the most holes...



.... However this is where planes that *returned* had bullet holes. The planes we want to protect are the ones that did *not* return, so we should place armor there.

Survivorship Bias



Another poll

Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments)

You can see how people vote. [Learn more](#)

Reinventing the wheel

Can't compete big company

Can't try as easy as FOSS

Insecure: bad guy see the code

20 votes • 2w left • [View results](#)





Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments if it is not listed)

Reinventing the wheel

17.6%

Can't compete big company

47.1%

Can't try as easy as FOSS

23.5%

Insecure:BadGuy see code

11.8%

17 votes • Final results



Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments)

You can see how people vote. [Learn more](#)

Reinventing the wheel ✓

13%

Can't compete big company ✓

53%

Can't try as easy as FOSS ✓

10%

Insecure: bad guy see the code ✓

23%

[30 votes](#) • 6d left • [Hide results](#)



Why is an open-source Wi-Fi chip needed? Do I miss your reason? Then comment on it!

| | |
|-------------------------------|--------------|
| Just for fun and sharing | 3.1% |
| Better security & privacy | 32.3% |
| Customize and optimize it | 23.1% |
| Education and Research | 41.5% |

65 votes • Final results

Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments if it is not listed)

| | |
|----------------------------------|--------------|
| Reinventing the wheel | 17.6% |
| Can't compete big company | 47.1% |
| Can't try as easy as FOSS | 23.5% |
| Insecure:BadGuy see code | 11.8% |

17 votes • Final results



Why is an open-source Wi-Fi chip needed? Do I miss your reason?
Then comment on it!

You can see how people vote. [Learn more](#)

| | |
|---------------------------------------|------------|
| Just for fun and sharing | 0% |
| Better security & privacy | 29% |
| Help customize and optimize it | 29% |
| Education and Research | 41% |

34 votes • 5d left • [Hide results](#)

Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments)

| | |
|---------------------------------------|------------|
| Reinventing the wheel | 13% |
| Can't compete big company | 53% |
| Can't try as easy as FOSS | 10% |
| Insecure: bad guy see the code | 23% |

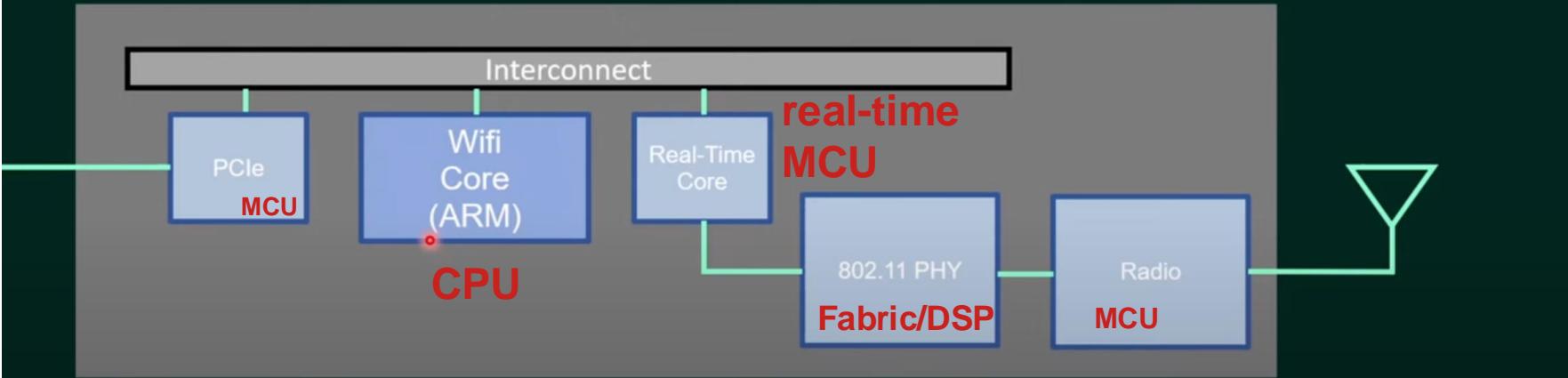
30 votes • 6d left • [Hide results](#)

Security&Privacy

Wi-Fi chip is NOT just a dumb device.

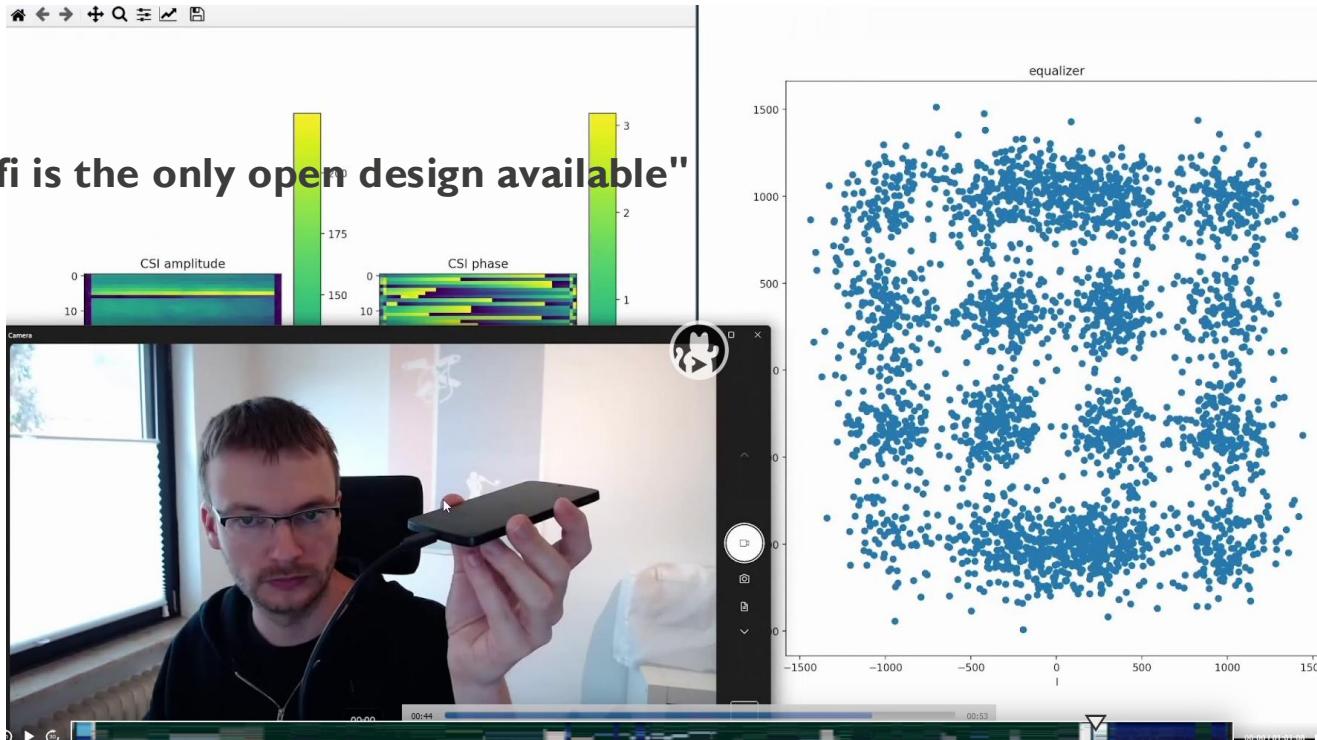
It is a highly complicated heterogeneous computing system.

Building blocks of a Wifi Chip



<https://media.ccc.de/v/gpn22-380-how-a-wifi-chip-works-internally>

<https://media.libreplanet.org/u/libreplanet/m/openwifi-project-the-dawn-of-the-free-libre-wifi-chip/>



<https://media.ccc.de/v/gpn22-380-how-a-wifi-chip-works-internally>

<https://media.libreplanet.org/u/libreplanet/m/openwifi-project-the-dawn-of-the-free-libre-wifi-chip/>

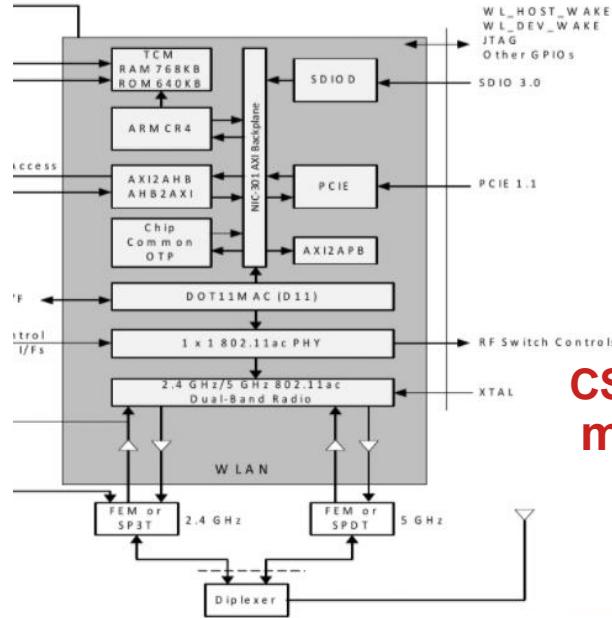
SECURITY&PRIVACY

NOT just a dumb device. A highly complicated heterogeneous computing system

- Reverse engineering
- Non-free blob – **ARM**
- Non-free microcode: **D11 core**

D11 core – best kept secret

- microcontroller
- implementations of LMAC protocols
- instructions from the Memory
- program counter
- ALU- two basic branch instructions



