Xilokar & Virtu

present

FUN with Watches

LeHACK 2025

Quarkslab

/WHO

Xilokar

- Embedded Software engineer
- Hobbyist reverser

Virtu

- Reverse-engineer at Quarkslab
- Love hacking stuff !
- Spend too much time (and money) on *AliExpress* and *Amazon* ...

IT ALL STARTS WITH ... A SMARTWATCH

- CAPTN OBVIOUS WAS HERE -

Opération 2 +1 offert sur les articles signalés ▸Voir conditions◂

GiFi

Qu'est-ce qui vous ferait plaisir aujourd'hui ?

GiFi Mon compte Panier

Plein air Jardin & Extérieur Offres du moment Nos produits Nos petits prix Nos nouveautés Nos cata

Indiquez votre magasin préféré pour voir la disponibilité des produits

Code postal ou ville

Vendu par GiFi

Montre connectée Homday Xpert bluetooth étanche écran tactile 1,83"

11€90

Dont 0,1€ d'éco-part

Caractéristiques du produit

- Compatibilité : **android/IOS**
- Dimensions cadran : **3,5 x 4 cm**
- Écran : **1,83 pouces**
- Entrée : **5V [DC] 0,2A**
- Batterie : **3,7V [DC] 200mAh**
- Matière(s) : **plastique ABS, alliage de zinc, silicone**

Description du produit

Découvrez la montre connectée Homday Xpert, un compagnon idéal pour un mode de vie actif et connecté !
Avec son écran tactile de 1,83 pouces, cette montre vous offre une interface intuitive et facile à naviguer.
Sa conception étanche vous permet de la porter sans souci lors de vos activités quotidiennes, qu'il pleuve ou que vous soyez en pleine séance d'entraînement. Grâce à

LOOKS AWESOME !

Description du produit

Découvrez la montre connectée Homday Xpert, un compagnon idéal pou
Avec son écran tactile de 1,83 pouces, cette montre vous offre une interfa
Sa conception étanche vous permet de la porter sans souci lors de vos ac
pleine séance d'entraînement. Grâce à sa connectivité Bluetooth, vous po
smartphone pour un suivi précis de vos activités. Restez stylé et connecte

Cet article rentre dans le cadre de la règlementation DEEE. Si vous souhai
magasin GiFi. Cliquez pour plus d'informations, sur les conditions de repri

Voir moins

REF. 0000000000000630391

(EN) Features: Waterproof, health monitoring, Bluetooth

OH, WAIT ...

Source: Underscore, feat. *Stéphane Marty* (a.k.a Deus Ex Silicium)

IS IT ... A SCAM ?

HARDWARE ANALYSIS

THE THING THAT SHOULD NOT BE

WATERPROOF, YOU SAY ?

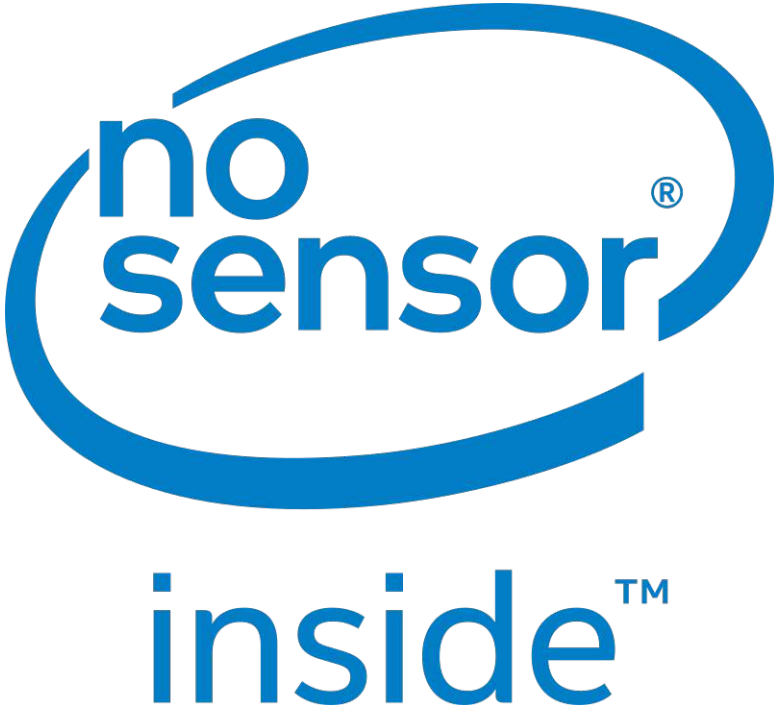
C'mon, no silicon/epoxy, really ?

LOOK AT THESE ~~SENSORS~~ LEDS !

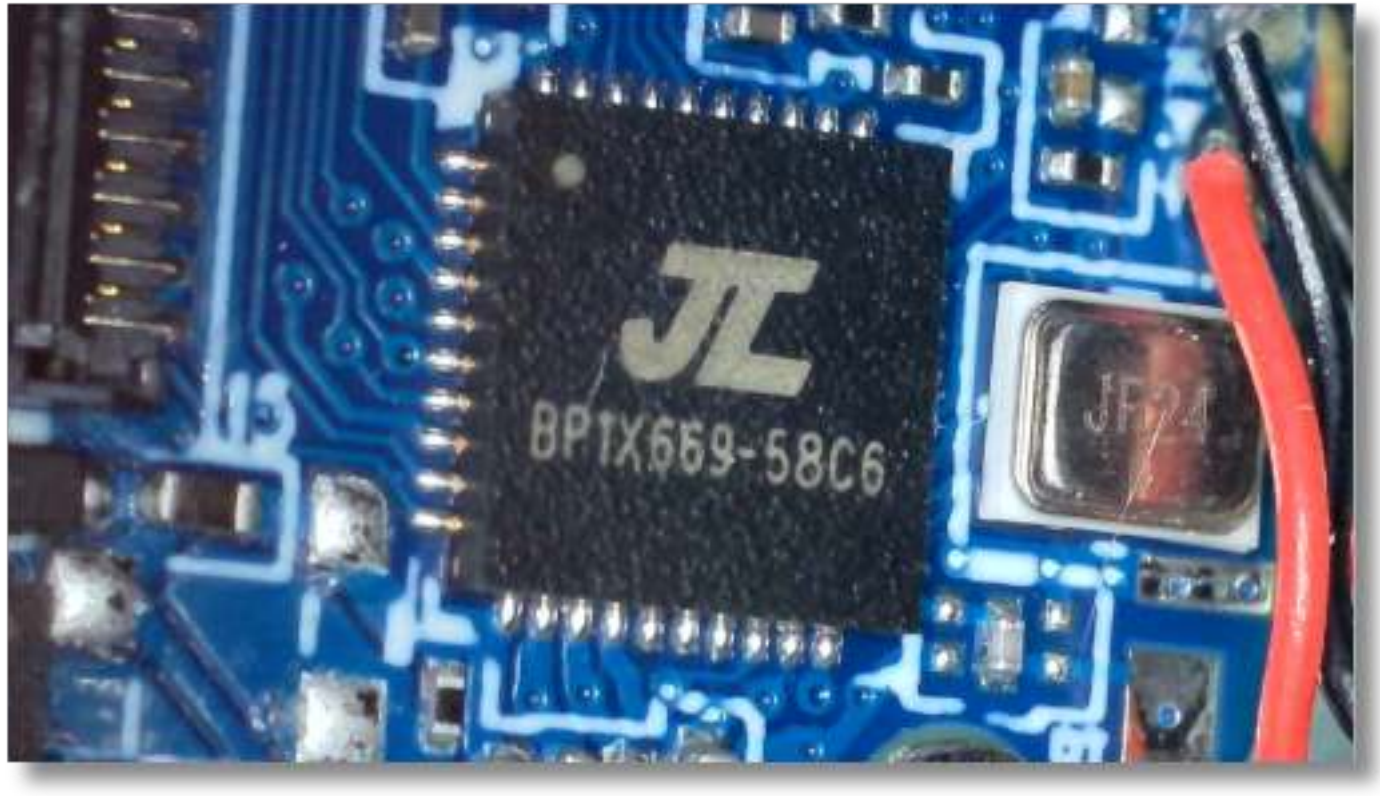
and still no glue/epoxy/silicon ...

LOOK AT THESE ~~SENSORS~~ LEDS !

and still no glue/epoxy/silicon ...


no
sensor®
inside™

WEIRD SYSTEM-ON-CHIP



Is it a **π** ? Is it "JC" ? No, it's "JL" !

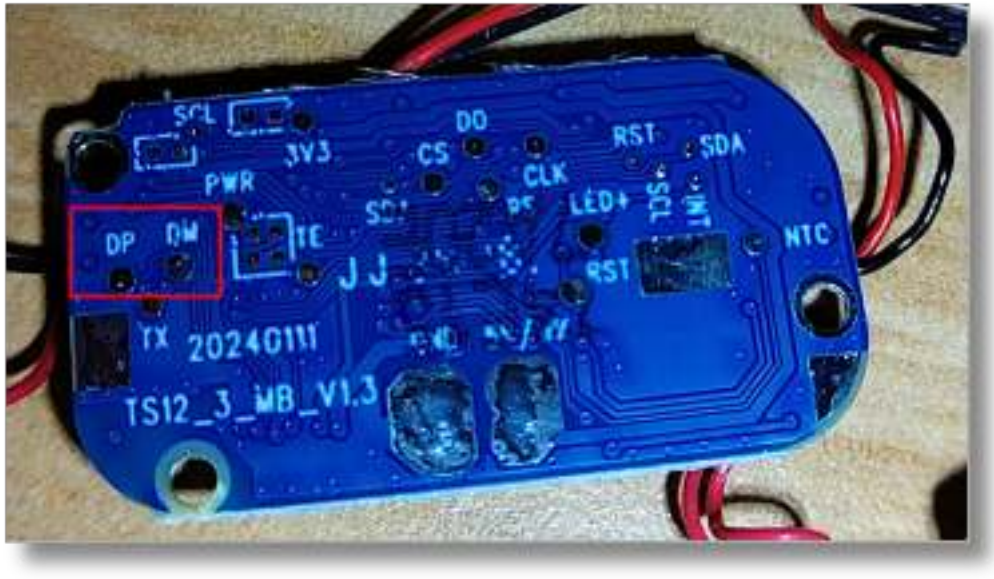
PEOPLE ARE STRUGGLING WITH JL CHIPS

https://github.com/kagaimiq/jielie/

LETS EXTRACT ITS FIRMWARE !

FIRMWARE EXTRACTION / PART #1

USB TEST PADS



- Soldered DM and DP to a USB connector
- Nope.

JIELI PROPRIETARY PROGRAMMER 😡

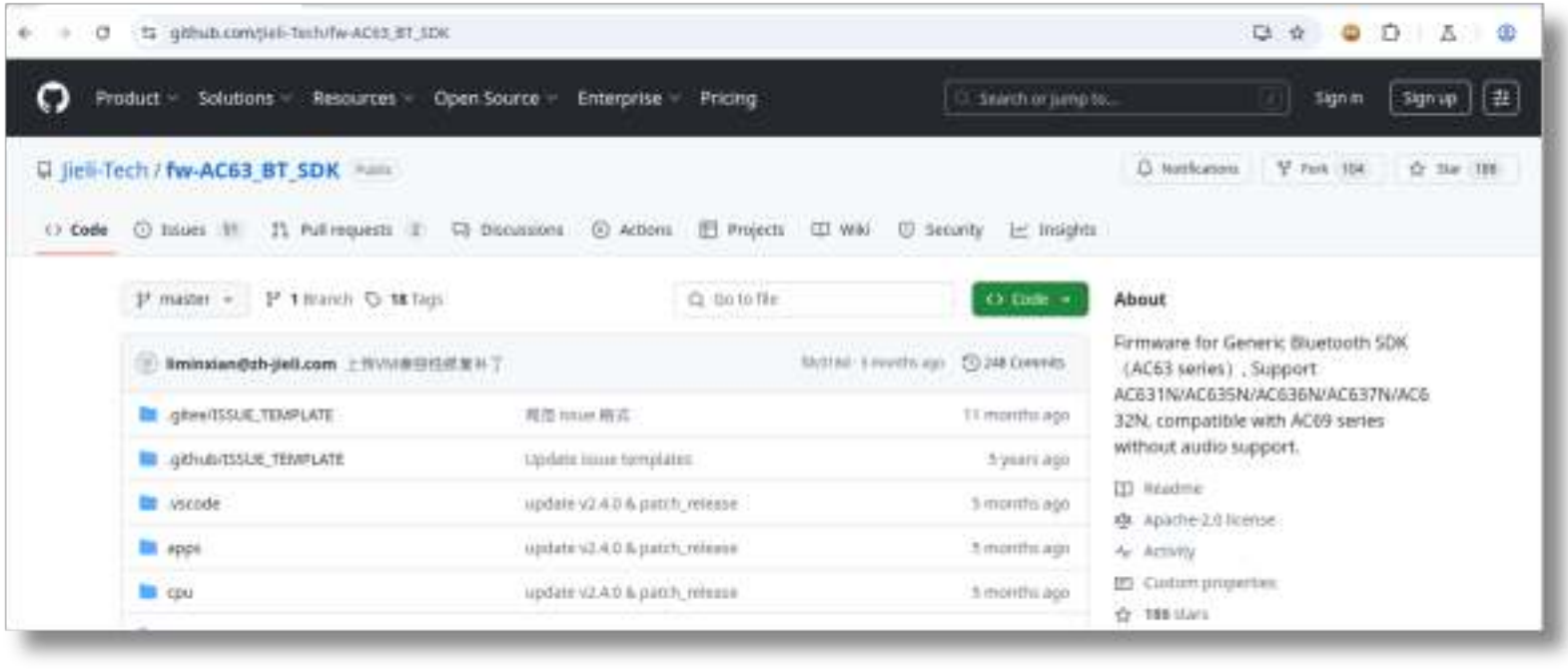
€30, 4 weeks to wait for delivery

```
#define DATA_PIN 8
#define CLOCK_PIN 7

void clockOut(int value) {
    digitalWrite(DATA_PIN, value);
    digitalWrite(CLOCK_PIN, 0);
    delayMicroseconds(7);
    digitalWrite(CLOCK_PIN, 1);
    delayMicroseconds(3);
}

void setup() {
    pinMode(CLOCK_PIN, OUTPUT);
    pinMode(DATA_PIN, OUTPUT);
}

void loop() {
    clockOut(0); clockOut(0); clockOut(0); clockOut(1);
    clockOut(0); clockOut(1); clockOut(1); clockOut(0);
    clockOut(1); clockOut(1); clockOut(1); clockOut(0);
    clockOut(1); clockOut(1); clockOut(1); clockOut(1);

    delayMicroseconds(2);
    digitalWrite(DATA_PIN, 0);
    digitalWrite(CLOCK_PIN, 0);
}
```

