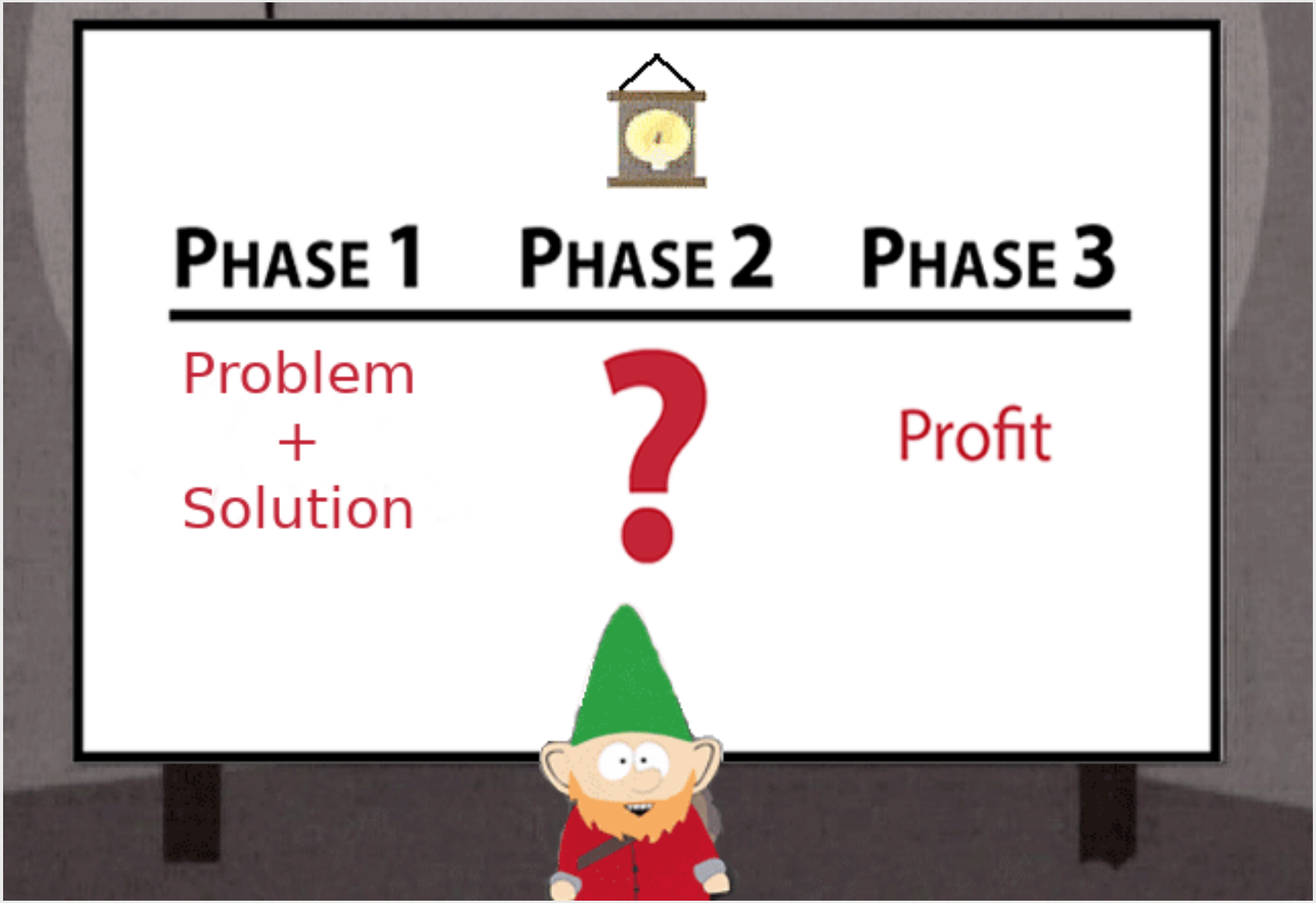
Where is my /dev/hardware, dude?