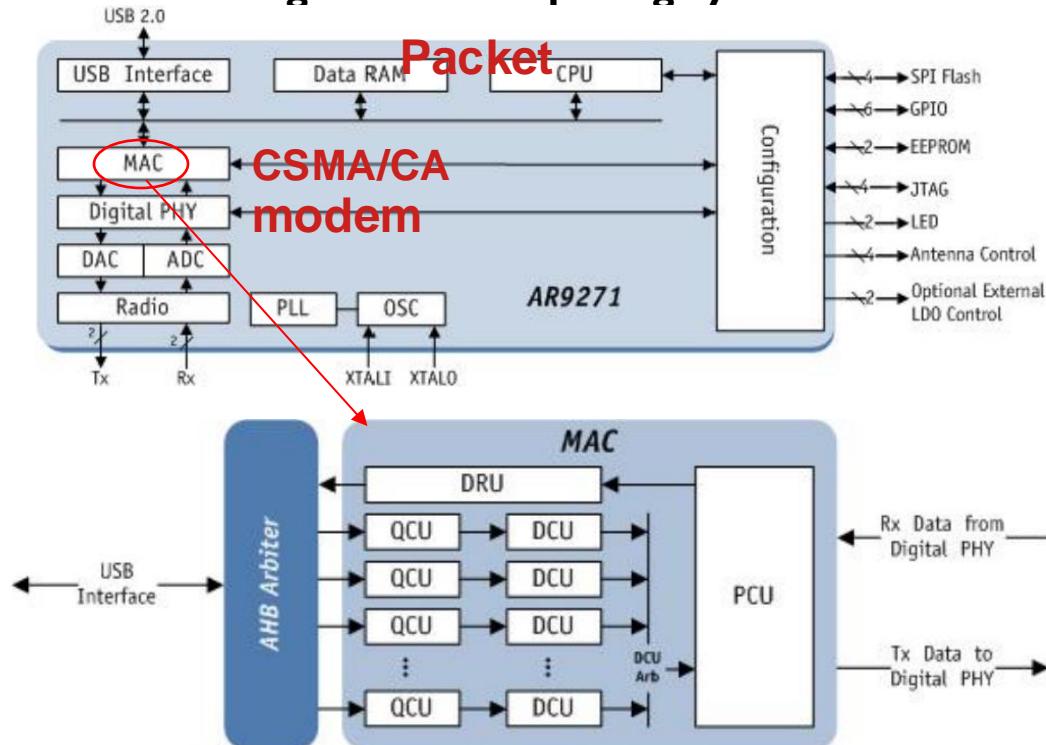
Bloc diagramm of the bcm4339



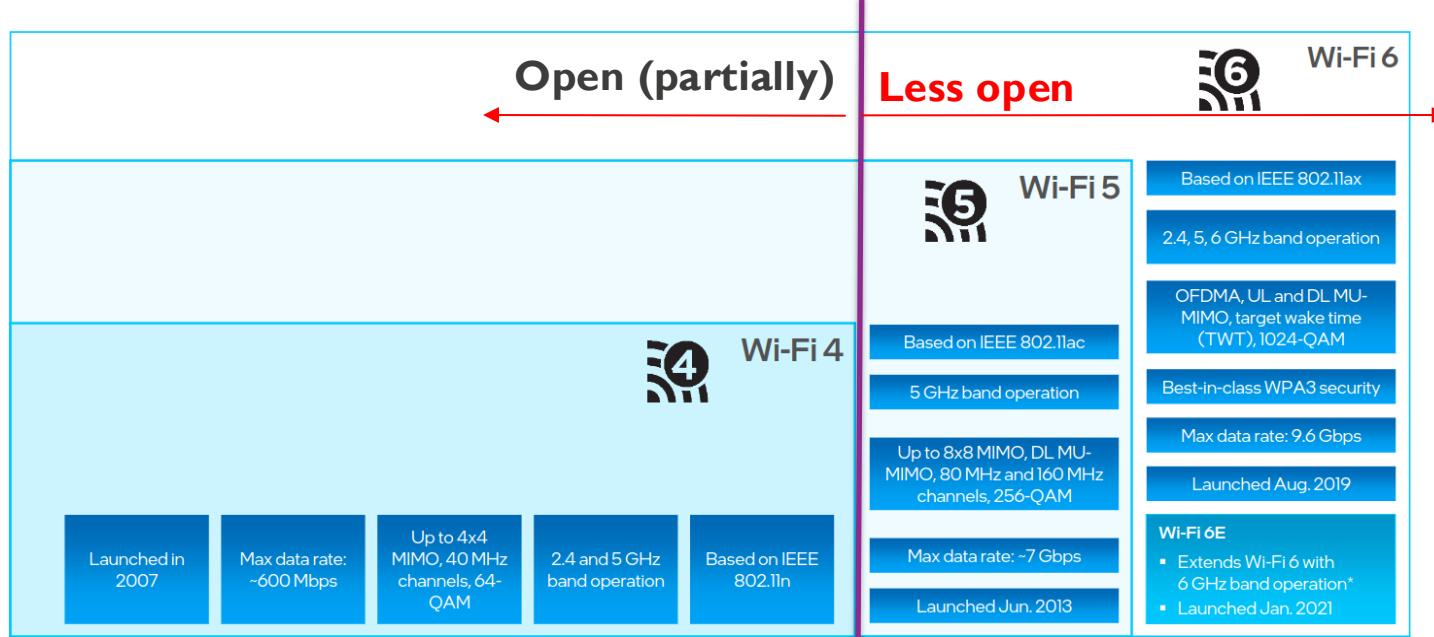
SECURITY&PRIVACY

NOT just a dumb device. A highly complicated heterogeneous computing system

- Free firmware from vendor
- Non-free microcode in **MAC cores – best kept secret**
 - QCU: Queue Control Unit
 - DCU: DCF Control Unit
 - DRU: DMA Rx Unit
 - PCU: Protocol Control Unit



SECURITY&PRIVACY



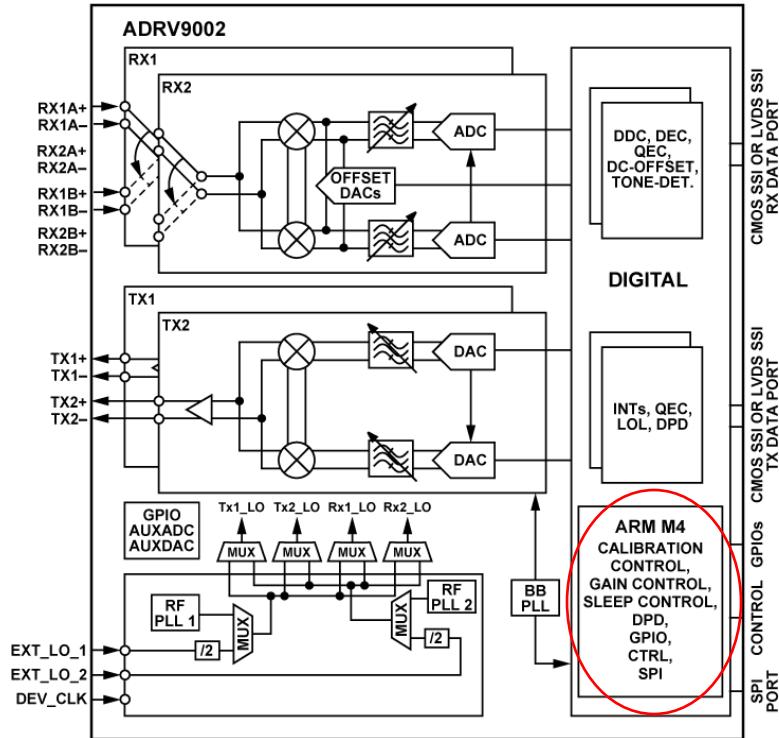
SECURITY&PRIVACY

NOT just a dumb device. A highly complicated heterogeneous computing system

RF chip also has processor inside.

Some stated in datasheet,
some didn't

RF chip could be tricked to
dead lock by RF signals!



<https://www.analog.com/en/products/ADRV9002.html>



*“Anything that
can go wrong
will go
wrong”*

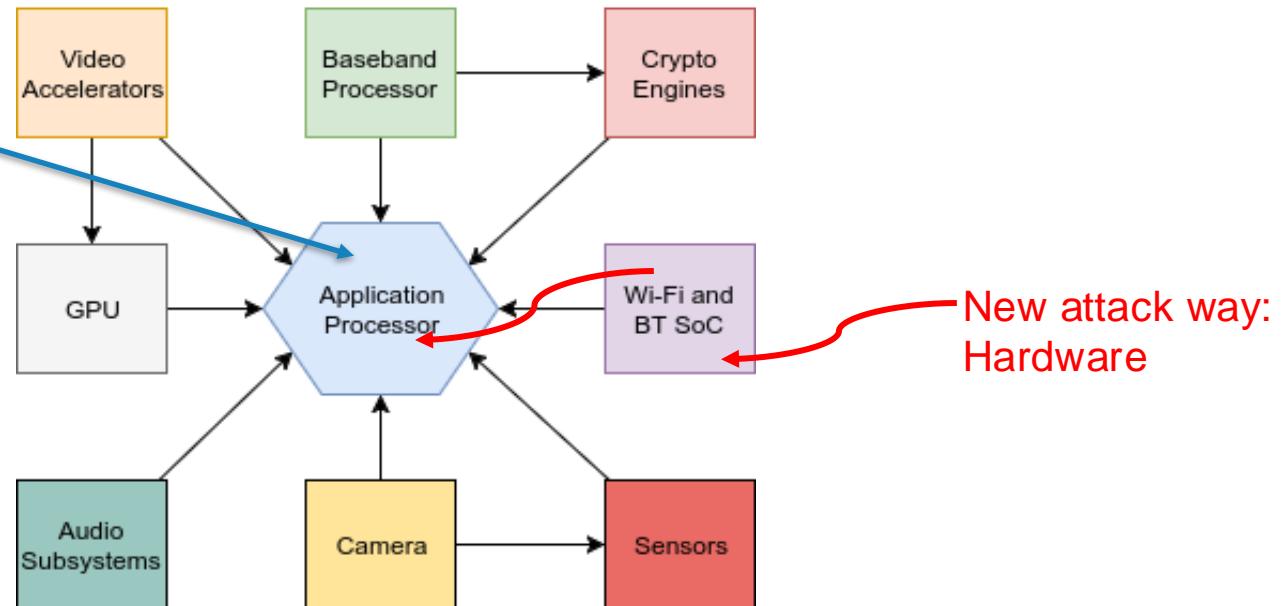
Edward A. Murphy, Jr.

<https://www.freightnews.co.za/article/tariff-classifications-how-avoid-murphys-law>

SECURITY&PRIVACY

Previously focus:
Software

Mobile Device Complexity



SECURITY&PRIVACY

Windows Wi-Fi Driver Remote Code Execution Vulnerability

CVE-2024-30078

Security Vulnerability

Released: Jun 11, 2024

FAQ

According to the CVSS metric, the attack vector is adjacent (AV:A). What does that mean for this vulnerability?

Exploiting this vulnerability requires an attacker to be **within proximity of the target system** to send and receive radio transmissions.

How could an attacker exploit the vulnerability?

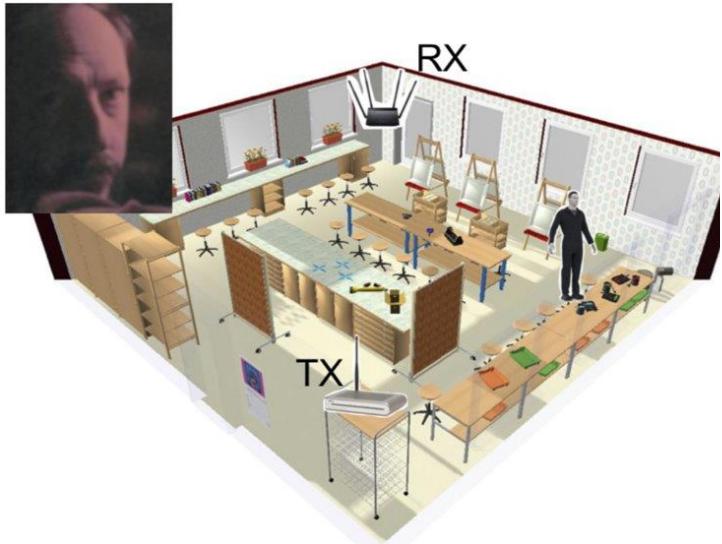
An unauthenticated attacker could send a malicious networking packet to an adjacent system that is employing a Wi-Fi networking adapter, which could enable remote code execution.