Cool hack discovered weeks later 🤦

SEARCHING THE (DEEP) WEB

SDK AVAILABLE ON GITHUB

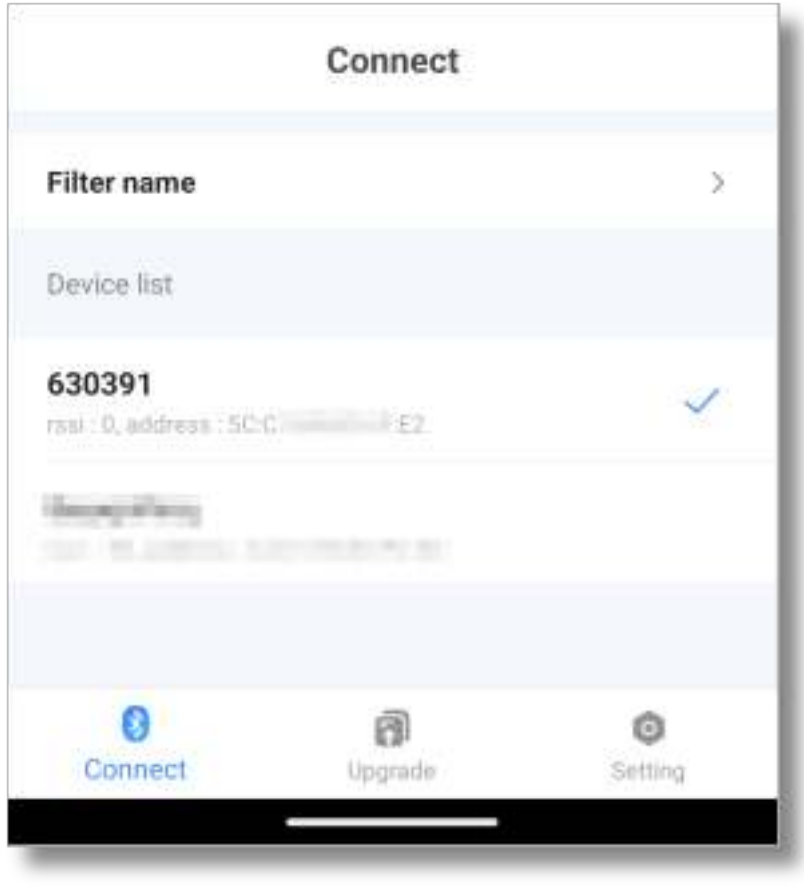


including a working toolchain

GITHUB REPO WITH OTA ?

and there's a release !

A WARRIOR HAS NO FEAR



ANDROID LOGCAT (EXTRACT)

```
> -startAuth- device = name : 630391
> -sendAuthDataToDevice- authData : 00E93EA141E1FC673E017E97EADC6B968F
> -handleAuthData- data : 015B196811ACDC6C1A8F454232D652A9CC
> -sendAuthDataToDevice- authData : 0270617373
> -handleAuthData- data : 00F3F1310CD723FF8290A1F513B7049B3B
> -sendAuthDataToDevice- authData : 01CC1C01B262AEBB4F340F74774FA8A713
> -handleAuthData- data : 0270617373
> -onAuthSuccess- auth ok.
> -handleAuthData- auth ok.
```

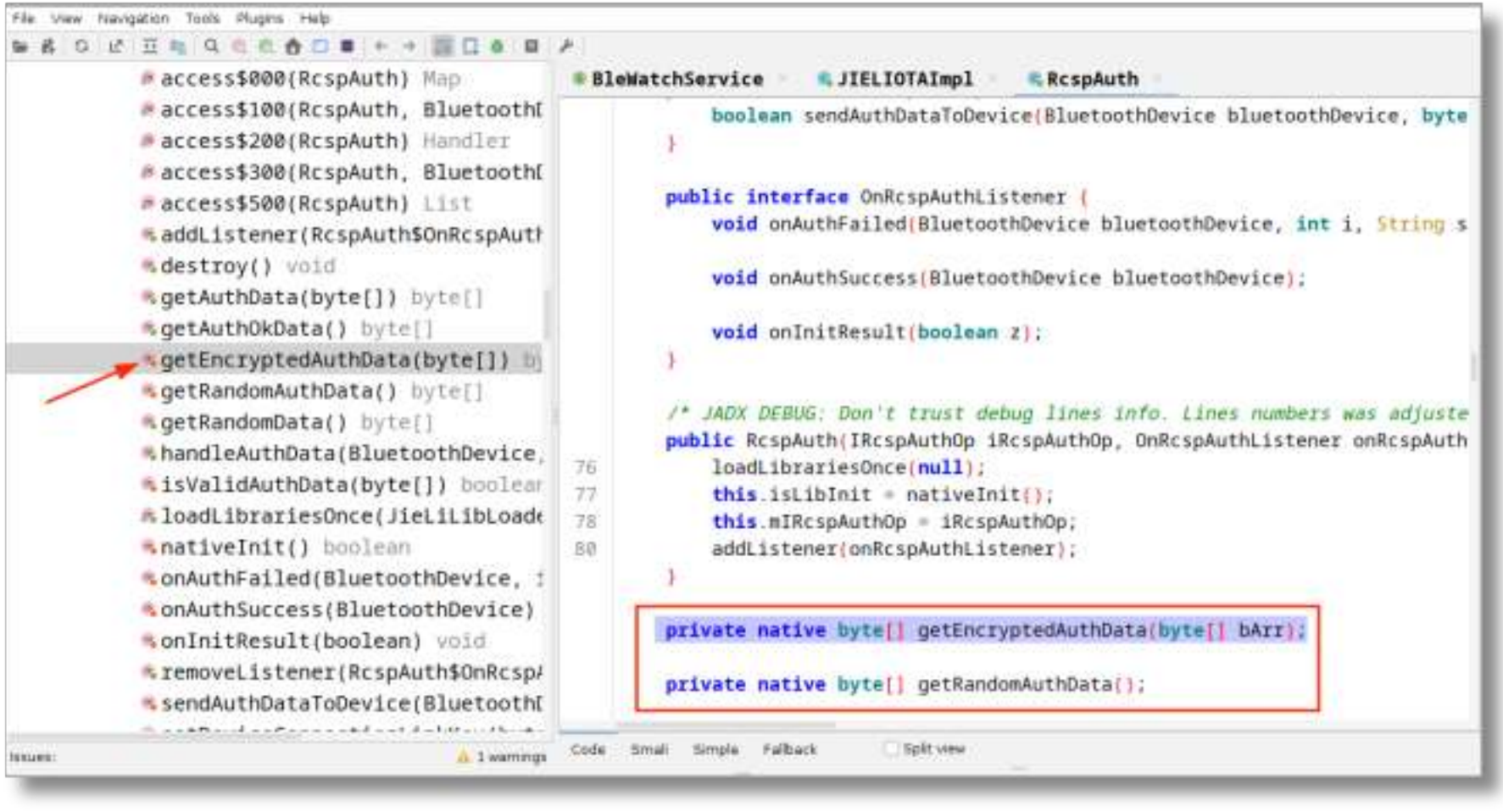
Authentication ongoing ...

ANDROID LOGCAT (CONTD)

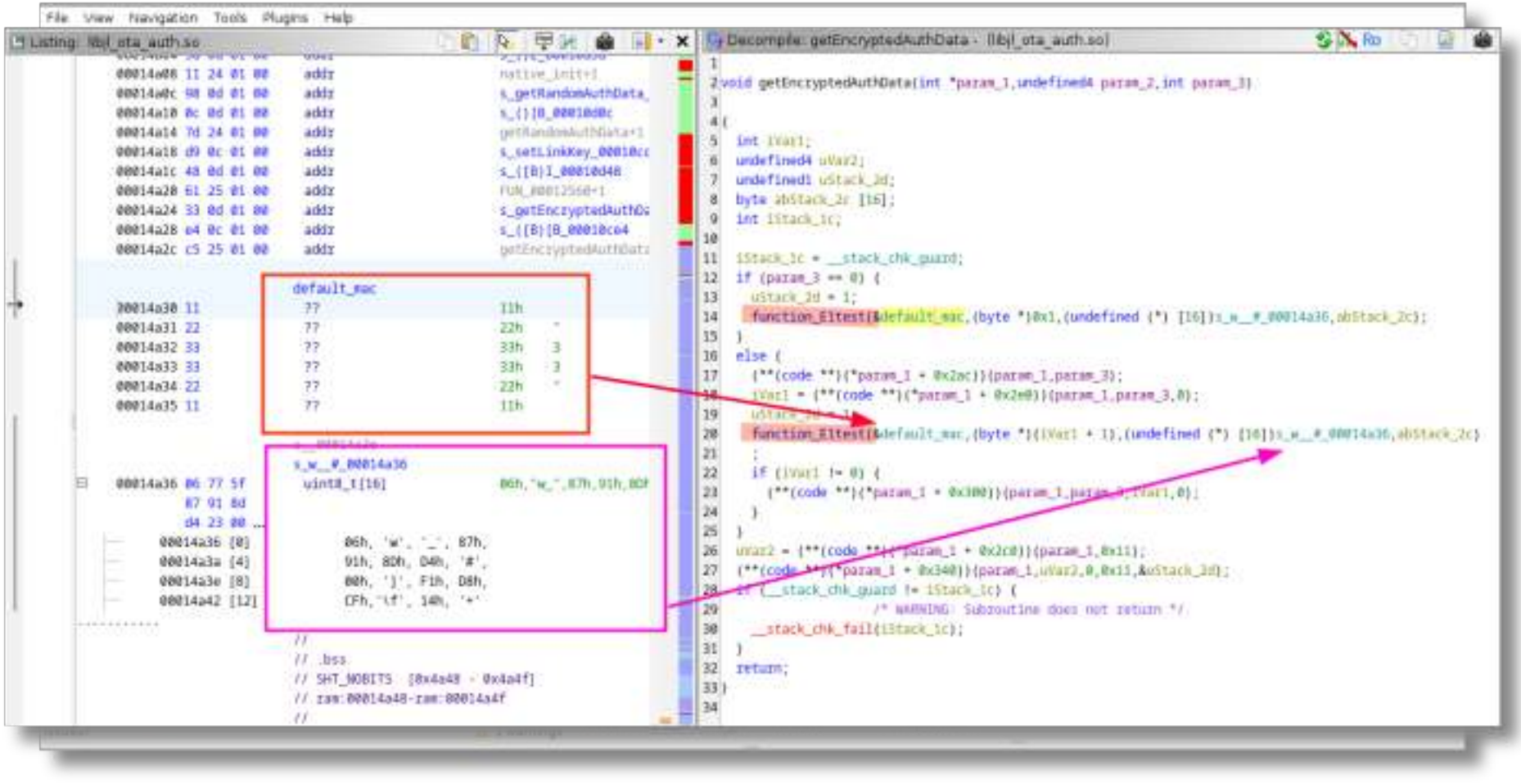
```
D ota:OTAManager: receiveDataFromDevice :: CommandBase{
    OpCodeSn=24, opCode=3, name='GetTargetInfoCmd', type=2, status=0,
    param=GetTargetInfoParam{mask=-1}, response=TargetInfoResponse{
        versionName='V_0.0.0.0', versionCode=0, protocolVersion='V_2.0',
        edrAddr='5C:C1:B9:4F:09:7A', edrStatus=0, edrProfile=-114,
        bleAddr='5C:C1:B9:BC:0F:E2', volume=0, maxVol=0, quantity=100,
        lowPowerLimit=30, functionMask=0, curFunction=0, sdkType=8,
        name='null', pid=95, vid=2, uid=0, mandatoryUpgradeFlag=0,
        requestOtaFlag=0, ubootVersionCode=58396,
        ubootVersionName='14.4.1.12', isSupportDoubleBackup=false,
        isNeedBootLoader=true, singleBackupOtaWay=1, allowConnectFlag=0,
        authKey='null', projectCode='null', customVersionMsg='null',
        bleOnly=false, isSupportMD5=false, isGameMode=false, expandMode=0,
        communicationMtu=540, receiveMtu=272
    }
}
```

UBoot version ? At least it speaks over OTA !