Embedded Bar 2025 // Moscow

Who am I? ia @ github

- System Engineer
- Open Source Developer
  - *IronOS* official maintainer
  - *HydraFW* contributor
  - patches, reports, docs, ...
- Conference Speaker
- Independent Researcher
- Community Enjoyer ♥
  - Free Software Ideology
  - Right to Repair movement
  - Hackerspace Culture

Plan

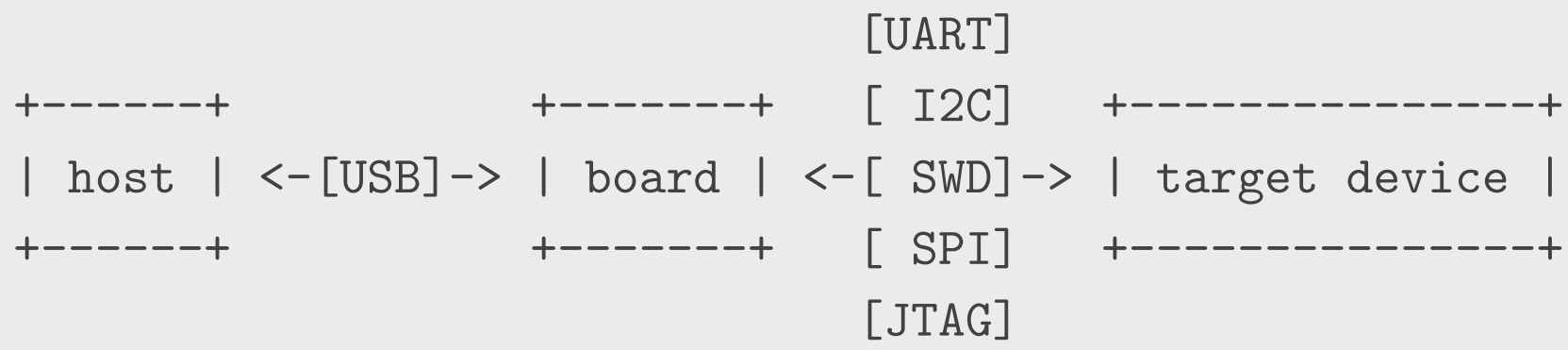


Problem

Embedded engineer's routine:

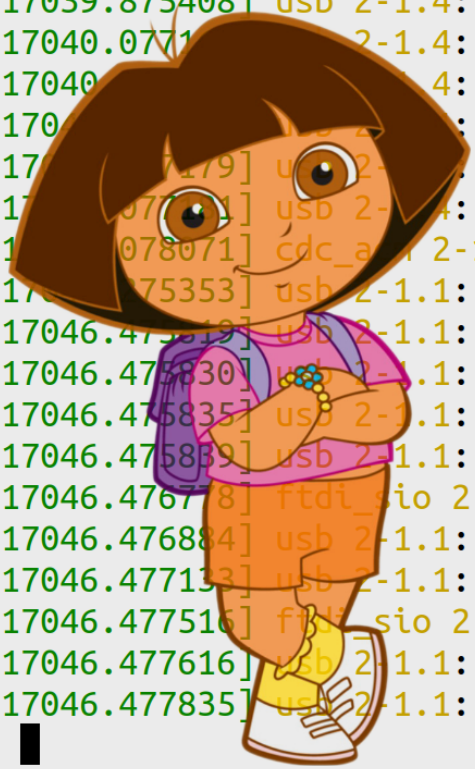
- option A:

- option B:



Problem (cont.): detect & access multiple devices in /dev

```
$ dmesg
[17031.995409] usb 2-1.3: new full-speed USB device number 16 using xhci_hcd
[17032.196253] usb 2-1.3: New USB device found, idVendor=067b, idProduct=2303
[17032.196261] usb 2-1.3: New USB device strings: Mfr=1, Product=2, SerialNumber=0
[17032.196266] usb 2-1.3: Product: USB-Serial Controller
[17032.196269] usb 2-1.3: Manufacturer: Prolific Technology Inc.
[17032.197062] pl2303 2-1.3:1.0: pl2303 converter detected
[17032.198211] usb 2-1.3: pl2303 converter now attached to ttyUSB0
[17039.875408] usb 2-1.4: new full-speed USB device number 17 using xhci_hcd
[17040.0771    2-1.4: New USB device found, idVendor=1d50, idProduct=60a7
[17040          4: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[170            : Product: HydraBus 1.0 COM Port2
[17     7179]   2-      : Manufacturer: Openmoko, Inc.
[1      078071] usb 2-     4: SerialNumber: 0041002D3436511139333434
[1      078071] cdc_a  2-1.4:1.0: ttyACM0: USB ACM device
[17     75353] usb 2-1.1: new high-speed USB device number 18 using xhci_hcd
[17046.47      2-1.1: New USB device found, idVendor=0403, idProduct=6010
[17046.475830] usb 2-1.1: New USB device strings: Mfr=1, Product=2, SerialNumber=0
[17046.475835] usb 2-1.1: Product: Dual RS232-HS
[17046.475839] usb 2-1.1: Manufacturer: FTDI
[17046.476778] ftdi_sio 2-1.1:1.0: FTDI USB Serial Device converter detected
[17046.476884] usb 2-1.1: Detected FT2232H
[17046.477113] usb 2-1.1: FTDI USB Serial Device converter now attached to ttyUSB1
[17046.477516] ftdi_sio 2-1.1:1.1: FTDI USB Serial Device converter detected
[17046.477616] usb 2-1.1: Detected FT2232H
[17046.477835] usb 2-1.1: FTDI USB Serial Device converter now attached to ttyUSB2
$
```



Solution

- **udev**
- **picocom**
- **bash**
- **configs**

udev

“userspace `/dev`”:

- *daemon* (aka user-space system service) to manage devices:
  - recieves message from the kernel about device events
  - managing devices through files in `/dev` virtual FS based on events
  - **apply custom rules if any**
- part of `systemd` since *~2012*

udev (cont.)

`udevadm` - command-line utility to *“talk”* with `udev` daemon.

Basic commands:

- update all configs and restart `udev`:

```
$ sudo  udevadm  hwdb    --update         && \
  sudo  udevadm  control --reload-rules && \
  sudo  udevadm  trigger
```

- monitor events in real time:

```
$ udevadm  monitor  --udev  [--environment]
```

- dump information about specific *`DEVICE`*:

```
$ udevadm  info  -a  -n  /dev/DEVICE
```

picocom

“Minimal dumb-terminal emulation program” (aka ***USB** to **UART** software*)

Cons:

- not maintained (last update in the official repo is ~7 years old)

Pros:

- portable & cross-platform (Android, MacOS, FreeBSD)
- lightweight & simple
- *automation friendly*
- still **just works!**

picocom (cont.)

```
$ picocom --baud 115200 --databits 8 --parity n --flow n --stopbits 1 /dev/ttyACM0
picocom v2.2

port is        : /dev/ttyACM0
flowcontrol    : none
baudrate is    : 115200
parity is      : none
databits are   : 8
stopbits are   : 1
escape is      : C-a
local echo is  : no
noinit is      : no
noreset is     : no
nolock is      : no
send_cmd is    : sz -vv
receive_cmd is : rz -vv -E
imap is        :
omap is        :
emap is        : crcrlf,delbs,

Type [C-a] [C-h] to see available commands

Terminal ready

> help
Available commands
   help           Available commands
```

femtocom

"Bash-based helper for picocom"

Missing `picocom` profile manager for devices.

```
$ cat ~/.femtocomrc
; options from this section will be applied to ALL configurations
; [GLOBAL]
;       echo=

[hydrabus]
        baud=115200
        databits=8
        parity=n
        flow=n
        stopbits=1

$ femtocom hydrabus

====>>>> exit: hold CTRL and press: A X

====>>>> picocom --baud 115200 --databits 8 --parity n --flow n --stopbits 1 /dev/hydrabus

picocom v2.2

port is        : /dev/hydrabus
flowcontrol    : none
baudrate is    : 115200
parity is      : none
databits are   : 8
stopbits are   : 1
```