SECURITY&PRIVACY

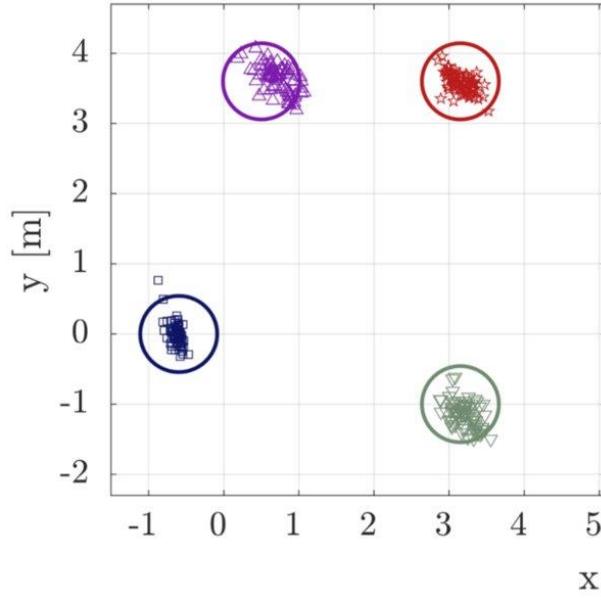


Wi-Fi sensing

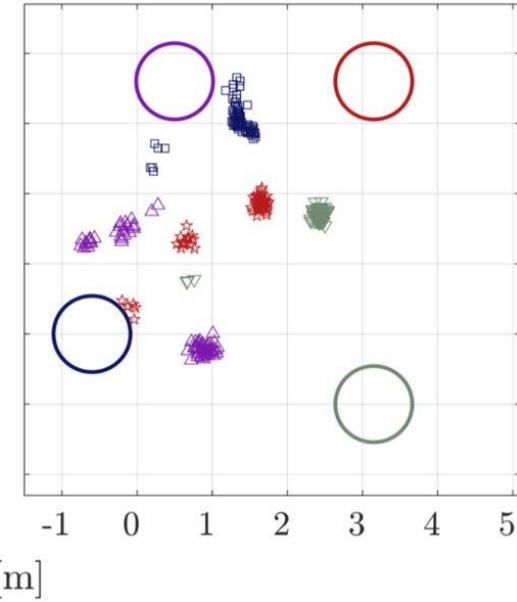
SECURITY&PRIVACY



Without randomization



With randomization



SECURITY&PRIVACY

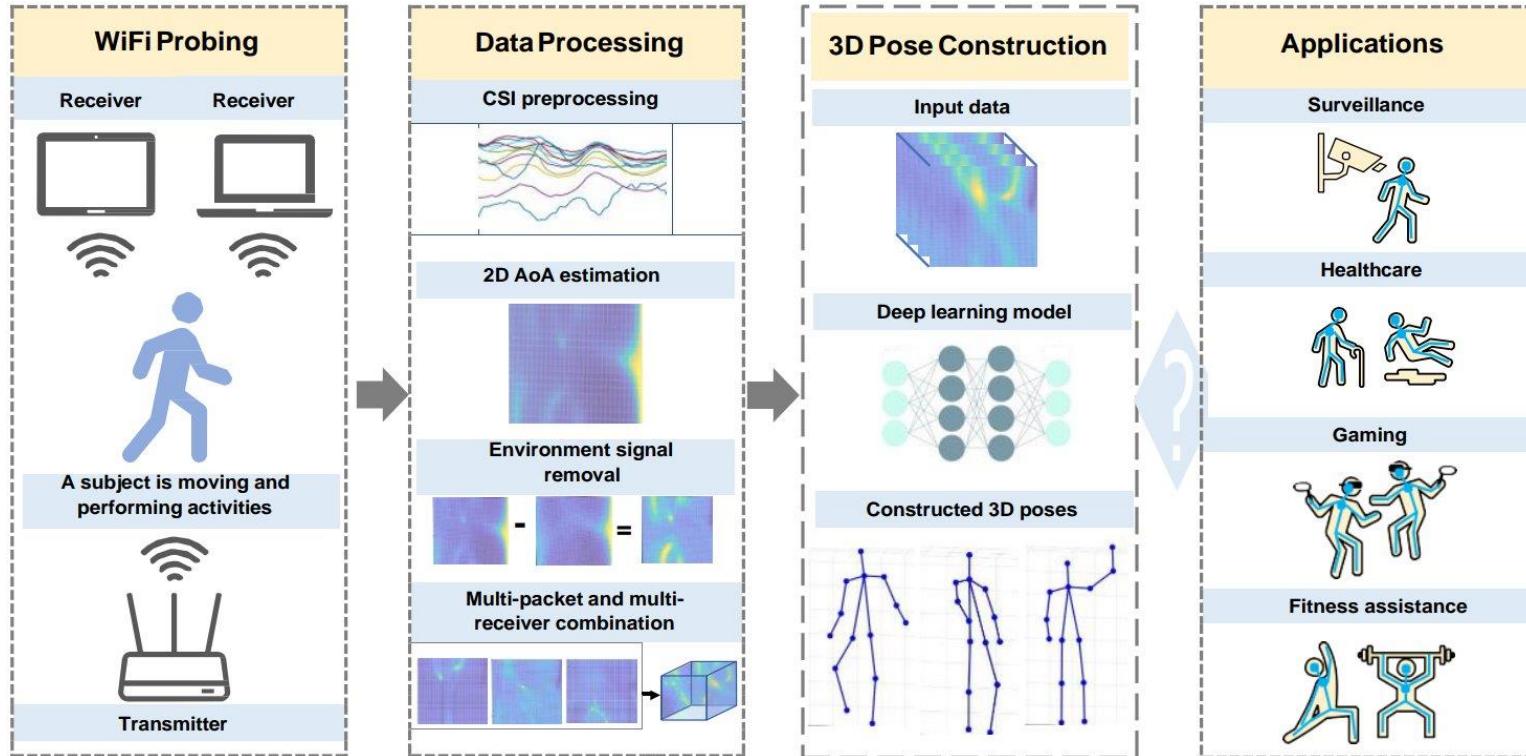


Fig. 4. System overview.

<https://arxiv.org/pdf/2204.07878.pdf>

SECURITY&PRIVACY

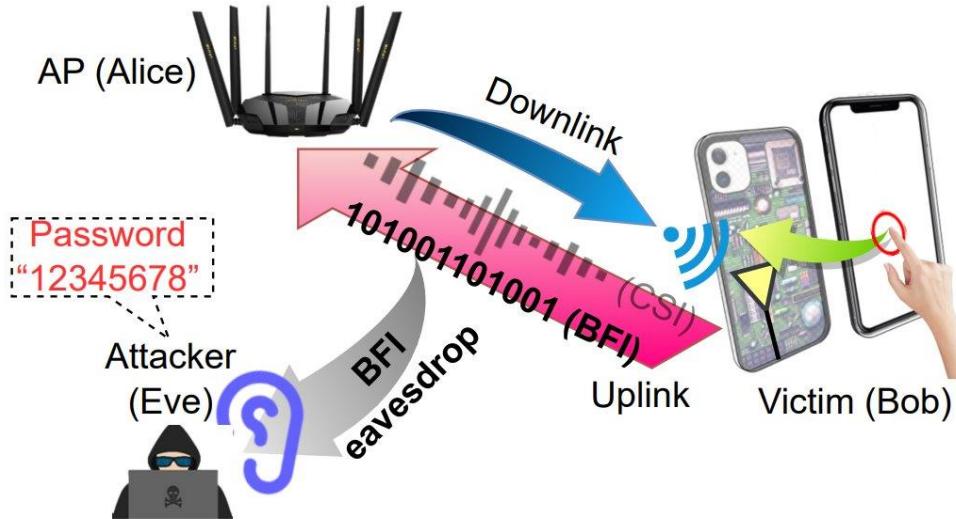


Figure 1: Vision of WiKI-Eve: eavesdropping clear-text BFI (representing downlink channel states) transmitted to the AP, Eve can readily infer the Bob's password typing that physically “hits” the Wi-Fi channel.

Security&Privacy

We need more transparent and open design of the Wi-Fi chip and its driver

Optimization&Customization

When Wi-Fi link has issue or encounter non-consumer scenario

OPTIMIZATION&CUSTOMIZATION

The control nobs in the standard&chip



The service interface to the consumer's data



OPTIMIZATION&CUSTOMIZATION

Try to tune some nobs or customize it for some special use cases?



OPTIMIZATION&CUSTOMIZATION

Wi-Fi:
Good enough (most of time) for:



<https://www.socialistsanddemocrats.eu/newsroom/sds-ask-worldwide-protection-online-consumers>

Wi-Fi:
NOT good enough for ...

<https://www.linkedin.com/pulse/offshore-wind-farm-osr-response-contractor-do-i-need-carroll-iii/>



<https://www.kivnon.com/everything-about-agv-and-different-types/>



<https://www.grayscalestrategy.com/why-wont-networks-collaborate/>



<https://www.eetimes.com/siemens-load-analyzer-app-reduces-aerospace-electrical-compliance-certification-risk/>

EDUCATION&RESEARCH

What can we learn and
Control in COTS Wi-Fi?

Switch ON/OFF

**Far not enough for fine
tuning!**

The screenshot shows the ASUS RT-AX86U router's configuration interface. At the top, it displays "Operation Mode: Wireless router" and "Firmware Version: 3.0.0.4.388_22525". The SSID is set to "asus_ax_24 asus_ax". The navigation bar includes links for "Quick Internet Setup", "General", "Network Map", and "AiMesh". On the left, a sidebar lists "VPN", "Firewall", "Administration", "System Log", and "Network Tools". The main content area is titled "Wireless - Professional" and contains a sub-section about wireless professional settings. A dropdown menu for "OFDMA/802.11ax MU-MIMO" is open, showing options: "DL OFDMA only" (selected), "Disable", "DL/UL OFDMA", and "DL/UL OFDMA + MU-MIMO". Below this, there are sections for "802.11ax/ac Beamforming", "Universal Beamforming", and "Tx power adjustment" (set to "Performance"). A large "Apply" button is at the bottom right.