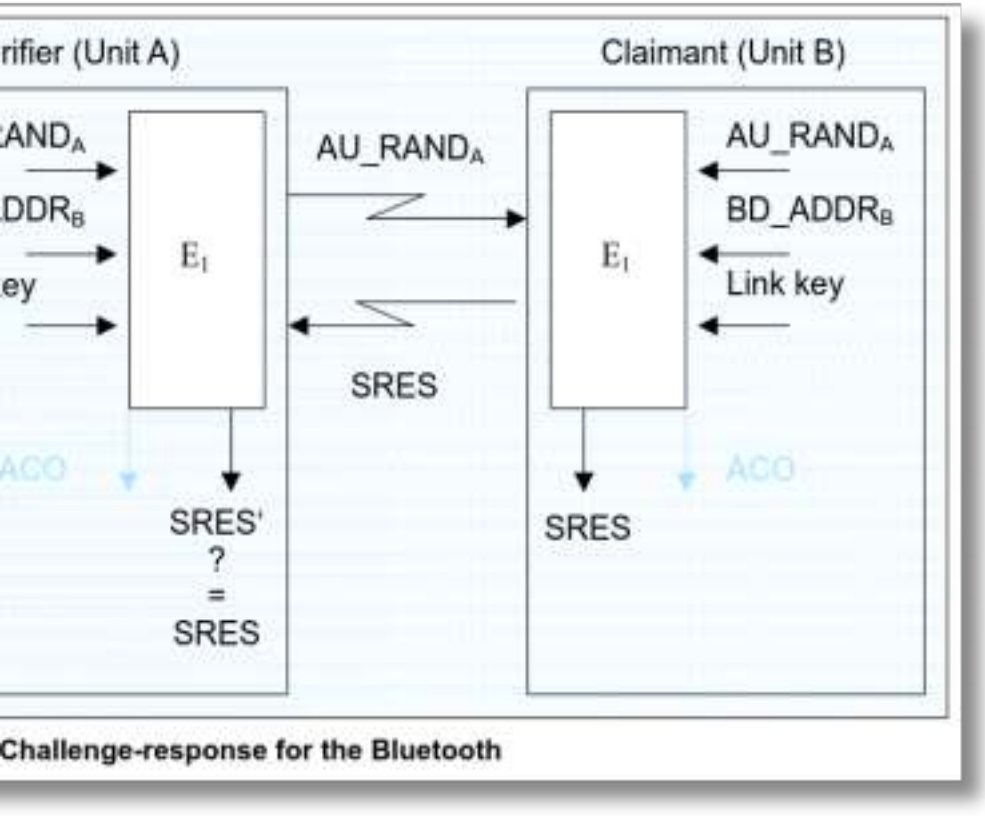
DIGGING DEEPER INTO THE APK

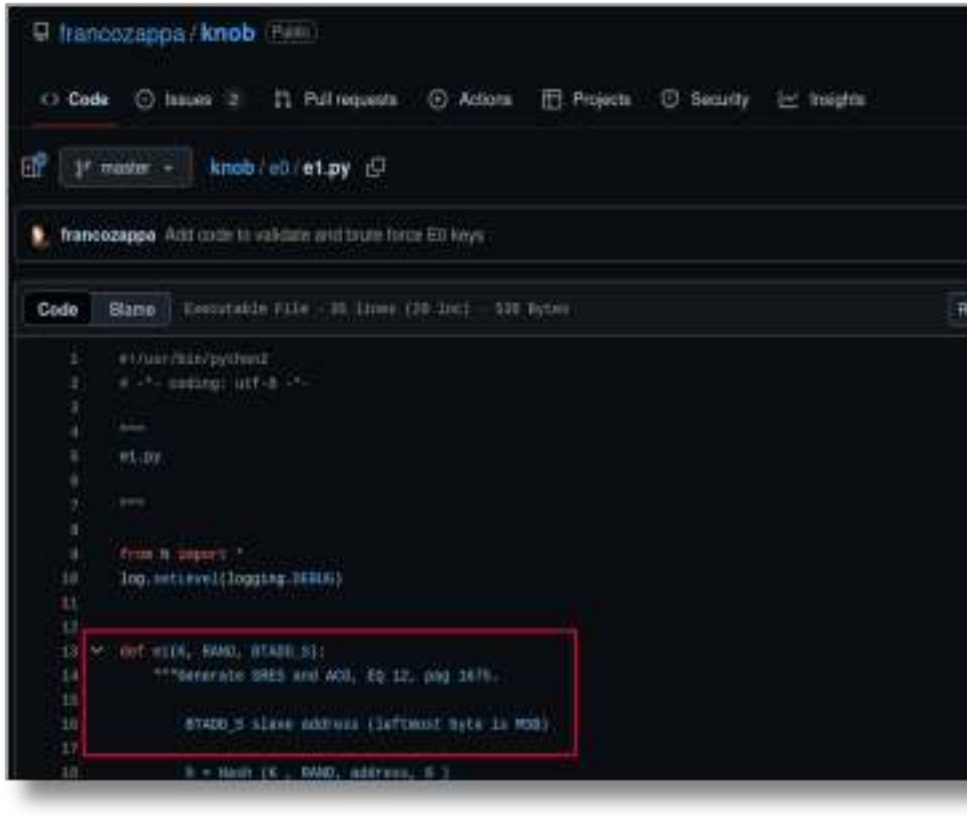


DIGGING DEEPER INTO THE APK



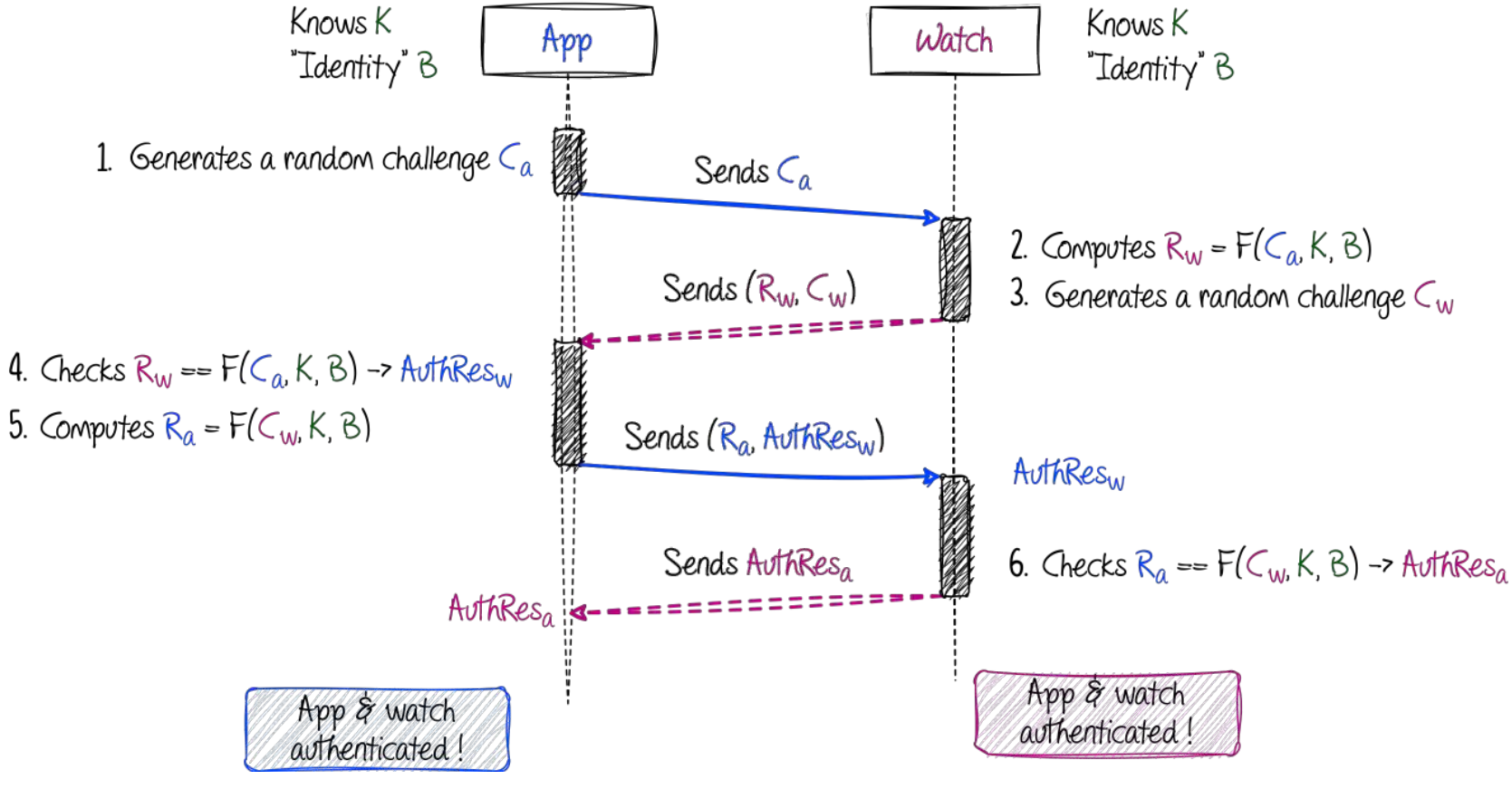
E1 FUNCTION ? KNOB HAS IT COVERED.





Thank you, Daniele Antonioli !
(a.k.a Franco Zappa)

JIELI OTA (MUTUAL) AUTH IN A NUTSHELL



Pre-shared constant values *K* and *B* used.

Btw, this scheme is prone to a reflective attack (no need to know *K* and *B*)

THIS IS THE MOMENT I KNEW … I F*CKED UP

- JieLi OTA cannot download firmware from device 😡
- Lost days on this for nothing … or maybe not ?

THIS IS THE MOMENT I KNEW ...
I F*CKED UP

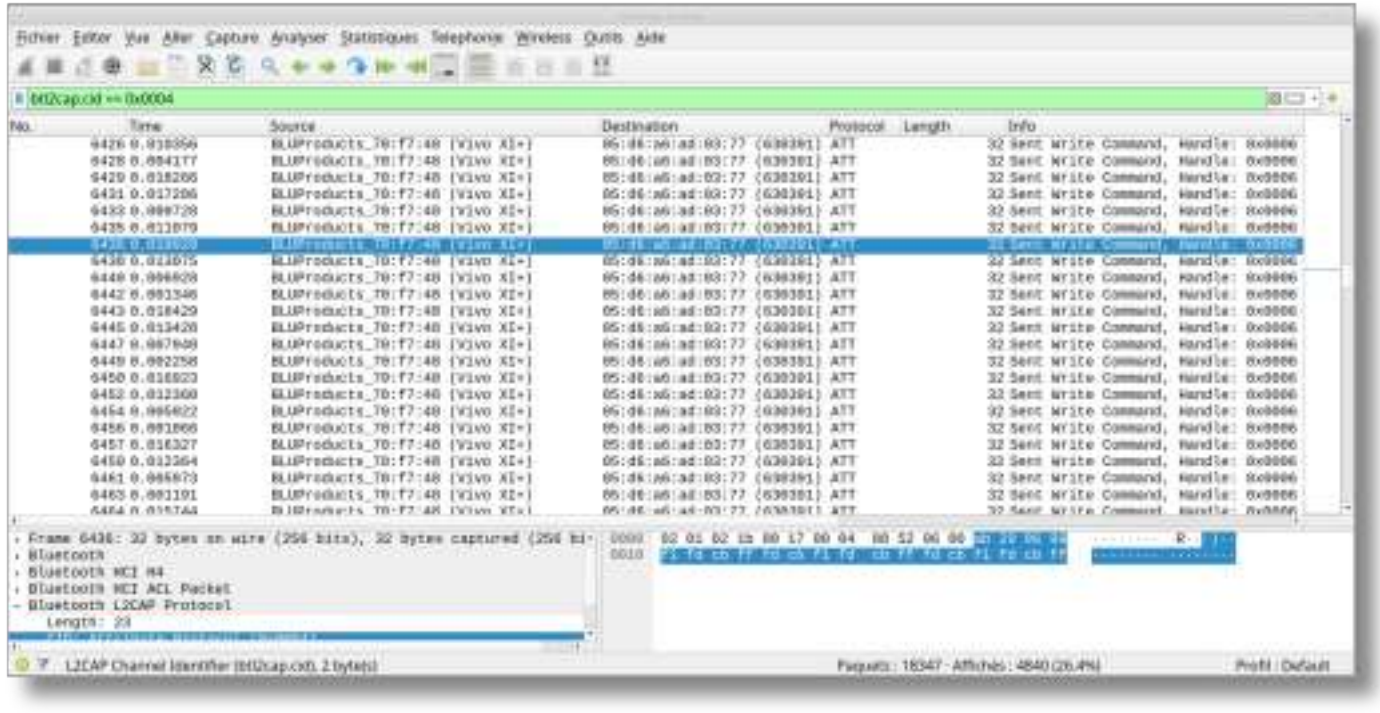
- JieLi OTA cannot download firmware from device 😡
- Lost days on this for nothing ... or maybe not ?
- Wait, I know how authentication works ! 

IN YOUR FACE ?

SO DYNAMIC

There must be some code here

SNIFFING THE DIALS



BLE OTA authentication first, then dial file is sent

SNIFFING THE DIALS

WE NEED MORE FILES...

WE NEED MORE FILES...

ANDROID LOGCAT (ONE MORE TIME)

```
I OKHTTP  : --->Date: Mon, 24 Feb 2025 21:59:00 GMT
I OKHTTP  : --->Content-Type: application/json
I OKHTTP  : --->Transfer-Encoding: chunked
I OKHTTP  : --->Connection: keep-alive
I OKHTTP  : --->Vary: Origin
I OKHTTP  : ---><-- 200 OK "https://app-overseas.sz-tjd.com/overseas/api/
      app/dialsmall/dialSmall/getTagDialCollection" (183ms)
I OKHTTP  : --->
I OKHTTP  : --->
I OKHTTP  : --->{"code":200,"msg":"æ<9f>¥è¯¢æ<88><90>å<8a><9f>","data":[...
I OKHTTP  : ---><-- END HTTP (715-byte body)
```

getTagDialCollection


```
{
 "16023": {
  "dialName": "JLC1198",
  "prepicUrl": "/statics/dial/2022/11/26/1669446584711_JLC1198.png",
  "price": 0.99
 },
 "16017": {
  "dialName": "JLC1192",
  "prepicUrl": "/statics/dial/2022/11/26/1669446429808_JLC1192.png",
  "price": 0.99
 },
 ...
}
```

getDialDetails


```
{
 "data" : {
  "id":16023,
  "price": "0.99",
  "dwCount": 8,
  "virtuallyDwCount": 6994,
  "url":"https://cdn.sz-tjd.com/pro/.../1669446584711_JLC1198.bin"
 }
}
```

getDialDetails


```
{
 "data" : {
  "id":16023,
  "price": "0.99",
  "dwCount": 8,
  "virtuallyDwCount": 6994,
  "url":"https://cdn.sz-tjd.com/pro/.../1669446584711_JLC1198.bin"
 }
}
```


Oh, thanks!

SO MUCH DIALS

```
:/tmp/dials$ ls
1668663382373_JLC1004.bin  1668750176491_JLC1010.bin  1668840703021_JLC1076.bin  1669433212835_JLC1170.bin
1668663469345_JLC1005.bin  1668751053088_JLC1014.bin  1668848301526_JLC1061.bin  1669433267575_JLC1171.bin
1668667414320_JLC1042.bin  1668753131397_JLC1015.bin  1668848309526_JLC1062.bin  1669433297777_JLC1172.bin
1668667515468_JLC1047.bin  1668756348403_JLC1027.bin  1668848317388_JLC1069.bin  1669445941871_JLC1174.bin
1668667542073_JLC1048.bin  1668756786184_JLC1031.bin  1668995560995_JL1215.bin   1669445974365_JLC1175.bin
1668667682597_JLC1053.bin  1668759748634_JLC1030.bin  1669103267962_JLC1058.bin  1669446166631_JLC1182.bin
1668667703870_JLC1059.bin  1668761038604_JLC1032.bin  1669103277886_JLC1074.bin  1669446194815_JLC1182.bin
1668668027738_JLC1006.bin  1668763254947_JLC1029.bin  1669103289668_JLC1075.bin  1669446226874_JLC1184.bin
1668670563689_JLC1007.bin  1668824115387_JLC1056.bin  1669103298237_JLC1077.bin  1669446252498_JLC1185.bin
1668670667342_JLC1016.bin  1668830359866_JLC1058.bin  1669103310647_JLC1078.bin  1669446314628_JLC1187.bin
1668734654741_JLC1021.bin  1668830367432_JLC1049.bin  1669103320270_JLC1079.bin  1669446338695_JLC1189.bin
1668734675000_JLC1024.bin  1668830383527_JLC1043.bin  1669103330700_JLC1080.bin  1669446429808_JLC1192.bin
1668734703725_JLC1025.bin  1668840374338_JLC1063.bin  1669171893118_JLC1044.bin  1669446454298_JLC1193.bin
1668734728641_JLC1033.bin  1668840404953_JLC1064.bin  1669190372418_JLC1009.bin  1669446484313_JLC1194.bin
1668734739456_JLC1035.bin  1668840427488_JLC1065.bin  1669432250265_JLC1152.bin  1669446510231_JLC1195.bin
1668734747026_JLC1036.bin  1668840451924_JLC1066.bin  1669432336966_JLC1156.bin  1669446538701_JLC1196.bin
1668734754539_JLC1037.bin  1668840475477_JLC1067.bin  1669432416127_JLC1159.bin  1669446562616_JLC1197.bin
1668734761327_JLC1038.bin  1668840498598_JLC1068.bin  1669432439880_JLC1160.bin  1669446584711_JLC1198.bin
1668734843901_JLC1008.bin  1668840583039_JLC1071.bin  1669433006286_JLC1165.bin  1669446975725_JLC1181.bin
1668734869423_JLC1011.bin  1668840606398_JLC1072.bin  1669433078382_JLC1167.bin  1670290515032_JLC1041.bin
1668734878896_JLC1013.bin  1668840632368_JLC1073.bin  1669433104702_JLC1168.bin  1679277875597_JLF13.bin
:/tmp/dials$
```