...

```
$ picocom --baud 115200 --databits 8 --parity n --flow n --stopbits 1 /dev/ttyACM0
picocom v2.2

port is        : /dev/ttyACM0
flowcontrol    : none
baudrate is    : 115200
parity is      : none
databits are   : 8
stopbits are   : 1
```

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```
$ femtocom hydrabus

====>>>> exit: hold CTRL and press: A X

====>>>> picocom --baud 115200 --databits 8 --parity n --flow n --stopbits 1 /dev/hydrabus

picocom v2.2

port is        : /dev/hydrabus
flowcontrol    : none
baudrate is    : 115200
parity is      : none
databits are   : 8
stopbits are   : 1
```

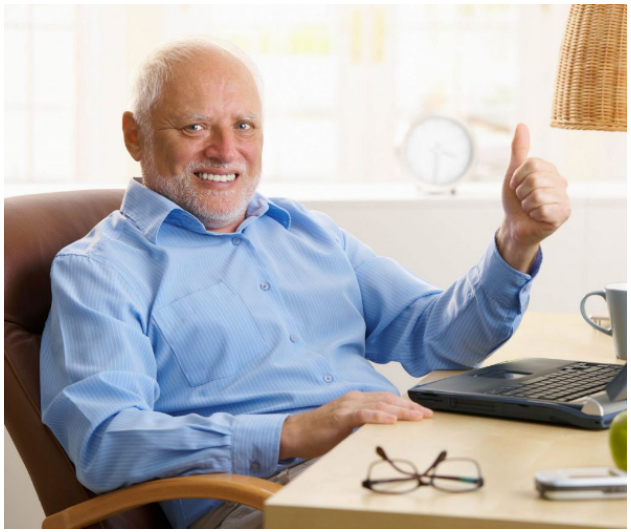
/etc/udev/rules.d/99-usb-user.rules

```
# Hydrabus board

## - set ignore for Modem Manager & permissions
ATTRS{idVendor}=="1d50", ATTRS{idProduct}=="60a7", ENV{ID_MM_DEVICE_IGNORE}="1",
ENV{ID_MM_TTY_BLACKLIST}="1", ENV{MTP_NO_PROBE}="1", ENV{ID_MM_PORT_IGNORE}="1",
ENV{ID_MM_TTY_MANUAL_SCAN_ONLY}="1", MODE="0664", GROUP="plugdev"

## - set symlink & permissions
SUBSYSTEM=="tty", ATTRS{bcdDevice}=="0200", ATTRS{idProduct}=="60a7", ATTRS{idVendor}
=="1d50", ATTRS{product}=="HydraBus 1.0 COM Port1", ATTRS{removable}=="removable",
ATTRS{version}==" 1.10", MODE="0664", GROUP="plugdev", SYMLINK+="hydrabus"

# usb-uart 5 pins model (5v & 3.3v)

SUBSYSTEM=="tty", ATTRS{bcdDevice}=="0300", ATTRS{idProduct}=="2303", ATTRS{idVendor}
=="067b", ATTRS{product}=="USB-Serial Controller", ATTRS{removable}=="removable",
ATTRS{version}==" 1.10", MODE="0664", GROUP="plugdev", SYMLINK+="uart"

# FT2232HL-based FTDI USB Serial Device converter

SUBSYSTEM=="tty", ATTRS{bcdDevice}=="0700", ATTRS{manufacturer}=="FTDI", ATTRS{idProduct}
=="6010", ATTRS{idVendor}=="0403", ATTRS{product}=="Dual RS232-HS", ATTRS{removable}
=="removable", ATTRS{version}==" 2.00", MODE="0664", GROUP="plugdev", SYMLINK+="ft2232hl"
```

PROFIT

- plug-in a device
- check `dmesg`
- find a name in `/dev`
- detect speed and other parameters
- run terminal emulator with parameters
- repeat on next plug-in

vs



- plug-in & configure once
- run at any time:

```
$ femtocom hydrabus
```

???

DEMO