Level of control = ON/OFF

OPTIMIZATION&CUSTOMIZATION

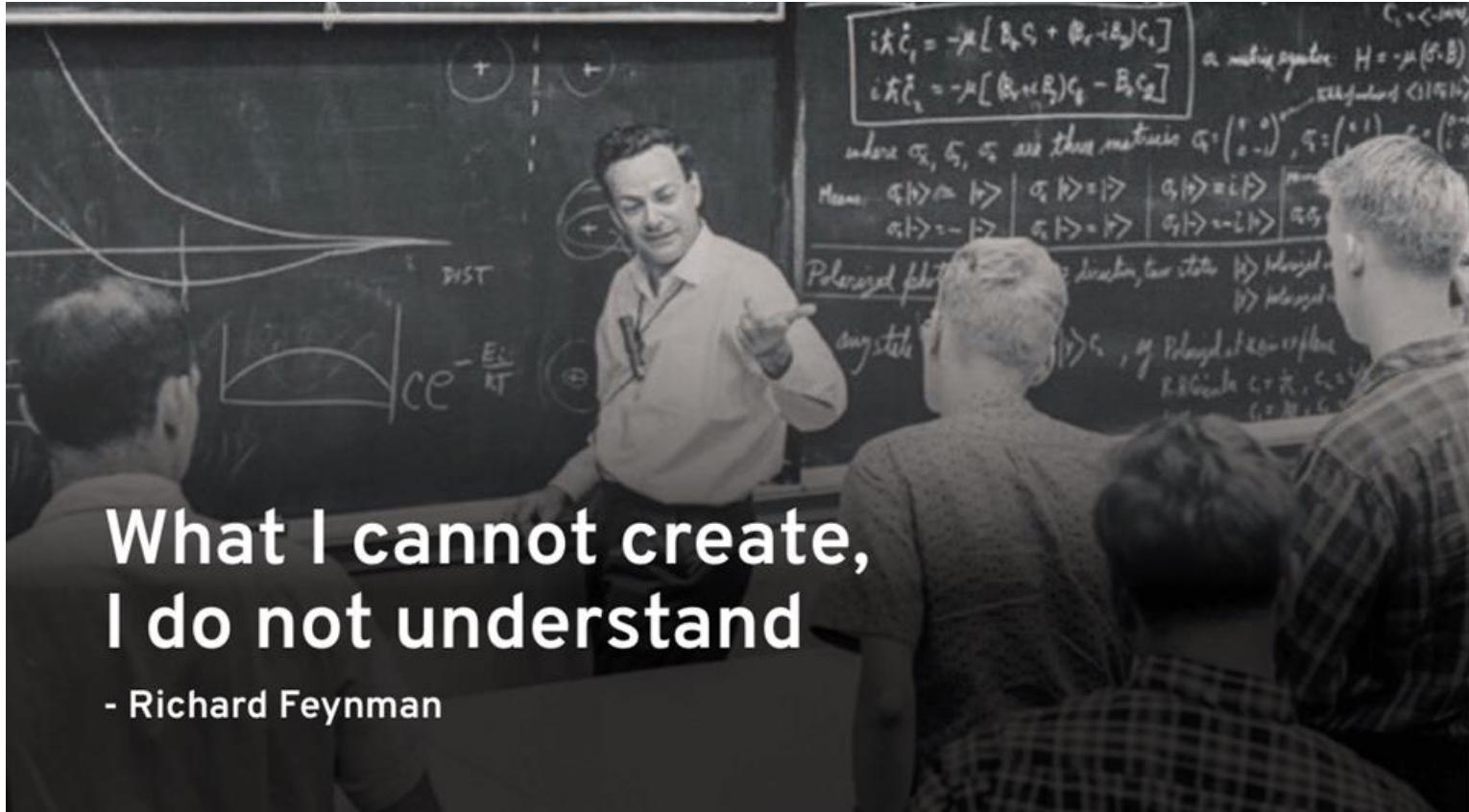
Optimization&Customization

The open-source Wi-Fi will enable optimization and customization for special use cases.

Education&Research

Open-source project is always the most popular option in this domain!

EDUCATION&RESEARCH



What I cannot create,
I do not understand

- Richard Feynman

EDUCATION&RESEARCH

<https://openairinterface.org/>



<https://oibox.allbesmart.pt/>

Portugal



4G/5G/6G research

<https://www.telecomreview.com/articles/wholesale-and-capacity/4466-five-e-uk-5g-projects-to-use-open-ran-technology>



<https://www.srsran.com/>



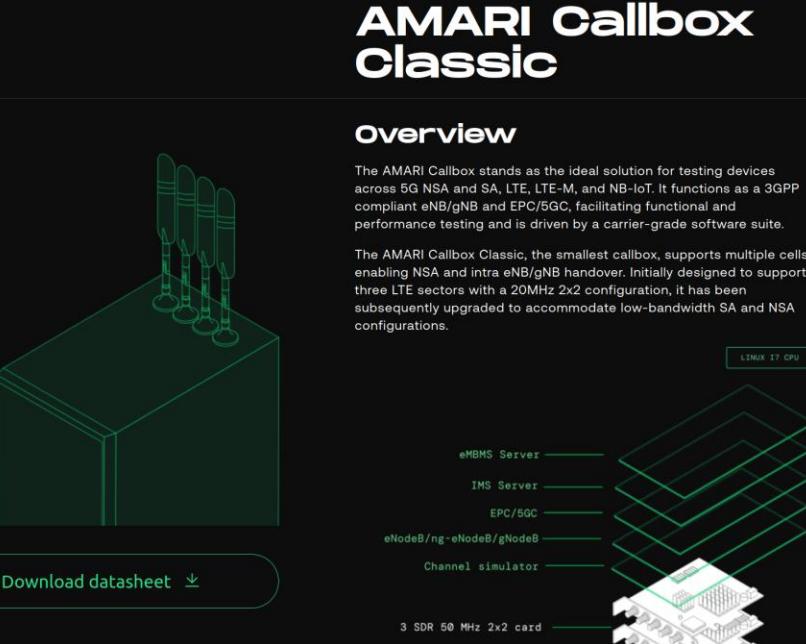
Ireland/Spain

EDUCATION&RESEARCH

4G/5G/6G research Software centric

<https://www.amarisoft.com/>

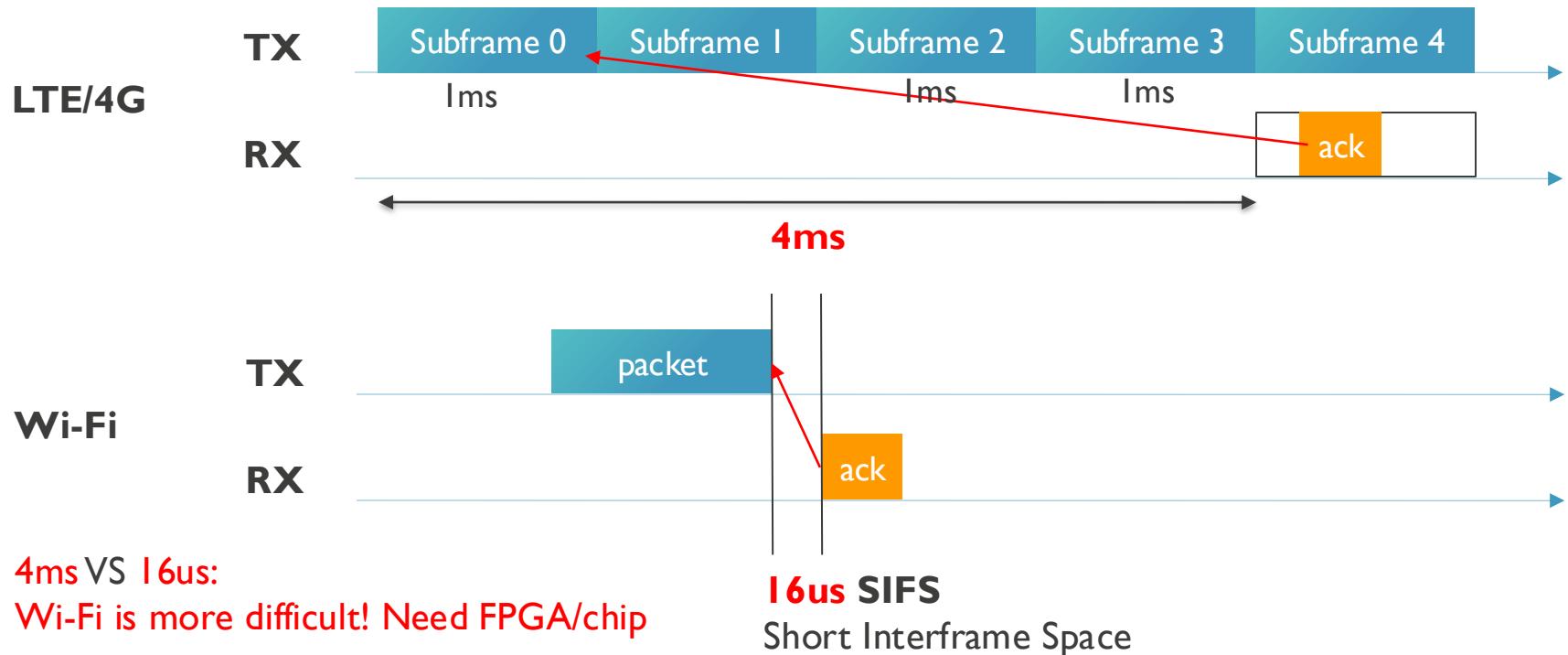
Why can't we do software based Wi-Fi?



The screenshot shows the AMARI Callbox Classic product page. It features a large image of the device, which is a dark rectangular box with four antennas extending from its top. Below the image is a green button labeled "Download datasheet". To the right of the image, the text "AMARI Callbox Classic" is displayed in bold white letters. Underneath, a section titled "Overview" provides a brief description of the device's capabilities. A detailed diagram on the right illustrates the internal architecture, showing various components stacked vertically: "LINUX IT CPU", "eMBMS Server", "IMS Server", "EPC/5GC", "eNodeB/ng-eNodeB/gNodeB", "Channel simulator", and "3 SDR 50 MHz 2x2 card".



EDUCATION&RESEARCH



Education&Research

There is a missing puzzle: Wi-Fi!