DIAL FORMAT

```
      00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0x0   04 00 02 00 01 00 04 00 01 FE 01 00 F0 00 1E 01
0x10  03 00 40 00 00 00 0A 04 F0 00 02 00 01 00 01 00
0x20  58 00 00 00 0A 04 F0 00 01 00 01 00 01 00 28 04
0x30  00 00 00 04 F0 00 07 00 01 00 01 00 18 06 00 00
0x40  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x50  00 00 00 00 00 00 00 00 FF FF 01 83 00 00 78 00
0x60  68 00 00 00 C0 03 00 00 A5 A5 A5 A5 FF FF FF FF
0x70  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

0+6	Header		24	Descriptor 3	
6+2	num_descriptor		58	Entry	
8	Descriptor 1		58+2	bg_color	
16	Descriptor 2		5A+2	type	
16+2	type		5C+2	x	
18+2	width		5E+2	y	
1A+2	height		60+4	offset	0x64
20+4	offset	0x58	64+4	size	0x30C
			68+960	payload	

DIAL FORMAT - DESCRIPTOR

- type (hour, minutes, picture)
- number of values
- entry offset in file

DIAL FORMAT - ENTRY

- background color
- pixel format
- position on screen
- payload offset in file

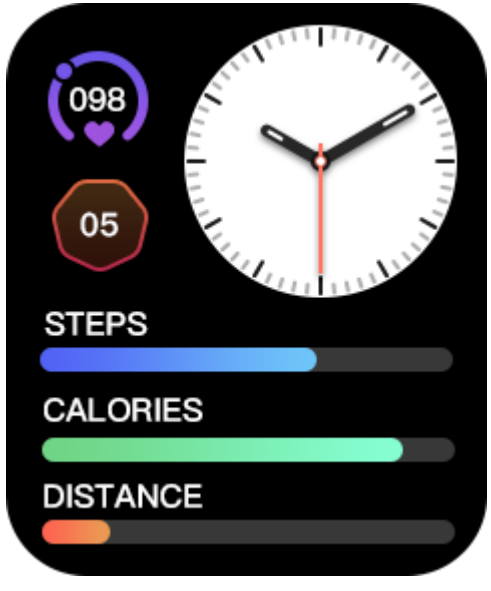
DIAL FORMAT - PAYLOAD

- raw RGB565
- RLE compressed
- mask with background color

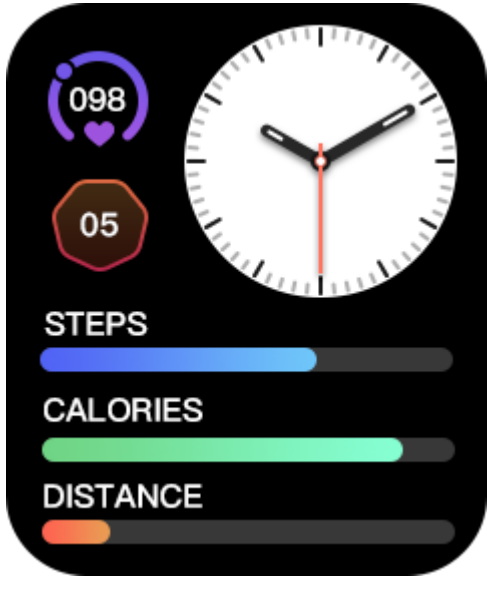
DIAL FORMAT - STRUCTURE

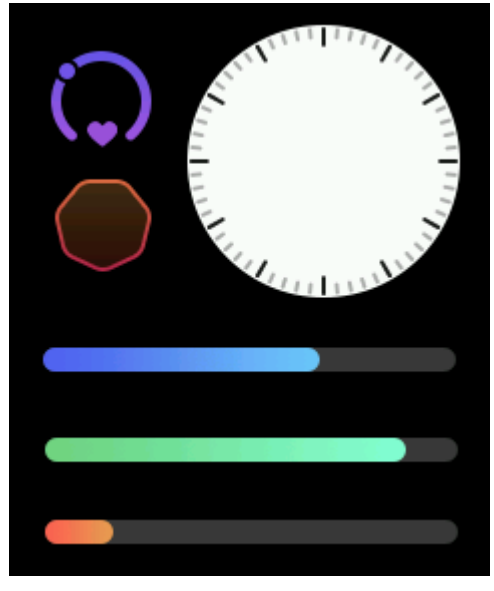
- small preview
- background
- fonts
- pictures

DIAL FORMAT - ODDITIES



DIAL FORMAT - ODDITIES





DIAL UPLOAD

- python dial generator
- whad script to upload (implements JieLi's OTA mutual Auth)

DIAL UPLOAD

COOL BUT

COOL BUT

WHERE IS THE CODE ?

FUN WITH OFFSETS


PAYLOADS ARE OFFSET IN FILE
OFFSETS CANNOT EXCEED FILE SIZE !
THEY CANNOT EXCEED FILE SIZE, RIGHT ?

FUN WITH OFFSETS

FUN WITH OFFSETS

FUN WITH OFFSETS

- Find base address

FUN WITH OFFSETS

- Find base address
- Sometimes, it crashes

FUN WITH OFFSETS

- Find base address
- Sometimes, it crashes
- Recovering is hard

FUN WITH OFFSETS

- Find base address
- Sometimes, it crashes
- Recovering is hard
- file loaded at 0xf9b000 ?

FUN WITH OFFSETS

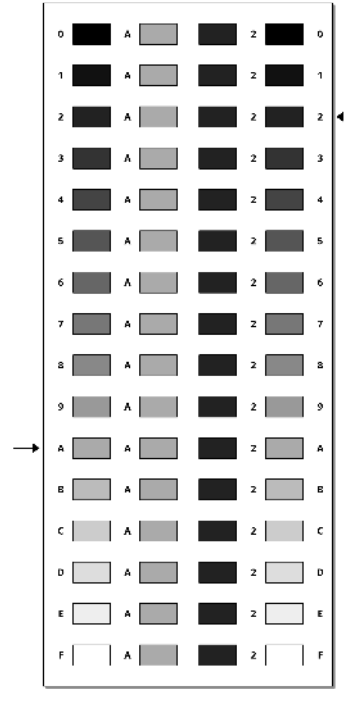
- Find base address
- Sometimes, it crashes
- Recovering is hard
- file loaded at 0xf9b000 ?

AND NOW, LETS EXTRACT THIS FIRMWARE !

FROM PIXELS TO FIRMWARE

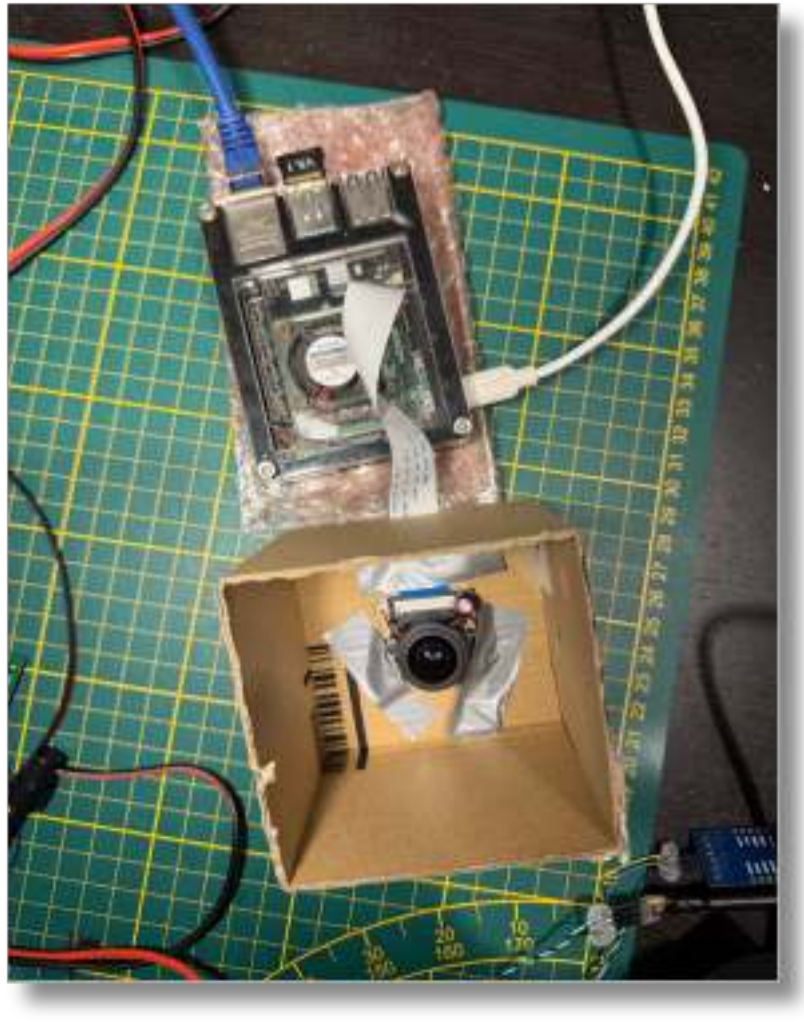
~~50~~ 16 SHADES OF GREY

~~50~~ 16 SHADES OF GREY

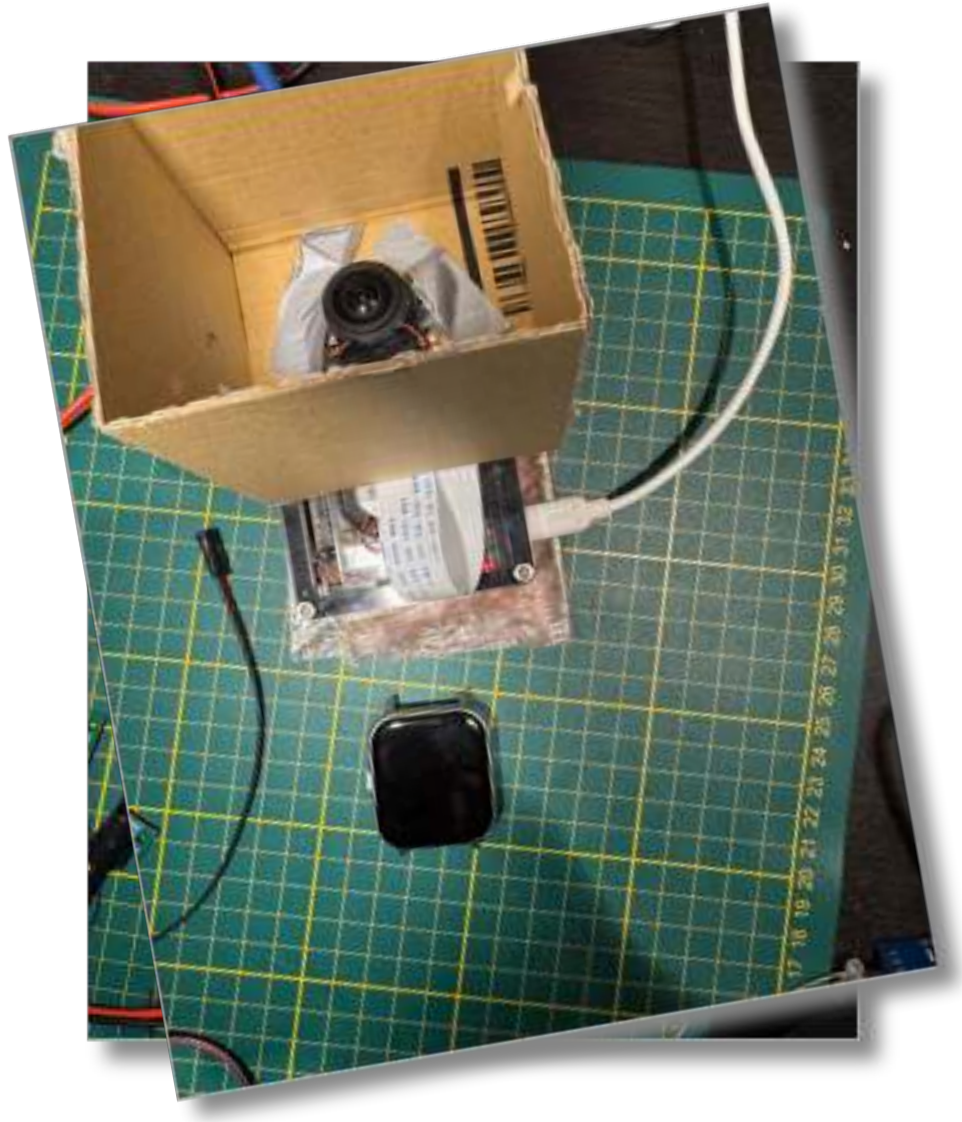


Theory for 0xA2

PROFESSIONAL SETUP

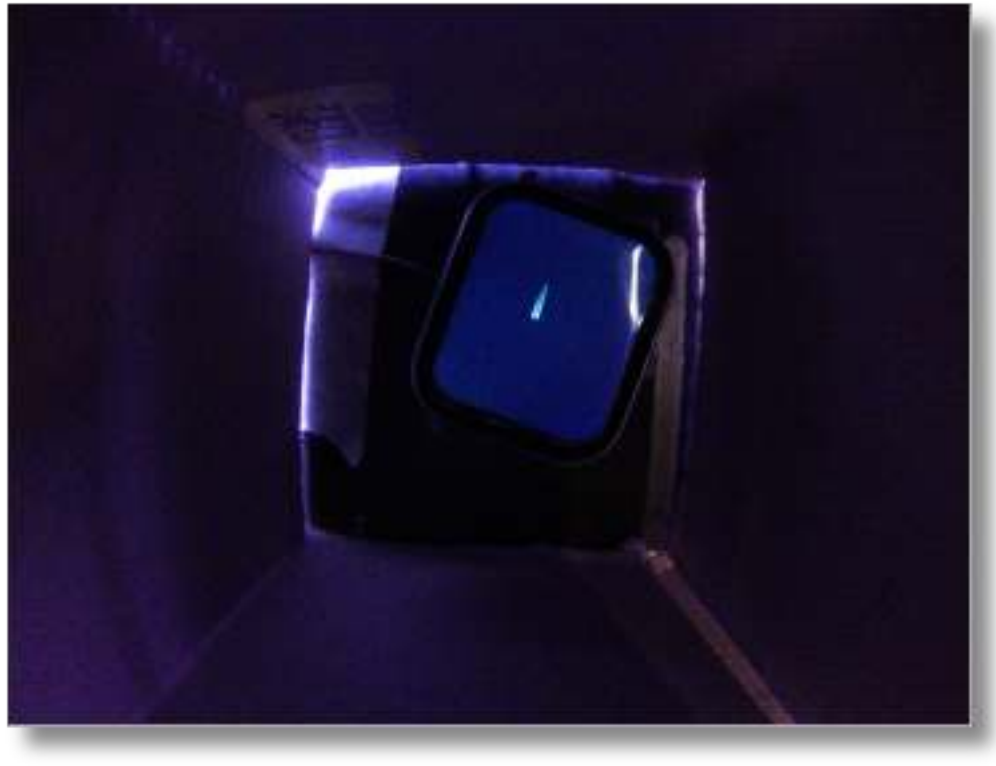


PROFESSIONAL SETUP

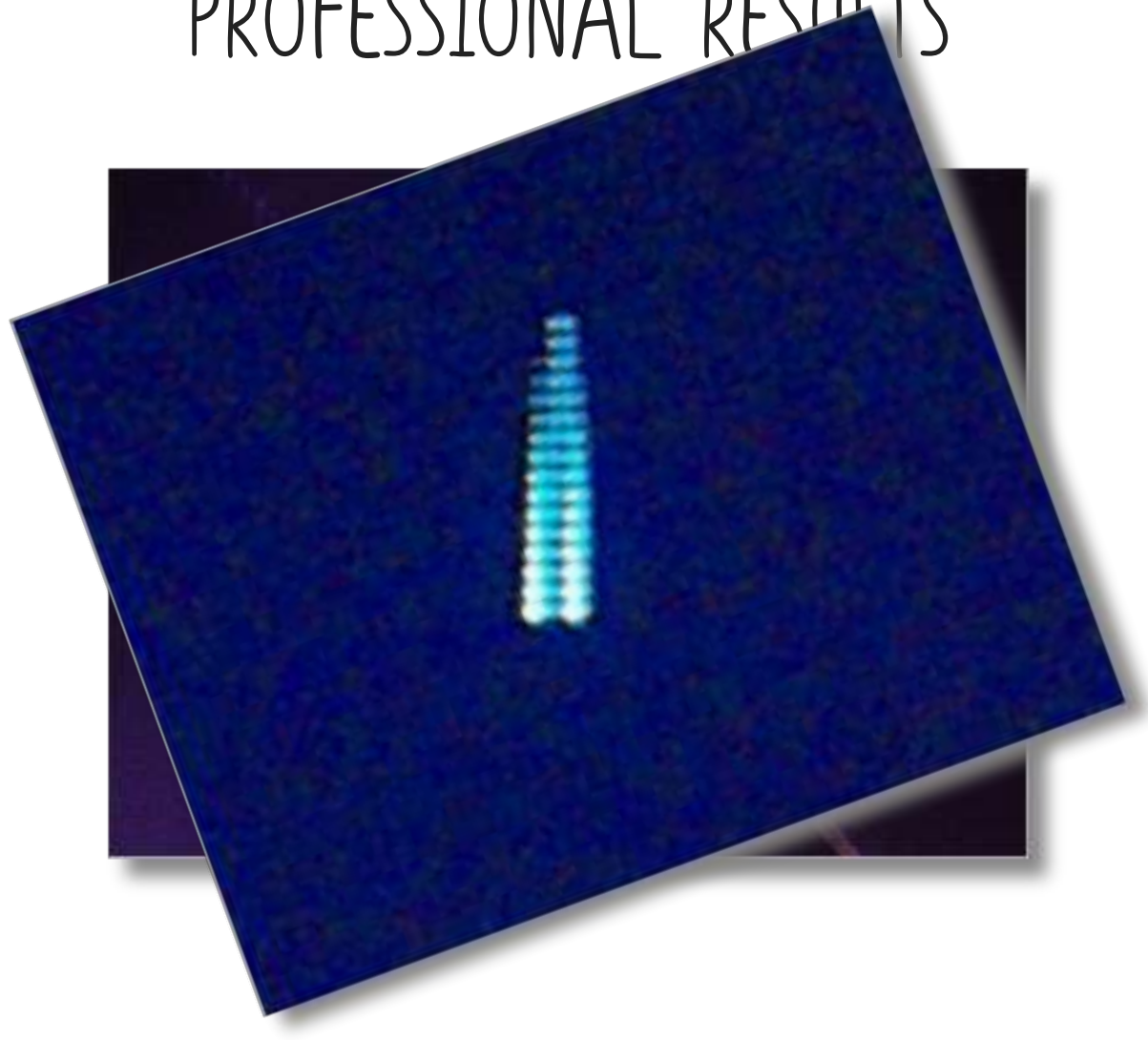


PROFESSIONAL SETUP

PROFESSIONAL RESULTS



PROFESSIONAL RESULTS



FIRMWARE EXTRACTION / PART #2

HERE WE GO AGAIN, M*THERF*CK3R !

READING PIXELS FROM SCREEN

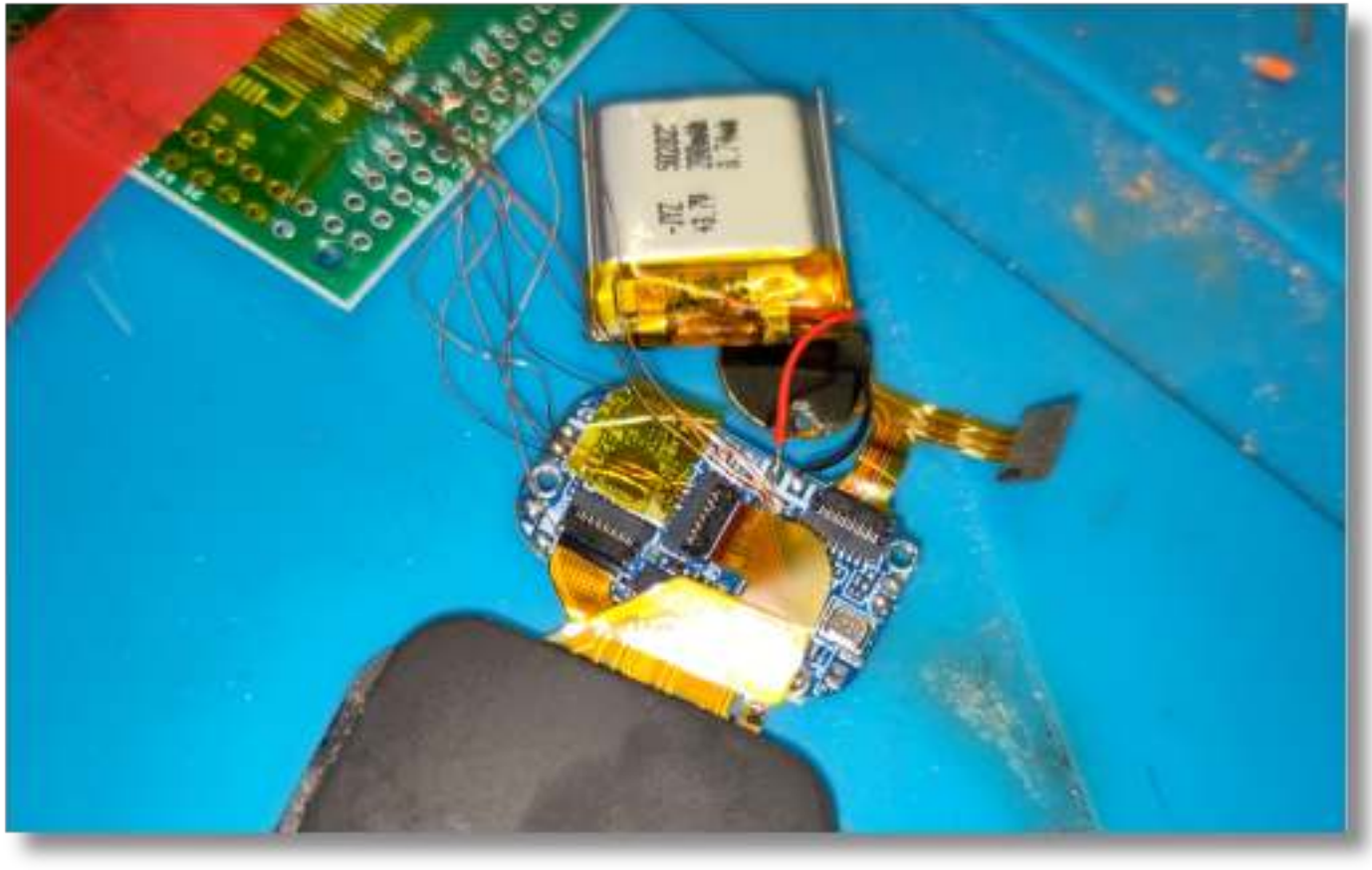
- Using a *camera* does not seem to work
- Why don't we simply sniff pixels *from the screen connector*?
- We just need to solder some wires and see what's going on

SCREEN CONTROLLER ?

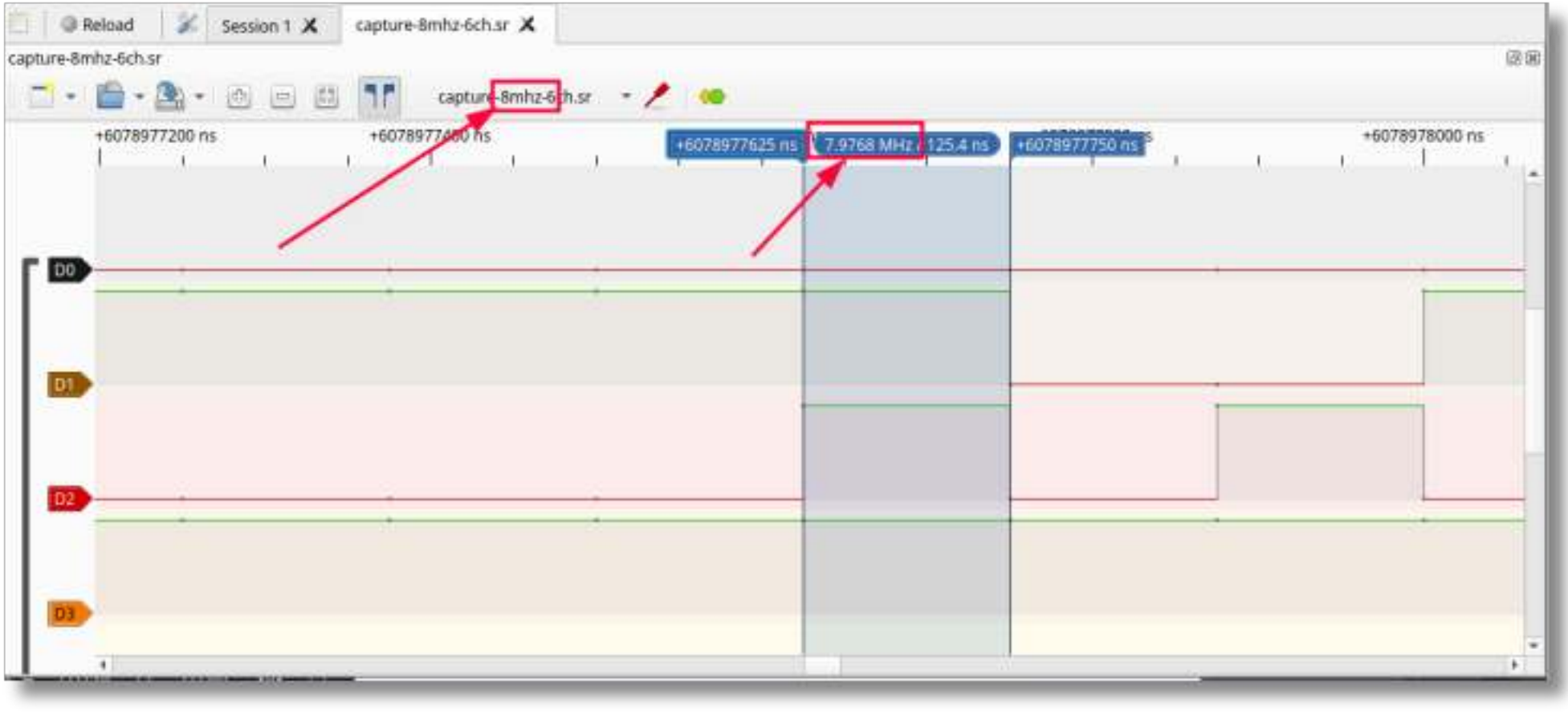
OEM	Place of Origin	Guangdong, C
ENH	Resolution	240×284
1.83	Viewing Angle	ALL
TFT	Driving IC	NV3030B
4 white LEDS	Operating temp	-20℃ To 70℃

Resolution	240×280
interface	4 Line SPI
Drive IC	ST7789V2
Top	-20℃~+70℃

WIRES, WIRES EVERYWHERE !



IT'S FAAAAST !


Reload
Session 1
capture-8mhz-6ch.sr
capture-8mhz-6ch.sr
+6078977200 ns
+6078977400 ns
+6078977625 ns
7.9768 MHz
125.4 ns
+6078977750 ns
+6078978000 ns
D0
D1
D2
D3

400 MHz Logic Analyzer on a Budget

HACKADAY

HOME BLOG HACKADAY.IO TINDIE CONTESTS SUBMIT ABOUT June 19, 2025

BUILD A 400 MHZ LOGIC ANALYZER FOR $35

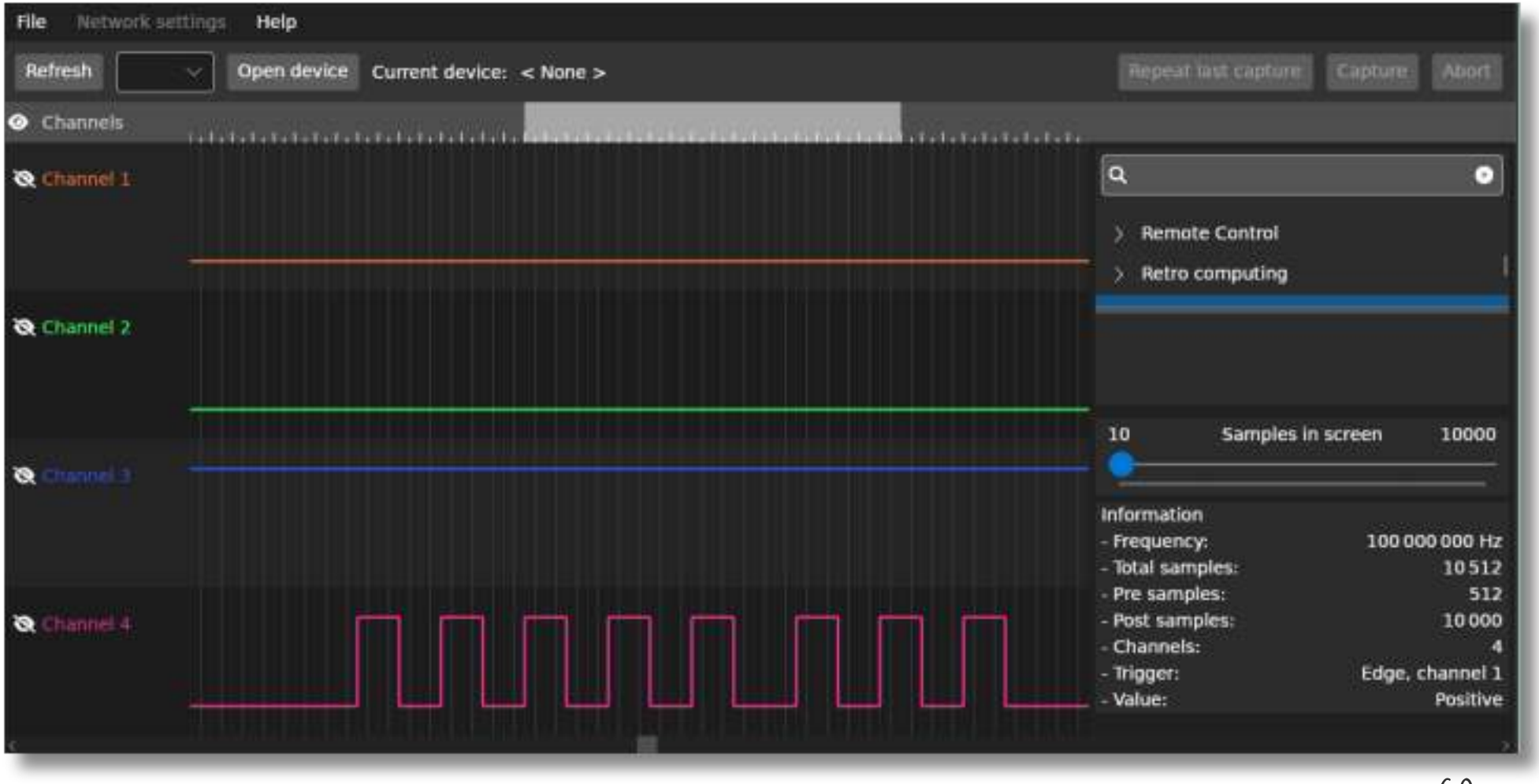
by: John Elliot V

14 Comments

June 12, 2025

SEARCH

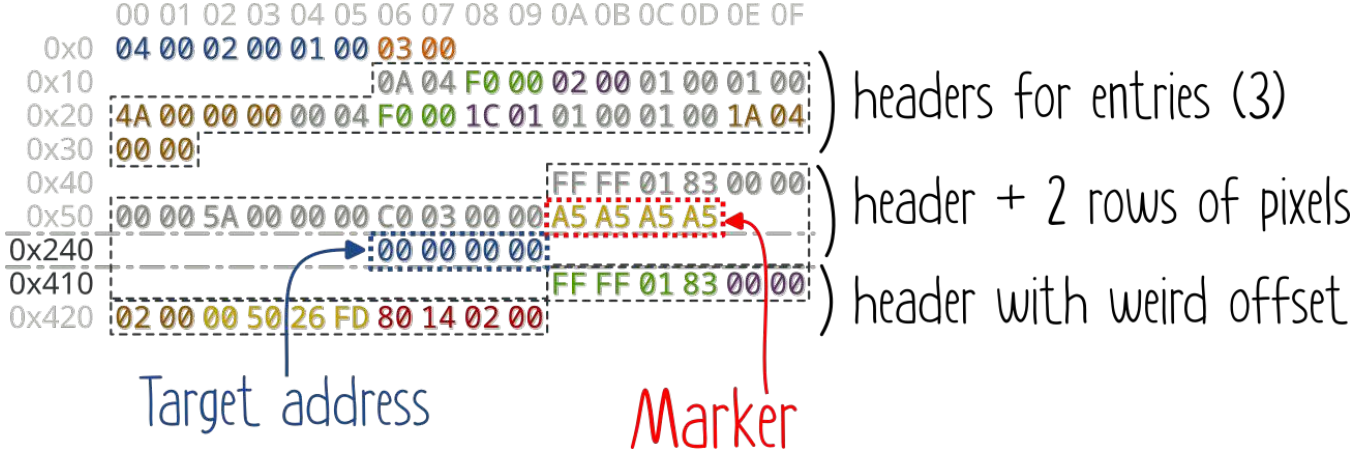
LOGIC ANALYZER FTW: 25 MHZ SIGNAL 🤯



PROGRESS SO FAR ...

- Screen communication uses a *3-wire interface*
- Clock line is about 25 MHz 🤯
- We found the *MOSI* line that ships pixels data
- Confirmed screen IC is NV3030B

CRAFTING A DIAL WITH MARKER AND OUT-OF-BOUND OFFSET



Weird offset is *0xfd265000*

Data size is 240 x 284 x 2 = *136320 (0x21480)*

UPLOADING DIAL WITH BLE

OVERCLOCKED RP2040 + PIO