WHAT, **WHY,** **HOW**

OPENWIFI

THE WORLD'S 1ST FREE AND OPEN WIFI DESIGN



<https://github.com/open-sdr>

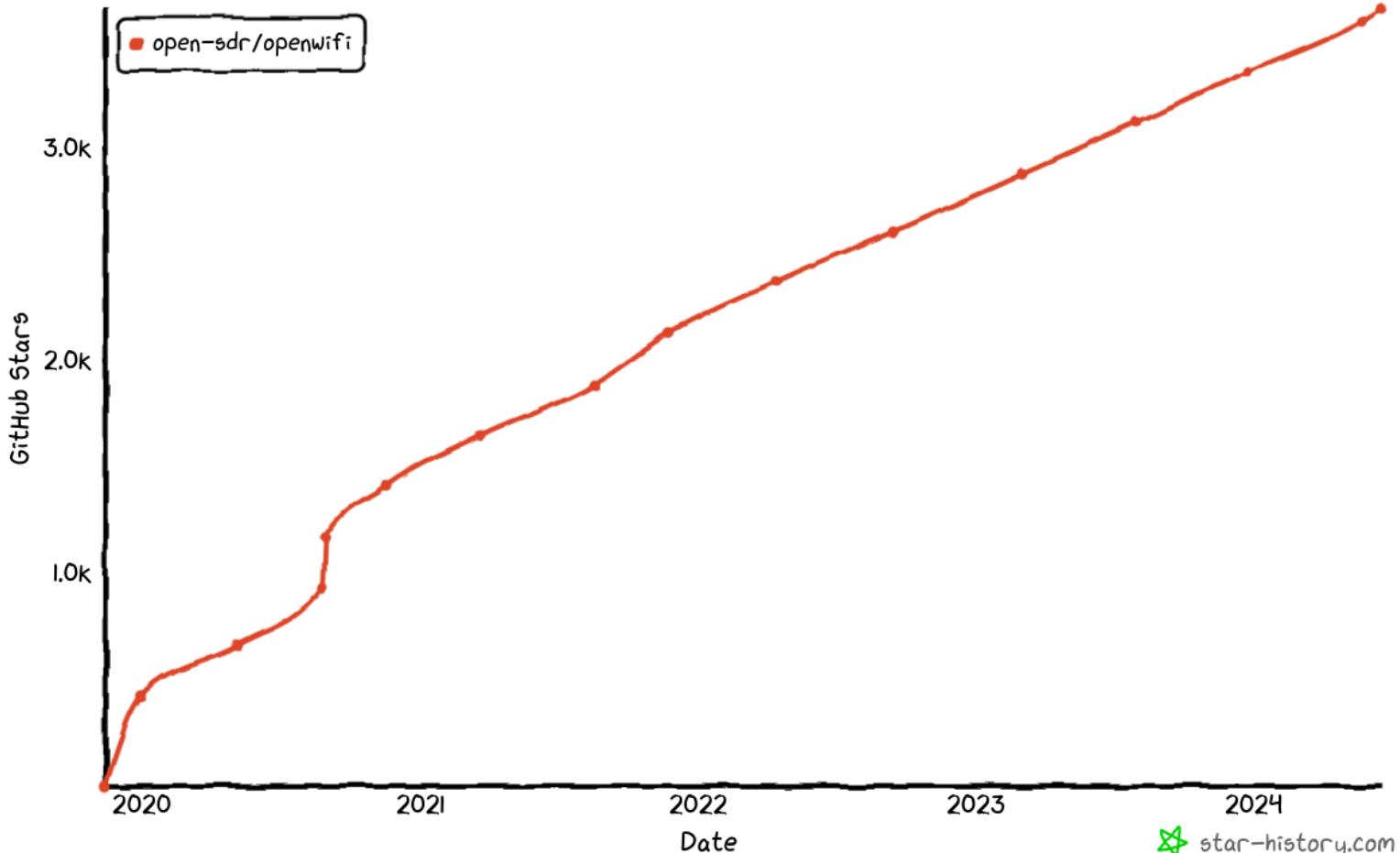
2017 : Started in EU H2020 ORCA project

2019-12: The first release on github

2020-02: The first public show in FOSDEM2020, Brussels



OPENWIFI



OPENWIFI



UGent, CUHK (Honkong), CUHK (Shenzhen), Northeastern university, Buffalo university, Stony Brook university, Michigan State university, Trinity College Dublin, University of Massachusetts, Danang University (Vietnam), Tsinghua University, Nanjing University, Wuhan university, BUPT (China), UST Korea, University of Dortmund, unibs (Italy), Loughborough University, University of Liverpool, University of Navarra, Frankfurt University, etc.

Also industrial companies.

On github (17/06/2024)
SW+HW repositories

- 4.3K stars
- 845 forks
- 171 watch
- 389 issues discussed

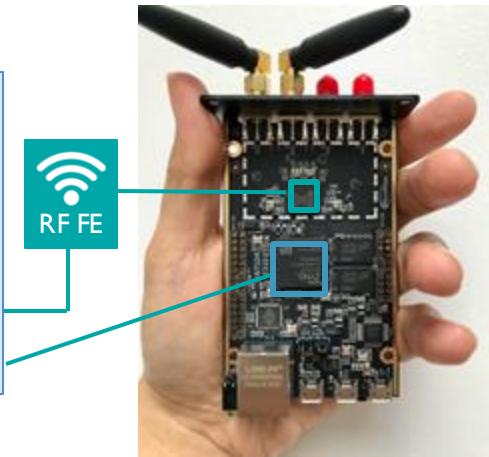
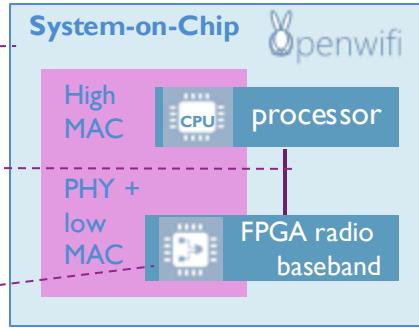
Rank 3 of Verilog topic on github:
<https://github.com/topics/verilog>

OPENWIFI

Single chip, combining radio/network/application processing

High-speed dedicated on-chip Tx/Rx bus for low latency: ping RTT < 300µs (vs 1ms in COTS Wi-Fi)

Reprogrammable hardware (unlike ASIC)



Basic features

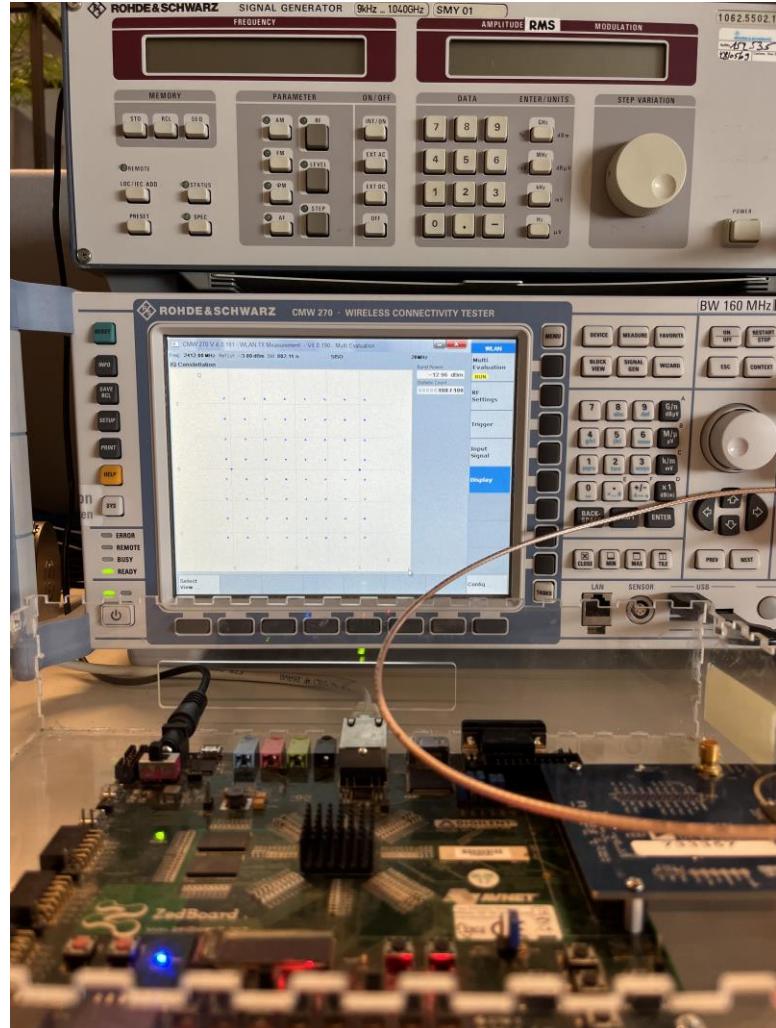
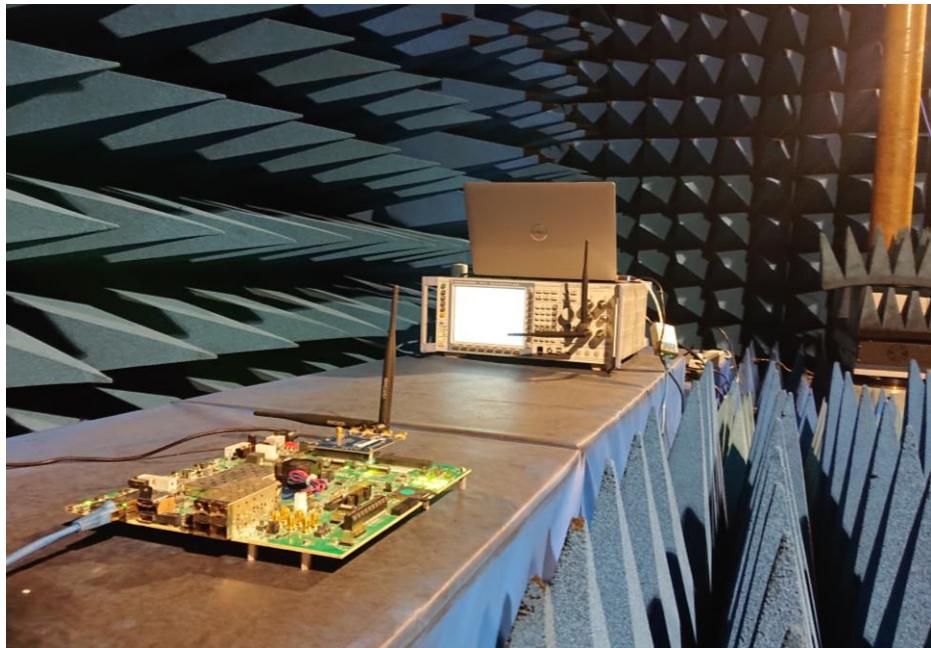
- IEEE 802.11a/g/n @ 20MHz
- 70MHz~6GHz (Partial 6E band)
- Linux mac80211 compatible mode:
 - Ad-hoc, AP, Station, Monitor
- Aggregation (A-MPDU)
- Sensitivity: -73dBm (MCS7), -92dBm (MCS0)
- EVM: -38dB
- Dynamic FPGA/driver reloading in seconds

lin -- nlnet

Work in progress

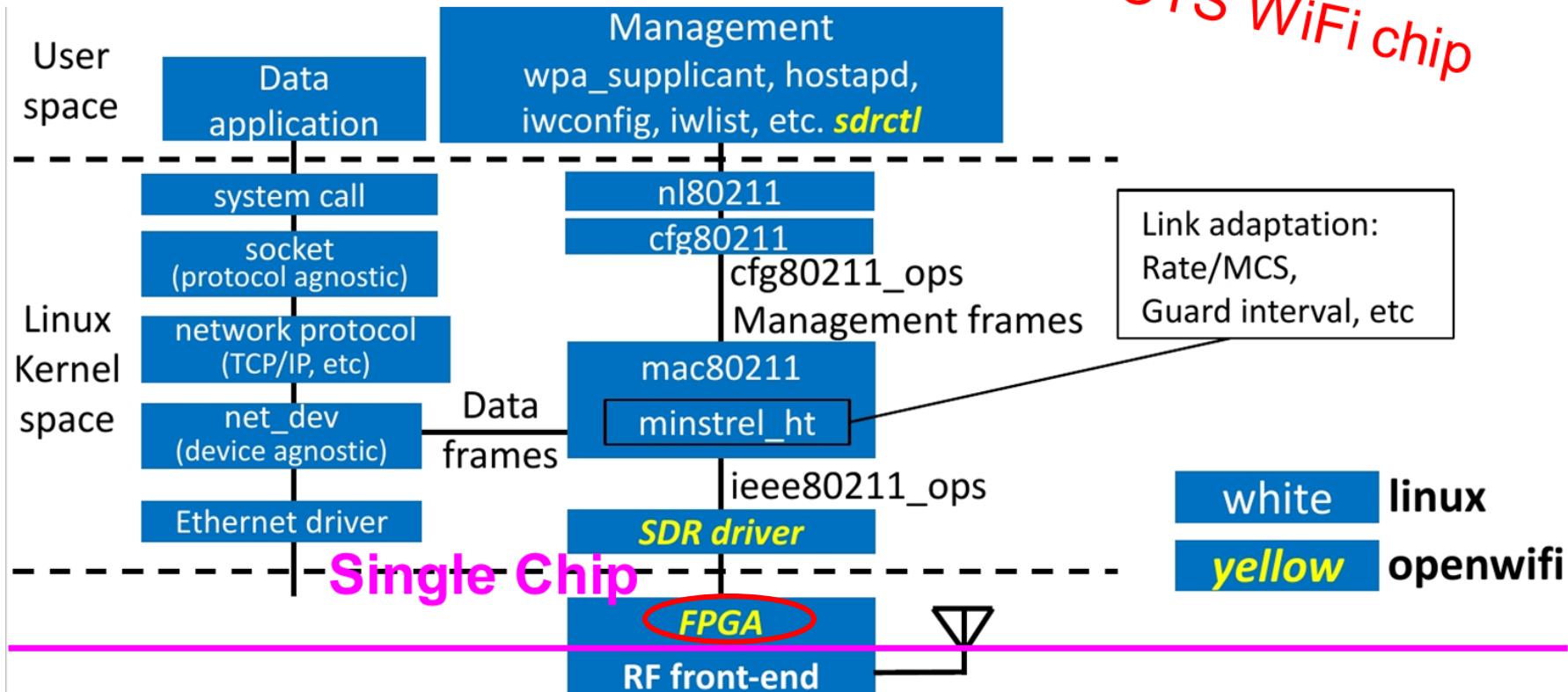
- IEEE 802.11ax (Wi-Fi 6) OFDMA
- Advanced PHY for multi-path environments
- Etc.