```
; Fetch bits when raising edge on clock
.define gpio_clock 3

.program sniff

    wait 1 gpio gpio_clock  ; wait clock to go high (raising edge)
    in pins, 1              ; read 1 bit from mapped GPIOs and feed
                            ; ISR (autopush set to 8), bytes read
                            ; will be automatically sent to RX FIFO
```

```
while(1) {
    index = 0; // Acquire data from PIO

    pd = (uint32_t *)buffer;
    while (pd < (uint32_t *)(buffer + BUFFER_SIZE))
        *(pd++) = pio_sm_get_blocking (pio, 0); // Wait for PIO to send a byte

    for (int j = 0; j < (BUFFER_SIZE/4); j++)
        printf("%02x%02x%02x%02x", buffer[j*4+3], buffer[j*4+2], buffer[j*4+1], buffer[j*4]);
}
```

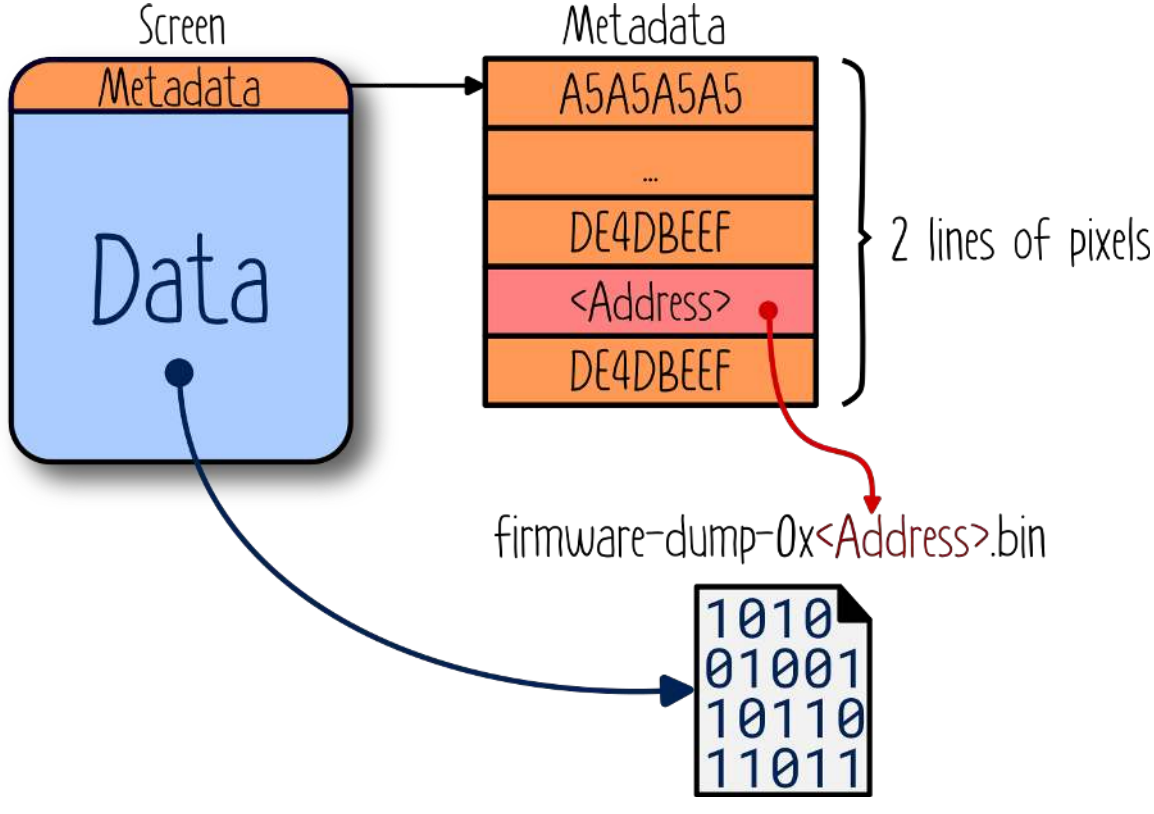
PYTHON: READING BYTES FROM SERIAL

```
# Open serial port and collect data. press CTL-C to process.
sniffer = Serial("/dev/ttyACM0", 115200)
content = b''
while True:
  try:
    buf = sniffer.read(4096)
    if len(buf) > 0:
      content += buf
      sys.stdout.write(f"[i] Collected {len(content)} bytes\r")
  except KeyboardInterrupt:
    break
```

RETRIEVING PIXELS FROM SNIFFED DATA

Sequence of *0x2A*, *0x2B*, and *0x2C* commands

SAVING LEAKED MEMORY INTO FILE



REPEAT UNTIL YOU GET THE WHOLE MEMORY

```
virtualabs@virtubox:/tmp/dumps$ ls -alh
total 3,2M
drwxr-xr-x 2 virtualabs virtualabs  32K 19 juin  17:49 .
drwxr-xr-x 7 virtualabs virtualabs  32K 20 juin  11:11 ..
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:37 firmware-dump-0x00000000.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:40 firmware-dump-0x00021480.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:42 firmware-dump-0x00042900.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:44 firmware-dump-0x00063d80.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:46 firmware-dump-0x00085200.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:47 firmware-dump-0x000a6680.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:52 firmware-dump-0x000c7b00.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:53 firmware-dump-0x000e8f80.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  08:56 firmware-dump-0x0010a400.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:02 firmware-dump-0x0012b880.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:03 firmware-dump-0x0014cd00.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:04 firmware-dump-0x0016e180.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:05 firmware-dump-0x0018f600.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:06 firmware-dump-0x001b0a80.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:07 firmware-dump-0x001d1f00.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:08 firmware-dump-0x001f3380.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:09 firmware-dump-0x00214800.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:10 firmware-dump-0x00235c80.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:21 firmware-dump-0x00257100.bin
-rw-r--r-- 1 virtualabs virtualabs 134K 17 mars  09:22 firmware-dump-0x00278580.bin
```

LAST STEP : MERGE DUMPS INTO A SINGLE FILE

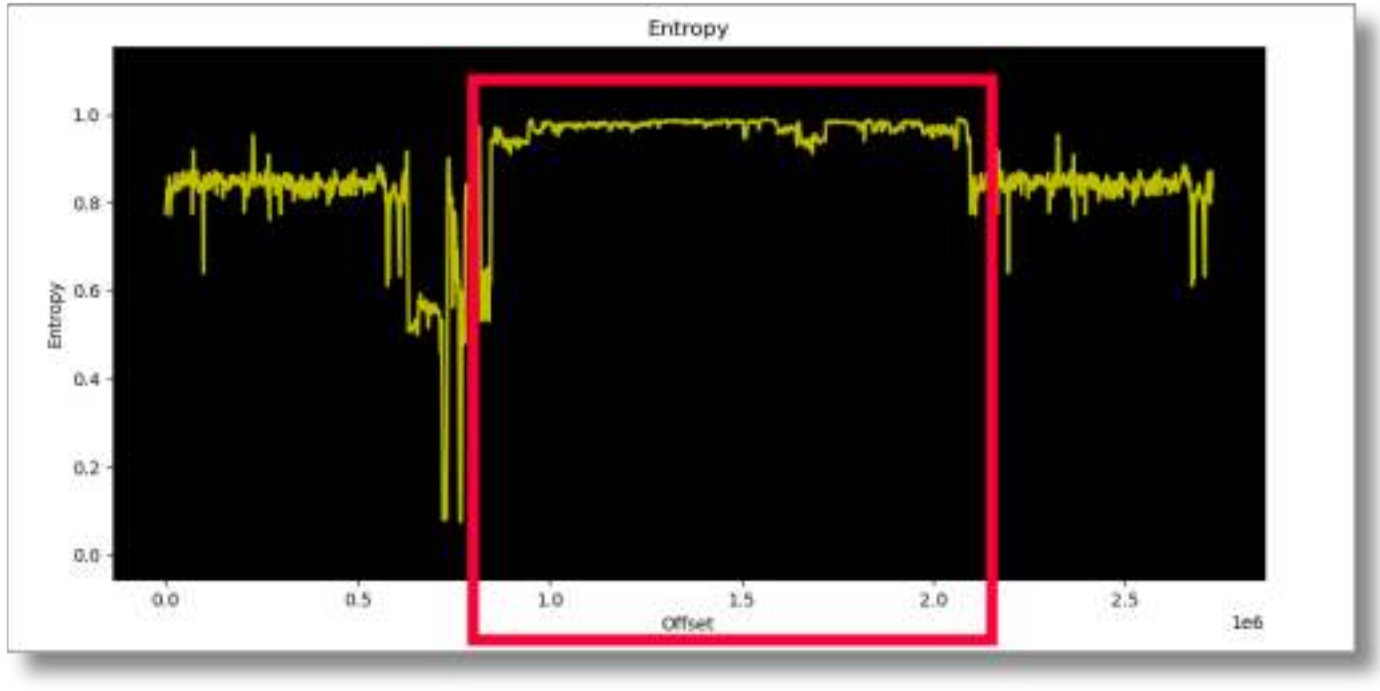
```
virtualabs@virtubox:/tmp/dumps$ xxd -l 300 final-flash-image.bin
00000000: 69f8 b6b1 2001 e001 ac4f 0c00 83ff 0000  i... ....O......
00000010: 6170 705f 6172 6561 5f68 6561 6400 ffff  app_area_head...
00000020: c320 892d 2001 0000 fc4a 0c00 82ff 0000  . .- ....J......
00000030: 6170 702e 6269 6e00 ffff ffff ffff ffff  app.bin.........
00000040: c7b1 d316 1c4c 0c00 9003 0000 82ff 0000  .....L..........
00000050: 6366 675f 746f 6f6c 2e62 696e 00ff ffff  cfg_tool.bin....
00000060: c9f9 01ff 0070 0d00 0020 0100 1281 0000  .....p... ......
00000070: 564d 00ff ffff ffff ffff ffff 0000 0100  VM..............
00000080: 2168 ffff 0000 0000 0070 0d00 9282 0000  !h.......p......
00000090: 5052 4354 00ff ffff ffff ffff 434f 4445  PRCT........CODE
000000a0: 8c6e ffff 0090 0e00 0010 0000 9281 0000  .n..............
000000b0: 4254 4946 00ff ffff ffff ffff 4155 544f  BTIF........AUTO
```

HURRAY, WE HAVE A FIRMWARE !

- Successfully leaked through unexpected data displayed on screen 😈
- Required some soldering, programming and BLE-fu
- That's 2 MiB of data !

LONG IS THE ROAD ...

WHAT HAVE WE JUST DUMPED ?



That's never a good sign when entropy is ~= 1.0

NOR FLASH STRUCTURE

JieLi's new firmware file structure

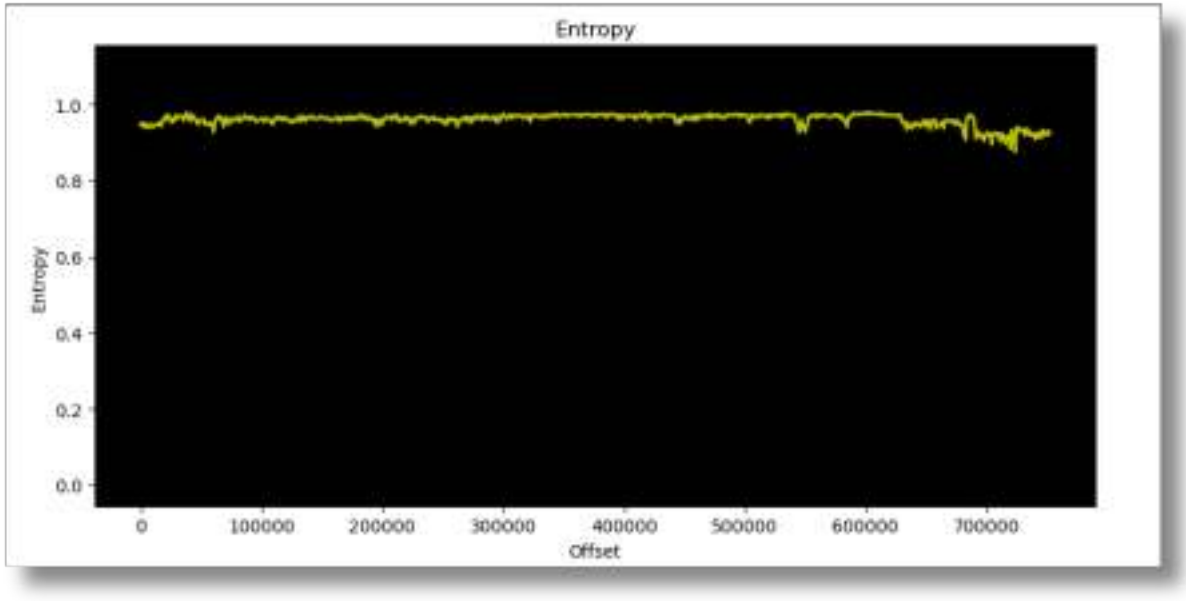
WHAT DO WE HAVE HERE ?

Generated with Corkami's SBud v2

FILES !

```
virtualabs@virtubox:/tmp/rootfs$ ls -l
total 2836
-rw-r--r-- 1 virtualabs virtualabs 805628 20 juin  11:10 app.bin
-rw-r--r-- 1 virtualabs virtualabs   4096 20 juin  11:10 BTIF
-rw-r--r-- 1 virtualabs virtualabs    912 20 juin  11:10 cfg_tool.bin
-rw-r--r-- 1 virtualabs virtualabs   4096 20 juin  11:10 EXIF
-rw-r--r-- 1 virtualabs virtualabs 753664 20 juin  11:10 FATFSI
-rw-r--r-- 1 virtualabs virtualabs 880640 20 juin  11:10 PRCT
-rw-r--r-- 1 virtualabs virtualabs 375068 20 juin  11:10 USERIF
-rw-r--r-- 1 virtualabs virtualabs  73728 20 juin  11:10 VM
virtualabs@virtubox:/tmp/rootfs$
```

STILL SOMETHING WRONG WITH SOME FILES ...



Entropy of *FATFSI*

JIELI'S "CRYPTO"

"ENC" chiper

The cipher used by the ENC periperal is of a simple stream chiper type, that basically uses the CRC16-CCITT shift register logic (with a polynomial x16+x12+x5+1 aka 0x1021) as the LFSR logic.

Each byte is XOR-ed with the low bits of the register (initialized with the "key" value, which is 16 bits long), and then the register is updated with the aforementioned LFSR logic.

Here's an example C snippet:

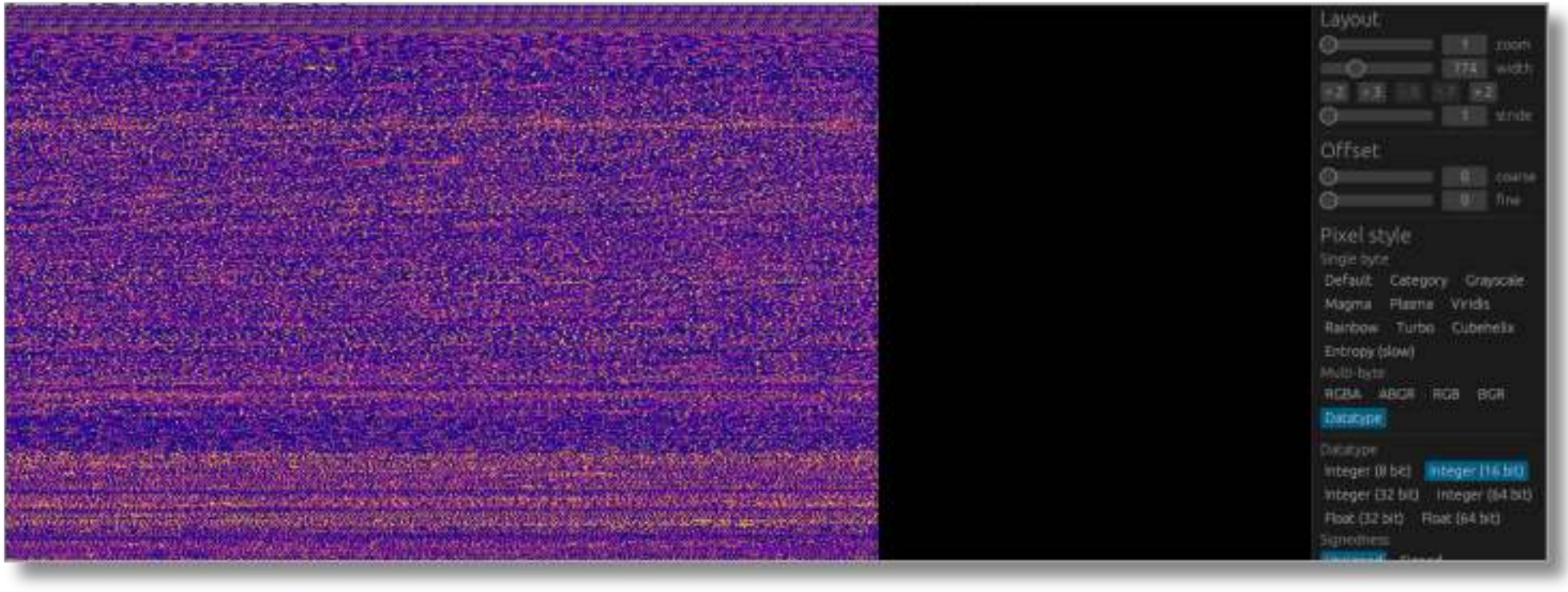
```
uint16_t jl_enc_cipher(uint8_t *data, int len, uint16_t key) {
        while (len--) {
                *data++ ^= key;
                key = (key << 1) ^ (key >> 15 ? 0x1021 : 0);
        }
        return key;
}
```

From https://github.com/kagaimiq/jielie/

FATFSI GOT DECRYPTED

```
virtualabs@virtubox:/tmp/rootfs$ xxd -l 256 FATFSI.dec.bin
00000000: 7cf0 0000 b9f0 0000 f6f0 0000 33f1 0000  |...........3...
00000010: 6df1 0000 aaf1 0000 e7f1 0000 27f2 0000  m...........'...
00000020: 67f2 0000 a7f2 0000 e4f2 0000 24f3 0000  g...........$...
00000030: 61f3 0000 a1f3 0000 e1f3 0000 21f4 0000  a...........!...
00000040: 61f4 0000 9ef4 0000 def4 0000 1ef5 0000  a...............
00000050: 5ef5 0000 89f5 0000 b4f5 0000 f4f5 0000  ^...............
00000060: 31f6 0000 71f6 0000 b1f6 0000 f1f6 0000  1...q...........
00000070: 2bf7 0000 6bf7 0000 abf7 0000 ebf7 0000  +...k...........
00000080: 19f8 0000 59f8 0000 96f8 0000 d0f8 0000  ....Y...........
00000090: 0df9 0000 4af9 0000 8af9 0000 c4f9 0000  ....J...........
000000a0: 01fa 0000 41fa 0000 81fa 0000 befa 0000  ....A...........
000000b0: fefa 0000 3efb 0000 7efb 0000 befb 0000  ....>...~.......
000000c0: fbfb 0000 3bfc 0000 7bfc 0000 bbfc 0000  ....;...{.......
000000d0: fbfc 0000 3bfd 0000 78fd 0000 b8fd 0000  ....;...x.......
000000e0: f8fd 0000 38fe 0000 78fe 0000 b8fe 0000  ....8...x.......
000000f0: f8fe 0000 38ff 0000 78ff 0000 b8ff 0000  ....8...x.......
virtualabs@virtubox:/tmp/rootfs$
```

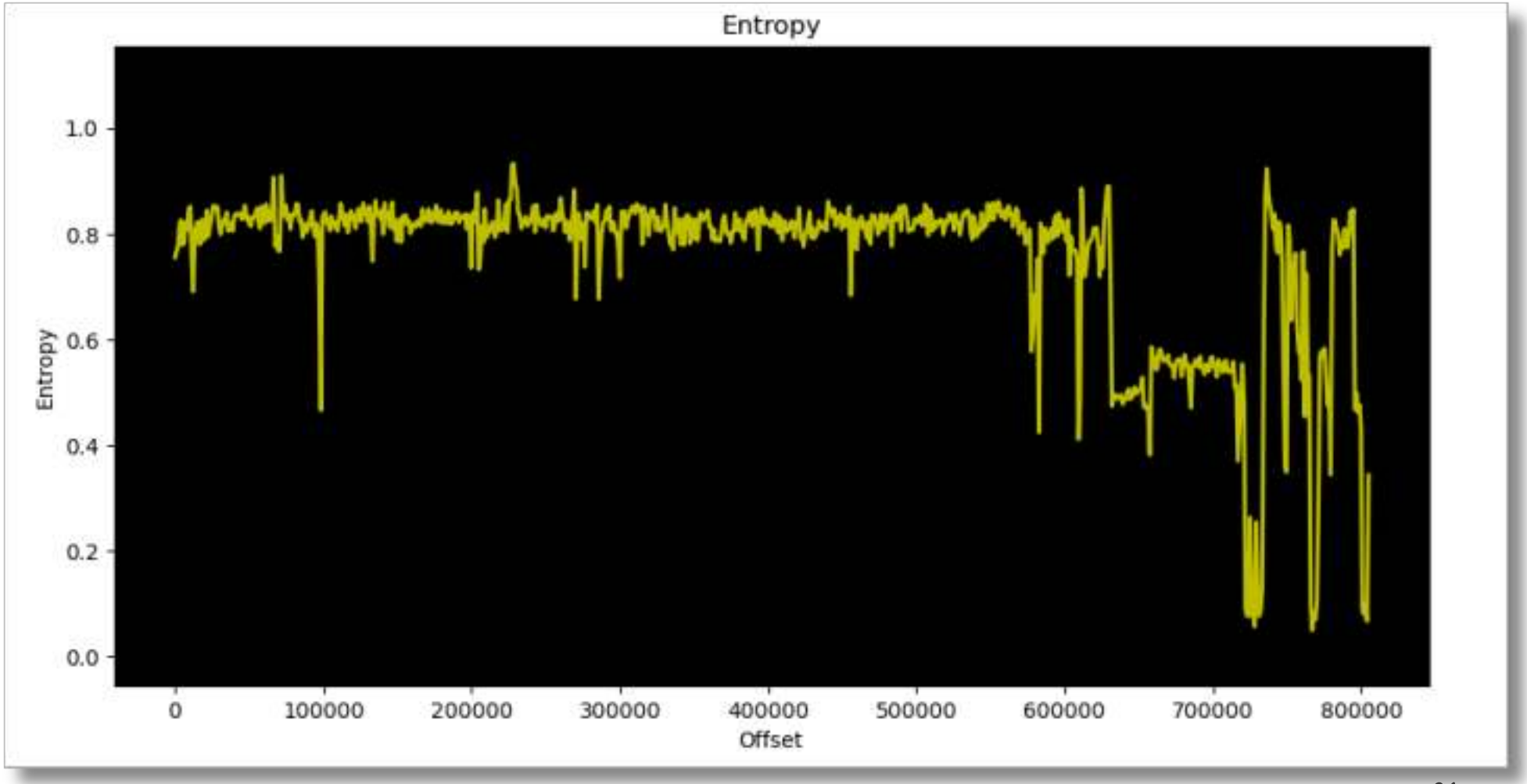
STILL SOME GARBAGE



Data viz with *Binocle*

FOUND A FUNNY LOST SECTOR 🤣

GOOD NEWS: APPLICATION IS NOT ENCRYPTED !



CODE REVERSE-ENGINEERING

IS IT ARM ? MIPS ?
NO, IT'S PI32 (V2) !

pi32

JieLi's own custom architecture that is heavily based off the Analog Devices' Blackfin core.

- ELF machine ID: 0xF0 (240)
- Little endian
- 32-bit architecture
- DSP-like instruction set
- 16 general purpose registers
- 64-bit multiply accumulator
- ...

DISASSEMBLING APP WITH GHIDRA