OPENWIFI

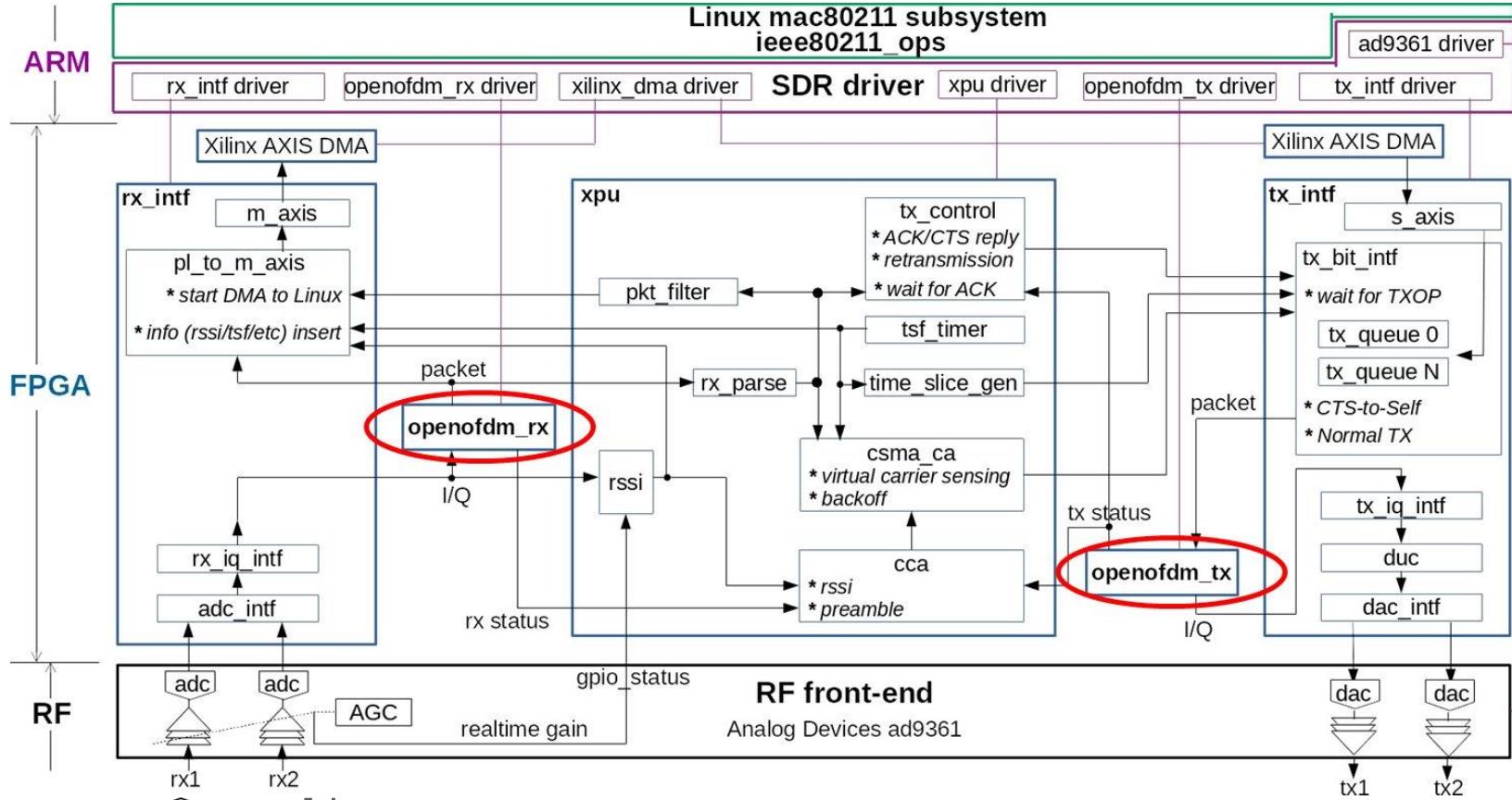


OPENWIFI: INSIDE

*Same way as
COTS WiFi chip*

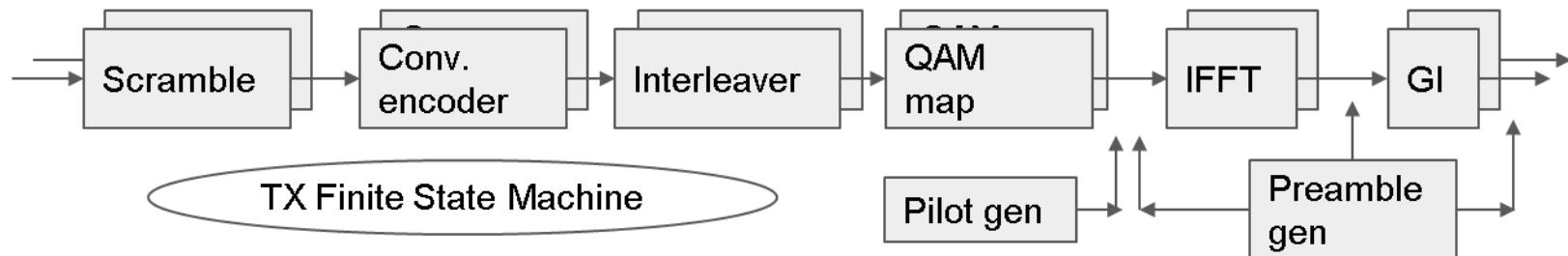


OPENWIFI: INSIDE

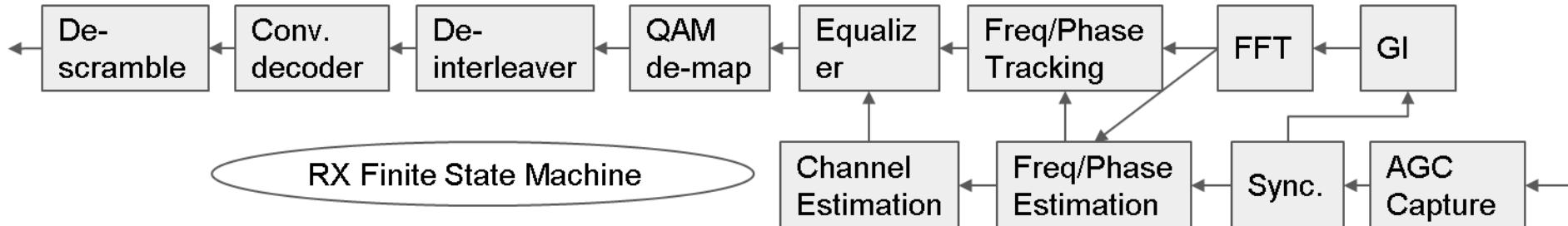


OPENWIFI: INSIDE

WiFi OFDM modulator (FPGA verilog)

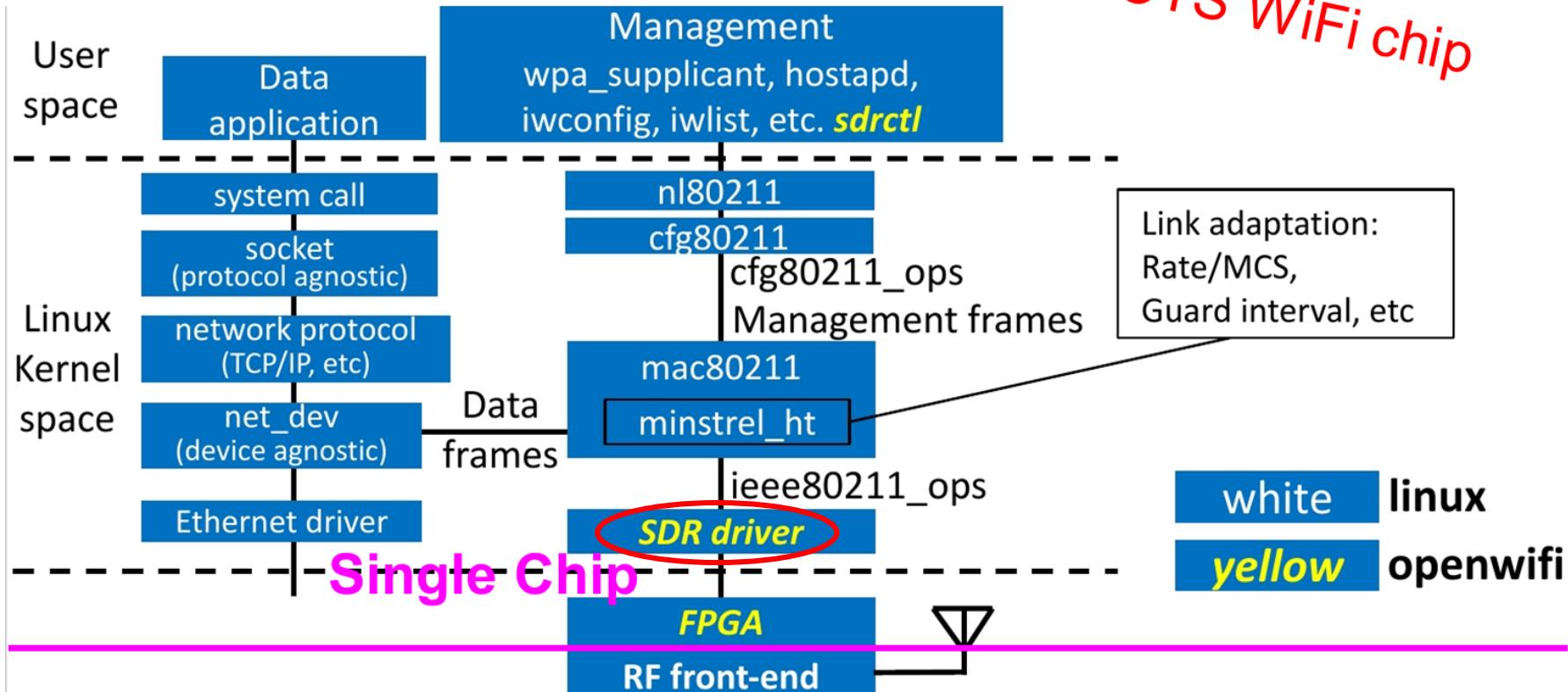


WiFi OFDM demodulator (FPGA verilog) – improved version of [openofdm](#)



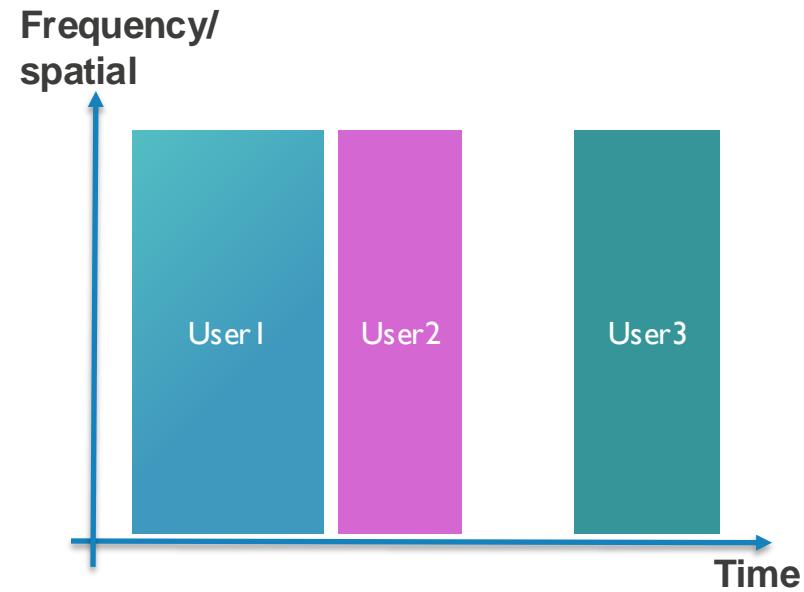
OPENWIFI: INSIDE

*Same way as
COTS WiFi chip*

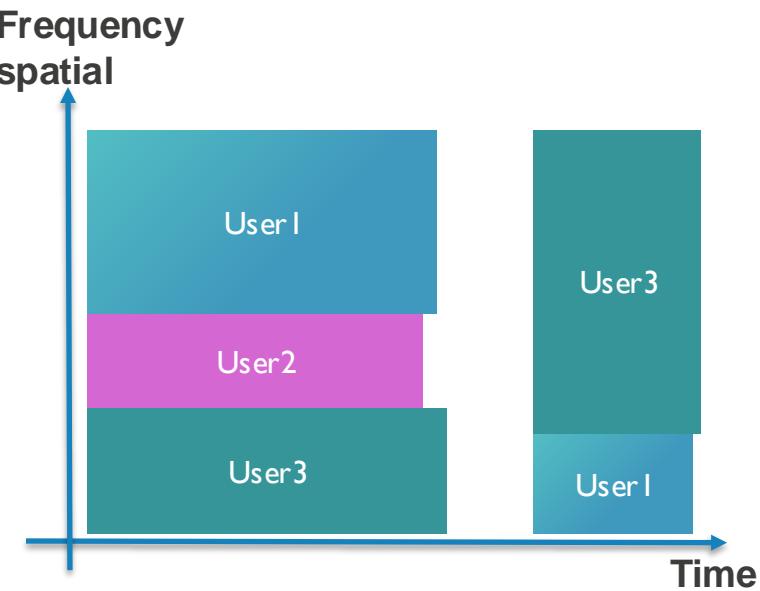


OPENWIFI: INSIDE

soft-MAC: Scheduler in driver is more complex from Wi-Fi5



Before Wi-Fi5



Wi-Fi5/6/7/8...

full-MAC: The real-time user packet
scheduling/composition is baked into the chip

OPENWIFI – WORK WITH HARDWARE MAKER

Check out all boards we support: <https://github.com/open-sdr/openwifi>

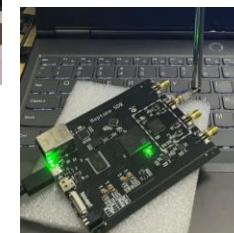
4300ERUO



330USD

Disruptive!

330usd with fully open Wi-Fi
Stack in your hand!



<https://www.crowdsupply.com/micropahse-technology/antsdr-e200>

OPENWIFI -- SECURITY RESEARCH

- **Wi-Fi security research tooling from the community**
 - WiSec23: Testing and Improving the Correctness of Wi-Fi Frame Injection
 - <https://papers.mathyvanhoef.com/wisec2023-wifi-injection.pdf>
 - **owfuzz**: a WiFi protocol fuzzing tool using openwifi
 - <https://github.com/alipay/Owfuzz>
 - [CVE-2021-34173](#)
 - [CVE-2021-34174](#)
 - [CVE-2021-1903](#)
 - [CVE-2021-30310](#)
 - [CVE-2021-33028](#)
 - [CVE-2021-33029](#)
 - [CVE-2022-34744](#)
 - [CVE-2022-34745](#)
- **Pain points of commercial chips for security research**
 - Off the market (End of Life)
 - Firmware update
 - Driver update
 - New chips (More and more close)



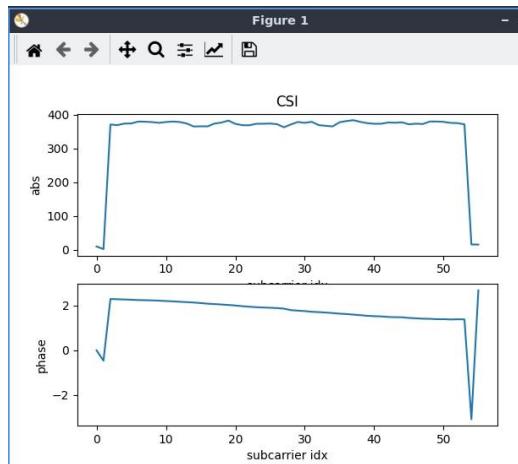
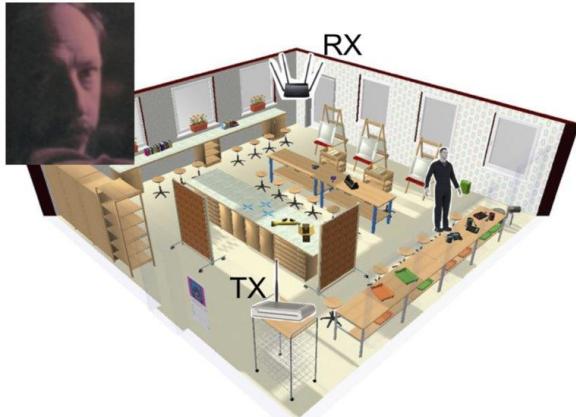
by @vanhoefm of KU Leuven / NYU Abu Dhabi

Key Reinstallation Attacks
Breaking WPA2 by forcing nonce reuse
Discovered by Mathy Vanhoef of imec-DistriNet, KU Leuven, 2017

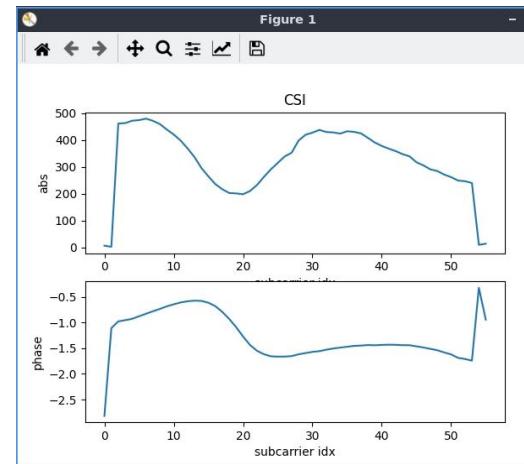
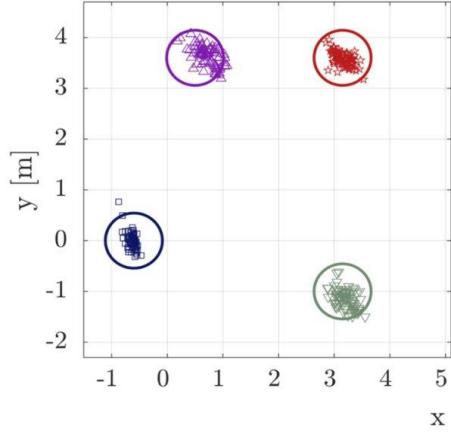
OPENWIFI -- PROTECT PRIVACY

WiSec21:

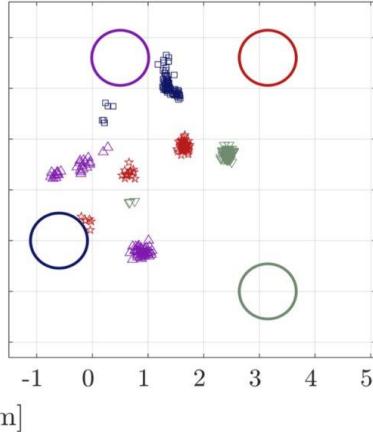
<https://dl.acm.org/doi/abs/10.1145/3448300.3468255>



Without randomization



With randomization



OPENWIFI – HELP CUSTOMIZATION

- ✓ In order to change SAMPLE_RATE from 20 to 40MHz what items would need to be changed in the database ?

#155 by chs9996 was closed on May 6, 2022

- ⌚ Modifying the bandwidth can impact the stability of work

#399 opened on Apr 7 by huangfu001206

- ⌚ Where do you set AD9361 trx_clock_chain_freq and update_rf_bandwidth

#34 by frestuc was closed on Oct 6, 2020

- ⌚ File Transfer Issue after Reducing Bandwidth to 2.5MHz on E310V2 Board

#358 by huangfu001206 was closed on Dec 30, 2023

- ⌚ How to change the bandwidth?

#370 opened on Nov 24, 2023 by chshux

- ⌚ Can OpenWiFi work properly with a 2 Mbps bandwidth?

#325 by huangfu001206 was closed on Sep 28, 2023

- ⌚ Differences between sub1g and openwifi modulation modes

#376 opened on Nov 28, 2023 by s-zhen66

- ⌚ How to operate in 802.11ah mode

#132 by TinYOneGit was closed on Feb 22, 2022

- ⌚ How to switch 802.11p mode?

#378 opened on Dec 2, 2023 by Denisfk1985

-  How to change bandwidth?