```
                    *************************************************************
                    undefined FUN_01e17186()
     undefined          r0:1           <RETURN>
                    FUN_01e17186                                XREF[1]:     FUN_01e0ac94:01e0ac9c(c)
01e17186 78 04          push        {0x8}
01e17188 0c 9c          add         r4,r0,#0x1c
01e1718a 46 e0 9c 01    movz        r6,#0x19c
01e1718e c7 ff 20       mov         r7,#0x11320
         13 01 00
01e17194 c8 ff a8       mov         r8,#0x10f1a8
         f1 10 00
01e1719a d8             ??          D8h
01e1719b ec             ??          ECh
01e1719c 7a             ??          7Ah    z
01e1719d 06             ??          06h
01e1719e 41             ??          41h    A
01e1719f 16             ??          16h
01e171a0 80             ??          80h
01e171a1 ea             ??          EAh
01e171a2 6b             ??          6Bh    k
01e171a3 cc             ??          CCh
```

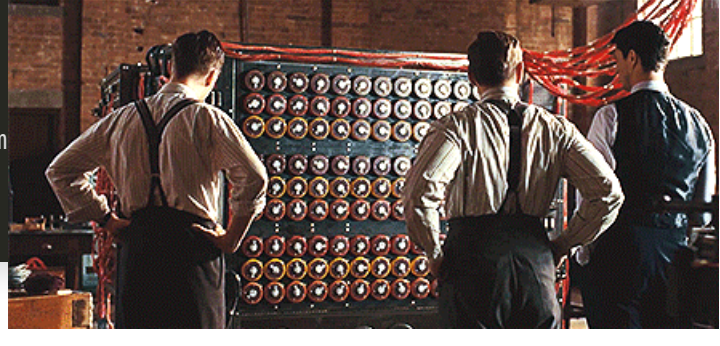
WAIT, WE HAVE AN SDK WITH OBJDUMP 

```
sdk.elf:  file format ELF32-pi32v2

Disassembly of section .text:
text_code_begin:
 1e00100:    81 ea 29 bd        call 227922 <boot_info_init : 1e37b56 >
 1e00104:    ee ff 10 a0 00 00  sp = 40976
 1e0010a:    ed ff 10 a0 00 00  ssp = 40976
 1e00110:    d8 e8 07 00        [--sp] = {r2-r0}
 1e00114:    c0 ff f0 cb eb 01  r0 = 32230384 <psram_laddr : 1ebcbf0 >
 1e0011a:    c1 ff 00 00 80 00  r1 = 8388608 <psram_vaddr : 800000 >
 1e00120:    c2 ff 00 00 00 00  r2 = 0 <test_encode_main.c : 0 >
 1e00126:    a2 a2              r2 = r2 >> 2
 1e00128:    12 03              rep 4 r2 {
 1e0012a:    03 05                r3 = [r0++=4]
 1e0012c:    93 05                [r1++=4] = r3
                                }
 1e0012e:    02 fc fb 01        if (r2 > 0) goto -10 <text_code_begin+0x28 : 1e00128 >
 1e00132:    d4 e8 07 00        {r2-r0} = [sp++]
```

Not sure if it really helps ...

SLEIGH OF HAND

```
# Recursively generate our push registers
pshmapregs: pshmapregs^pshmreg^msep is counter<15 & mregread & msep & pshmreg & next & pshmapregs
    { build pshmapregs; build pshmreg; }
pshmapregs: pshmreg is counter=15 & mregread & pshmreg {}
pshmap: pshmapregs is pshmapregs [bitset=0; counter=0; sep=0;] {}


# Recursively generate our pop registers
popmapregs: popmapregs^popmreg^msep is counter<15 & mregread & msep & popmreg & next & popmapregs
    { build popmreg; build popmapregs; }
popmapregs: popmreg is counter=15 & mregread & popmreg {}
popmap: popmapregs is popmapregs [bitset=0; counter=0; sep=0;] {}

# Recursively generate our pop special registers
popmapsregs: popmapsregs^popmsreg^msep is counter<3 & msregread & msep & popm
    { build popmsreg; build popmapsregs; }
popmapsregs: popmsreg^msep is counter=3 & msep & msregread & popmsreg {}
popsrmap: popmapsregs is popmapsregs [bitset=0; counter=0; sep=0;]{}
```



THAT'S WAY BETTER

```
                    ****************************************************
                    *                          FUNCTION                *
                    ****************************************************
                    undefined FUN_01e17186()
                      assume elsebranch = 0x0
                      assume group = 0x7
                      assume ifblock = 0x0
                      assume thenbranch = 0x0
          undefined         r0:1           <RETURN>
                    FUN_01e17186                                    XREF

01e17186 78 04          push        {lets,r8,r7,r6,r5,r4}
01e17188 0c 9c          add         r4,r0,#0x1c
01e1718a 46 e0 9c 01    movz        r6,#0x19c
01e1718e c7 ff 20       mov         r7,#0x11320
         13 01 00
01e17194 c8 ff a8       mov         r8,#0x10f1a8
         f1 10 00

                    LAB_01e1719a                                    XREF
01e1719a d8 ec 7a 06    lw          r0,[r7+r6<<DAT_000452f0<<2]
01e1719e 41 16          mov         r1,r4
01e171a0 80 ea 6b cc    call        FUN_01e30a7a
01e171a4 05 16          mov         r5,r0
01e171a6 85 58          jnz         r5,LAB_01e171d8
01e171a8 64 e0 00 0b    mov         r0,icfg
01e171ac 60 e1 40 0f    and         r0,r0,#0x300
01e171b0 45 20          mov         r5,#0x0
01e171b2 01 ff 00       jne         r0,#0x300,LAB_01e171e6
         03 17 00
01e171b8 d0 ec 80 00    ldw         r0,r8<<DAT_0010f1a8,#0x0
01e171bc 00 f8 13 0c    je          r0,0x6,LAB_01e171e6
01e171c0 64 e0 00 0b    mov         r0,icfg
```

```
/* WARNING: Globals starting with '_' overlap smaller symbols at the same address */

undefined4 * FUN_01e17186(int param_1)

{
  undefined4 *puVar1;
  int iVar2;
  undefined4 *puVar3;
  uint in_icfg;

  while( true ) {
    puVar1 = (undefined4 *)FUN_01e30a7a(_DAT_000452f0,param_1 + 0x1c);
    if (puVar1 != (undefined4 *)0x0) {
      iVar2 = 7;
      puVar3 = puVar1;
      do {
        *puVar3 = 0;
        puVar3 = puVar3 + 1;
        iVar2 = iVar2 + -1;
      } while (iVar2 != 0);
      puVar1[4] = puVar1 + 4;
      puVar1[5] = puVar1 + 4;
      return puVar1;
    }
    if ((in_icfg & 0x300) != 0x300) {
      return (undefined4 *)0x0;
    }
    if (_DAT_0010f1a8 == 6) {
      return (undefined4 *)0x0;
    }
    if ((in_icfg & 0xff) != 0) break;
    iVar2 = FUN_01e0137e(0x12824,0);
    if (iVar2 != 0) {
```

Decompile: FUN_01e17186 × | Bytes: app.bin × | Defined Strings ×

IS IT REALLY FAKE ?

```
01e02b40 73 63 37        ds          "sc7a20"
         61 32 30 00
01e02b47 00 00 00 00     addr        00000000
01e02b4b 00 00 00 00     addr        00000000
01e02b4f 00 00 00 00     addr        00000000
01e02b53 00 00 00 00     addr        00000000
01e02b57 00              ??          00h
01e02b58 3c 6a e4 01     addr        FUN_01e46a3c
01e02b5c 98 6a e4 01     addr        LAB_01e46a98
01e02b60 e4 8f e4 01     addr        LAB_01e48fe4
01e02b64 04 90 e4 01     addr        LAB_01e49004
01e02b68 44 90 e4 01     addr        LAB_01e49044
01e02b6c 92 90 e4 01     addr        LAB_01e49092
01e02b70 68 72 5f        ds          "hr_fake"
         66 61 6b
         65 00
01e02b78 00 00 00 00     addr        00000000
01e02b7c 00 00 00 00     addr        00000000
01e02b80 00 00 00 00     addr        00000000
01e02b84 ea 90 e4 01     addr        LAB_01e490ea
01e02b88 00 00 00 00     addr        00000000
01e02b8c 24 91 e4 01     addr        FUN_01e49124
01e02b90 d6 91 e4 01     addr        FUN_01e491d6
```

HR for Heart Rate, and *fake* says it all 🤡

FOUND SOME INTERESTING STRINGS

```
if ((DAT_00015a0d == '\x01') || (DAT_00015a0e == '\x01')) {
  _sprintf(&s_bp_systolic,s_%03d/%02d_01eb8740,(uint)blood_pressure_systolic,
           (uint)blood_pressure_diastolic_);
  puVar1[2] = 0xffff;
  puVar1[1] = &s_bp_systolic;
  *puVar1 = 0x23;
  draw_text(param_1,0x193,0x30,0x31);
  _sprintf(&s_bp_diastolic,s_%03d/%02d_01eb8740,(uint)blood_pressure_systolic,
           (uint)blood_pressure_diastolic_);
  *(undefined8 *)(puVar1 + 1) = 0xffff0000c2a0;
  *puVar1 = 0x23;
  draw_text(param_1,0x1b9,0x42,0xe4);
```

AAA/BB

FOLLOWING THE WHITE RABBIT ...

```
if ((CONCAT22(uVar15,CONCAT11(uVar14,uVar10)) == 2) &&
   (4 < CONCAT22(uVar11,CONCAT11(uVar6,uVar8)))) {
  uVar2 = randint();
  blood_pressure_systolic = ((char)uVar2 - (char)(((int)uVar2 / 0x10 & 0xffU) << 4)) + 110;
  uVar2 = randint();
  blood_pressure_diastolic = (char)uVar2 + (char)((int)uVar2 / 0x14) * -0x14 + 70;
```

```
uint8_t seed = randint() & 0xff;
blood_pressure_systolic = (seed - seed/16)*16 + 110;
```

110 <= blood_pressure_systolic <= 125

PRNG

```
5  uint32_t randint(void)
6
7  {
8    int rand_state;
9    longlong lVar1;
10   uint uVar2;
11
12   rand_state = (int)*(undefined8 *)(_random_state + 0xa04);
13   lVar1 = (longlong)rand_state * 0x4c957f2d;
14   uVar2 = rand_state * 0x5851f42d + (int)((ulonglong)lVar1 >> 0x20) +
15           (int)((ulonglong)*(undefined8 *)(_random_state + 0xa04) >> 0x20) * 0x4c957f2d;
16   *(ulonglong *)(_random_state + 0xa4) = CONCAT44(uVar2,(int)lVar1 + 1);
17   return uVar2 & 0x7fffffff;
18 }
```

SAME FOR HEART RATE !

```
if ((4 < DAT_00011548) && (DAT_00054834 == 1)) {
  uVar2 = randint();
  heart_rate_current = ((char)uVar2 - (char)(((int)uVar2 / 0x10 & 0xffU) << 4)) + 0x41;
  if (heart_rate_max <= heart_rate_current) {
    heart_rate_max = heart_rate_current;
  }
  uVar9 = 0;
  uVar17 = 0;
  bVar16 = heart_rate_min;
  if (heart_rate_current <= heart_rate_min) {
    bVar16 = heart_rate_current;
  }
  bVar12 = heart_rate_current;
  if (heart_rate_min != 0) {
    bVar12 = bVar16;
  }
```

65 <= heart_rate_current <= 80

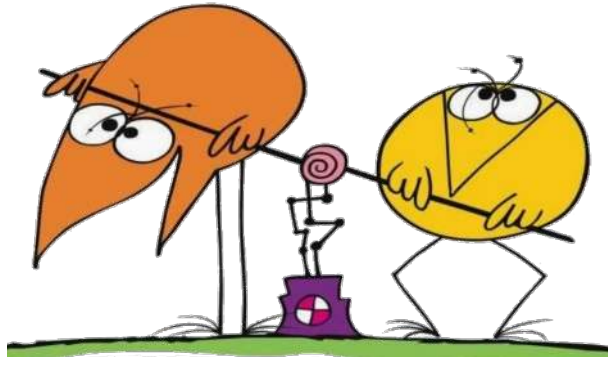
OH NO, THIS SH*T IS REAL !

FAKE VS. "REAL" MEASURES

- Randomly generated:
  - Heart rate
  - Blood pressure
  - SPO2
- No evidence of random:
  - Footsteps counter
  - Sleep monitoring

CONCLUSION

WELL, THERE'S SO MUCH TO SAY ABOUT THIS...



"TRYING AGAIN AND AGAIN EVENTUALLY LEADS TO SUCCESS.
THEREFORE, THE MORE WE FAIL THE GREATEST CHANCE WE HAVE TO SUCCEED."
- SHADOK PROVERB

SUMMARY OF OUR JOURNEY

SUMMARY OF OUR JOURNEY

That's too much work to make sure it's a scam !

SUMMARY OF OUR JOURNEY

That's too much work to make sure it's a scam !

Full stop.

KEY TAKEAWAYS

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- Bluetooth addresses not randomized: tracking is possible

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- No *sensor*: measured values are randomly generated*

* Except maybe for footsteps and sleep monitoring

KEY TAKEAWAYS

- Bluetooth addresses not randomized: tracking is possible
- No *real* authentication: anybody can upload a rogue firmware or dial
- No *sensor*: measured values are randomly generated*
- Bad input validation: easy to remotely DoS any watch

* Except maybe for footsteps and sleep monitoring

JIELI'S USB PROGRAMMER ?

- Received weeks after we got the firmware out of the watch
- Too much work, did not have time to test it 🙄
- Also got a devboard, but that's tricky to use

SO, WHAT'S NEXT ?

- Firmware modification and upload through OTA
- 100% of Pi32v2 instructions supported in Ghidra
- Asking Gifi for a refund ?

ARTICLE 8 – DROIT APPLICABLE – RÉCLAMATIONS - LITIGES - MEDIATION

Le droit français s'applique aux présentes conditions de vente.

Pour toute réclamation vous pouvez vous adresser au service clients à l'adresse postale, GIGAMARKET Zone Industrielle la Barbière – 47300 Villeneuve sur Lot ; nous contacter au : 05 53 40 54 68 ou par mail à l'adresse serviceclient@gifi.fr.

Conformément à l'article L. 612-1 du Code de la consommation, vous pouvez, si votre réclamation n'a pas abouti, recourir gratuitement au service de médiation SAS MEDIATION SOLUTION dont nous relevons :

Email : contact@sasmediationsolution-conso.fr

THANK YOU, Q/A TIME !

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