AnVuNam asked on May 16 in Q&A · Unanswered

- ⌚ enable 802.11p

#394 opened on Mar 8 by nits-skydeploy

- ⌚ How to modify RX/TX bandwidth under current modulation method

#85 by dz6242 was closed on Jul 21, 2021

OPENWIFI -- EDUCATION&RESEARCH

THE FIRST CHOICE OF WIFI SYSTEM EXPERIMENTAL RESEARCH

<https://github.com/open-sdr/openwifi/blob/master/doc/publications.md>

- Top journal: ptp
 - Muhammad Aslam, et al. Hardware Efficient Clock Synchronization across Wi-Fi and Ethernet Based Network Using PTP. IEEE Transactions on Industrial Informatics 2021
- Best paper: Traffic gen
 - INFOCOM 2022. ChARM: NextG Spectrum Sharing Through Data-Driven Real-Time O-RAN Dynamic Control -- **North eastern university**
- Top conf: Real-time
 - Zelin Yun, et al. RT-WiFi on Software-Defined Radio: Design and Implementation. accepted RTAS2022 paper and demo -- **University of Connecticut and Texas at Austin**
 - Thijs Havinga, et al. Improved TDD operation on Software-Defined Radio platforms towards future wireless standards. Computer Communications, Volume 209, 1 September 2023
 - Yuyang Du, et al. The Power of **Large Language Models** for Wireless Communication System Development: A Case Study on FPGA Platforms. arxiv, Submitted on 14 Jul 2023 -- **The Chinese University of HongKong**
 - Christian Arendt, et al. Empowering the Convergence of **Wi-Fi and 5G** for Future Private 6G Networks. Accepted by European Wireless 2023; 28th European Wireless Conference 2023 **TU Dortmund**

OPENWIFI -- EDUCATION&RESEARCH

THE FIRST CHOICE OF WIFI SYSTEM EXPERIMENTAL RESEARCH

<https://github.com/open-sdr/openwifi/blob/master/doc/publications.md>

CSI &
Anti sensing

- Marco Cominelli, et al. IEEE 802.11 CSI randomization to preserve location privacy: An empirical evaluation in different scenarios. ELSEVIER Computer Networks, 2021 -- **Italy unibis**
- Xianjun Jiao, et al. Openwifi CSI fuzzer for authorized sensing and covert channels. ACM WiSec 2021
- MethodsX. A novel method for utilizing RF information from IEEE 802.11 frames in Software Defined Networks **RMIT Australia**
- Wen Liu, et al. A New Paradigm for Device-free Indoor Localization: Deep Learning with Error Vector Spectrum in Wi-Fi Systems. arxiv 2023 – **NYCU Taiwan**
- Seppe Dejonckheere, The design of a CSI sensing authorisation mechanism using the open source Openwifi project. UGnet master thesis 2022

Security

- Hongjian Cao, et al. OWFuzz: WiFi Protocol Fuzzing Tool Based on OpenWiFi. **Blackhat asia 2021**
- Mathy Vanhoef, et al. Testing and Improving the Correctness of Wi-Fi Frame Injection. ACM WiSec 2023 **KU Leuven**
- Steven Heijse, IEEE 802.11 Physical Layer Fuzzing Using OpenWifi. UGent master thesis 2021
- Jasper Devreker, Developing IEEE 802.11 PHY fuzzing capabilities using the open source Openwifi project. UGent master thesis 2022. <https://esp32-open-mac.be/>
- Thomas Schuddinck, Cybersecurity: Breaking IEEE 802.11 Devices at the Physical Layer. UGent master thesis 2022

WHAT, WHY, HOW



Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments if it is not listed)

Reinventing the wheel 17.6%

Can't compete big company 47.1%

Can't try as easy as FOSS 23.5%

Insecure:BadGuy see code 11.8%

17 votes • Final results



Open-source Wi-Fi chip is pointless. I need your toughest criticism! Why open-source Wi-Fi chip is not a good idea: (Leave your comments)

You can see how people vote. [Learn more](#)

Reinventing the wheel ✓ 13%

Can't compete big company ✓ 53%

Can't try as easy as FOSS ✓ 10%

Insecure: bad guy see the code ✓ 23%

[30 votes](#) • 6d left • [Hide results](#)

REINVENTING THE WHEEL

NO two leaves wheels are ever *exactly* alike

---**Gottfried Leibniz**

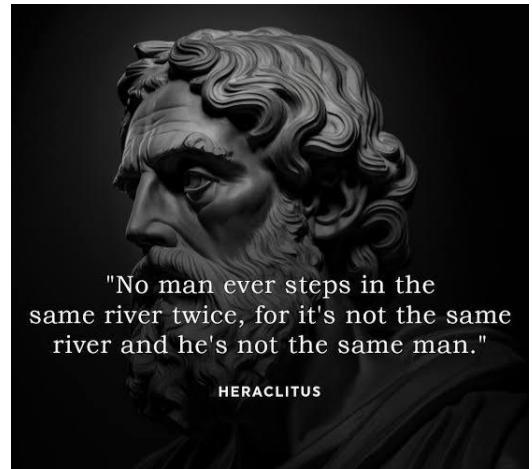
<https://iep.utm.edu/leib-met/>



No man ever *steps* designs in the same *river* wheel twice

---**Heraclitus**

https://www.reddit.com/r/QuotesPorn/comments/l6kbty/no_man_ever_steps_in_the_same_river_twice_for_its/#lightbox



BIG COMPANIES

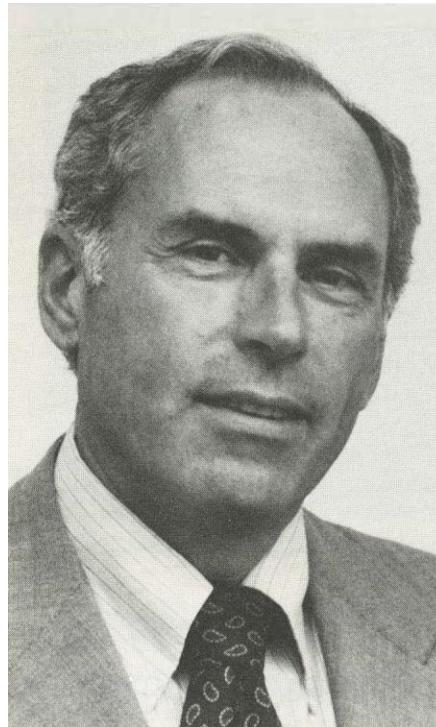
- Big companies started from small project.
- Only tiny group of people are doing new things in the big companies.
- Before Linux, GCC, Raspberry Pi, etc., there were already big companies running big business in those domains.
- Unix was born in 1969. After 22 years, 1991 Linux came into the world.
- The 1st IEEE 802.11 was released in 1997. After 22 years, 2019 openwifi came.

BIG COMPANIES

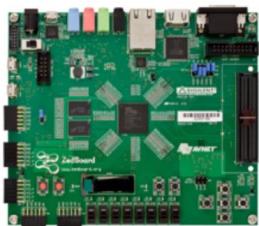
- Competing with big companies should not be the focus at the beginning.
- The current COTS Wi-Fi are good, and we should (have to) use daily. Meanwhile it should not stop us to make Wi-Fi in a way we like
 - More secure
 - Protect privacy better
 - More open for:
 - Tuning/customization: different frequency/bandwidth/waveform, lower latency, higher reliability, etc.
 - Research
 - Education
- Make it **LOOOOONG** run

BIG COMPANIES

We tend to **overestimate** the effect of a technology in the short run and **underestimate** the effect in the long run.



MAKE IT CHEAP!



330USD

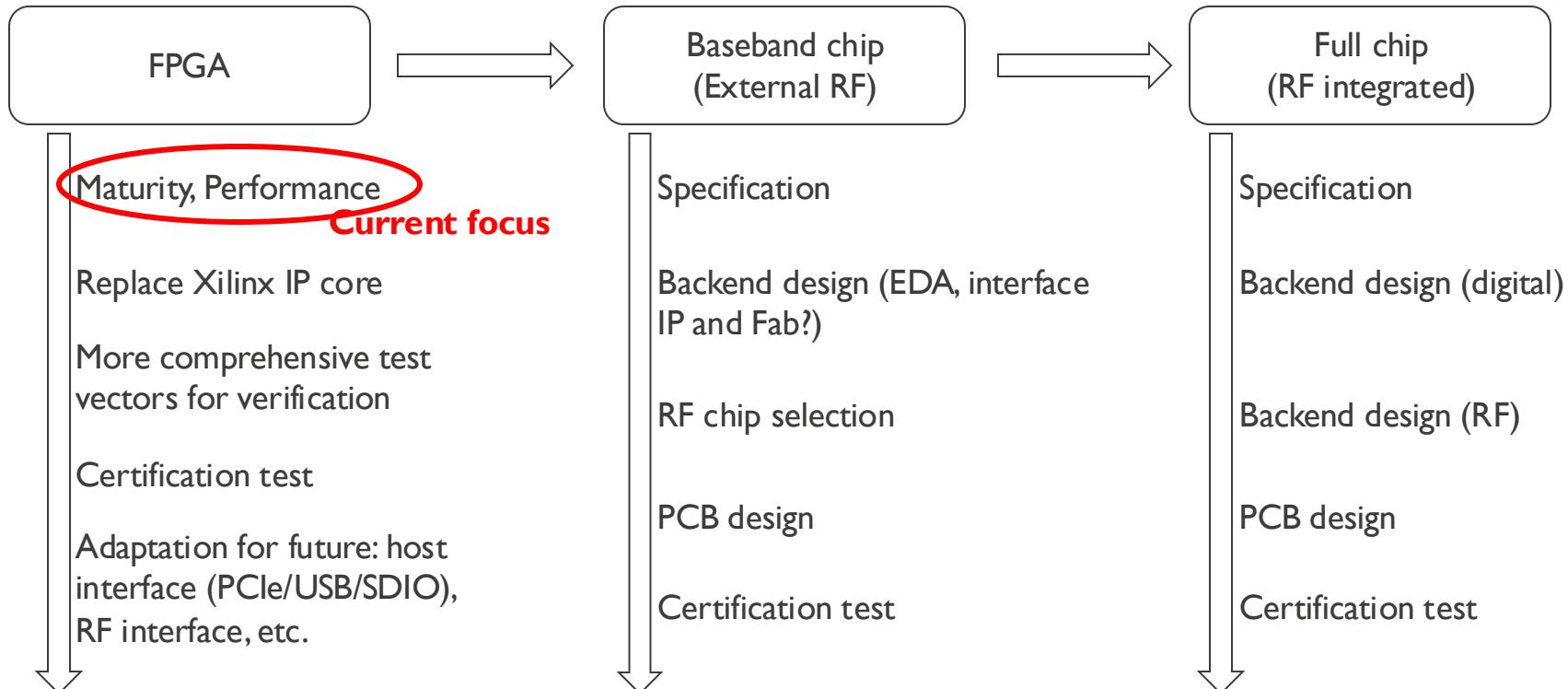
<https://www.crowdsupply.com/micropulse-technology/antsdr-e200>

Leap of faith



A real chip.

MAKE IT STEP BY STEP



OPTIMIZATION&CUSTOMIZATION

We need

A low cost open-source Wi-Fi chip that captures common requests:
Security, Privacy protection, more knobs open for tuning: bandwidth, frequency,
PHY&MAC parameter real-time configure and control, etc.

An entity that captures common interest of open-source Wi-Fi chip and
attracts continuous funding
(There is already a **role model** in 4G/5G/6G domain)

ROLE MODEL:

About the OpenAirInterface Software Alliance

Established in 2014, the OSA is a French non-profit organization ("Fonds De Dotation"), funded by corporate sponsors.

Our board comprises the representatives from Strategic Members of the Alliance.

The OSA is the home of OpenAirInterface, an open software that gathers a community of developers from around the world, who work together to build wireless cellular Radio Access Network (RAN) and Core Network (CN) technologies.

The Alliance is responsible for :

- the development roadmap,
- the quality control,
- the promotion of the OAI software packages, deployed by our academic and industrial community for varied use-cases.

The Alliance's mission is to facilitate OpenAirInterface adoption.



<https://github.com/open-sdr/openwifi>



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