

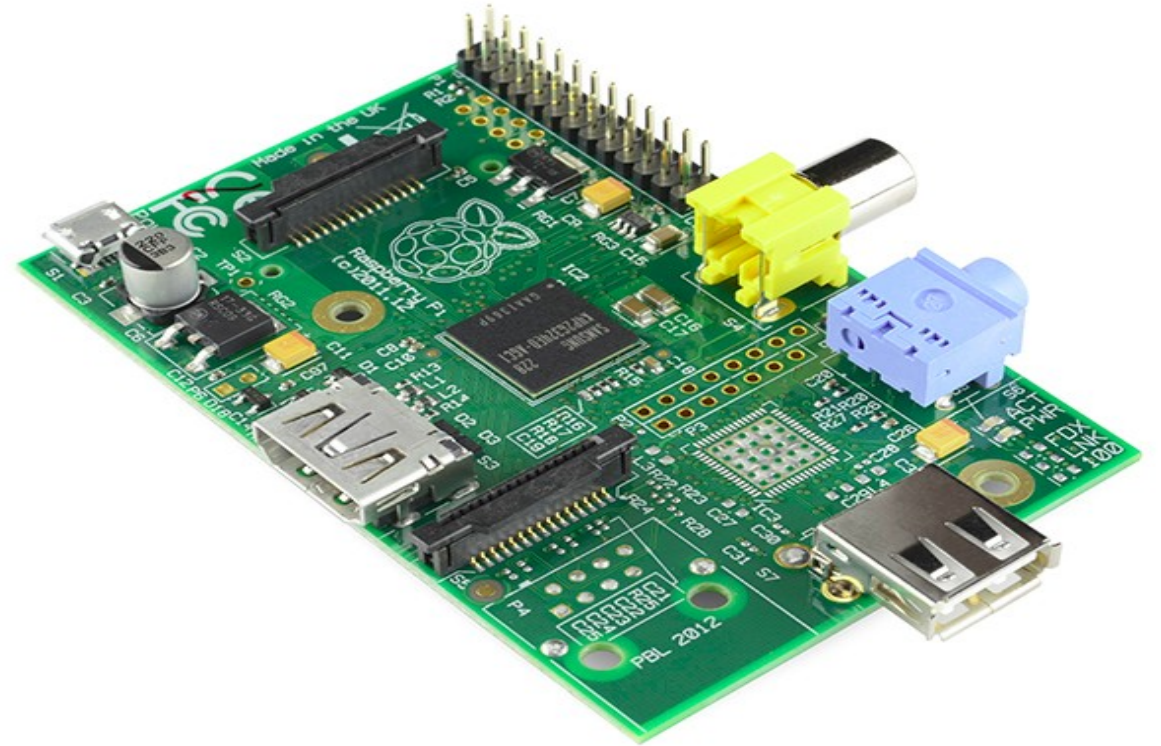
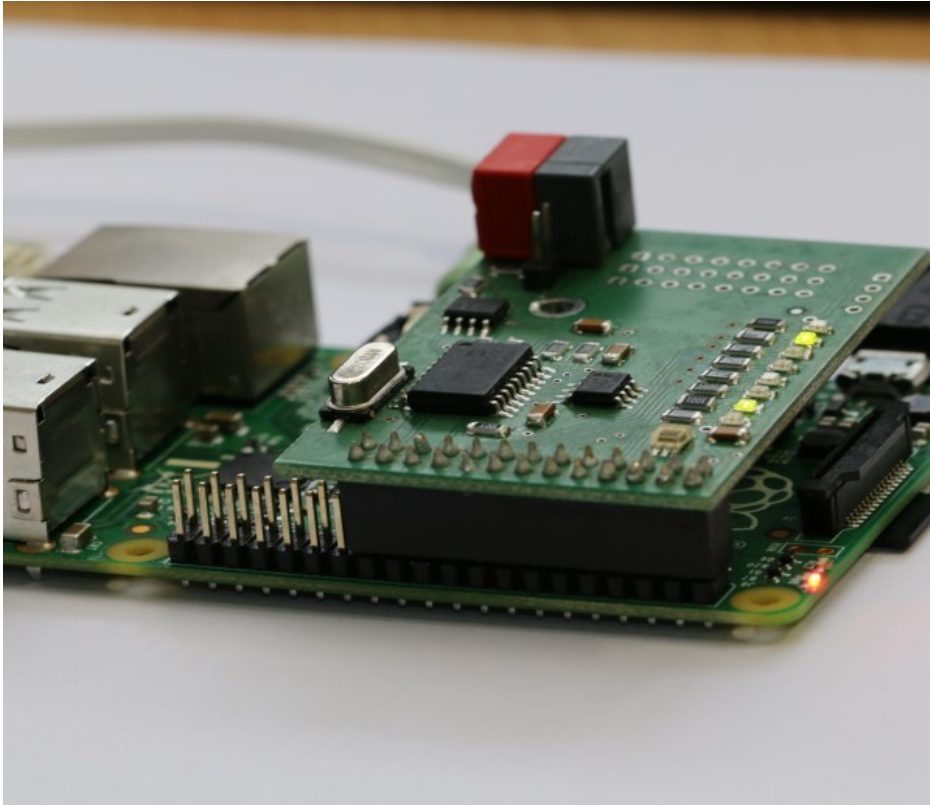
How to write a Linux device driver

Bart Tanghe – AmiEs 2015

Agenda

- Raspberry Pi
- Lack of official pwm driver
- PWM hardware
- PWM linux subsystem
- First commit
- Final commit
- Result

Raspberry Pi - Expansion board

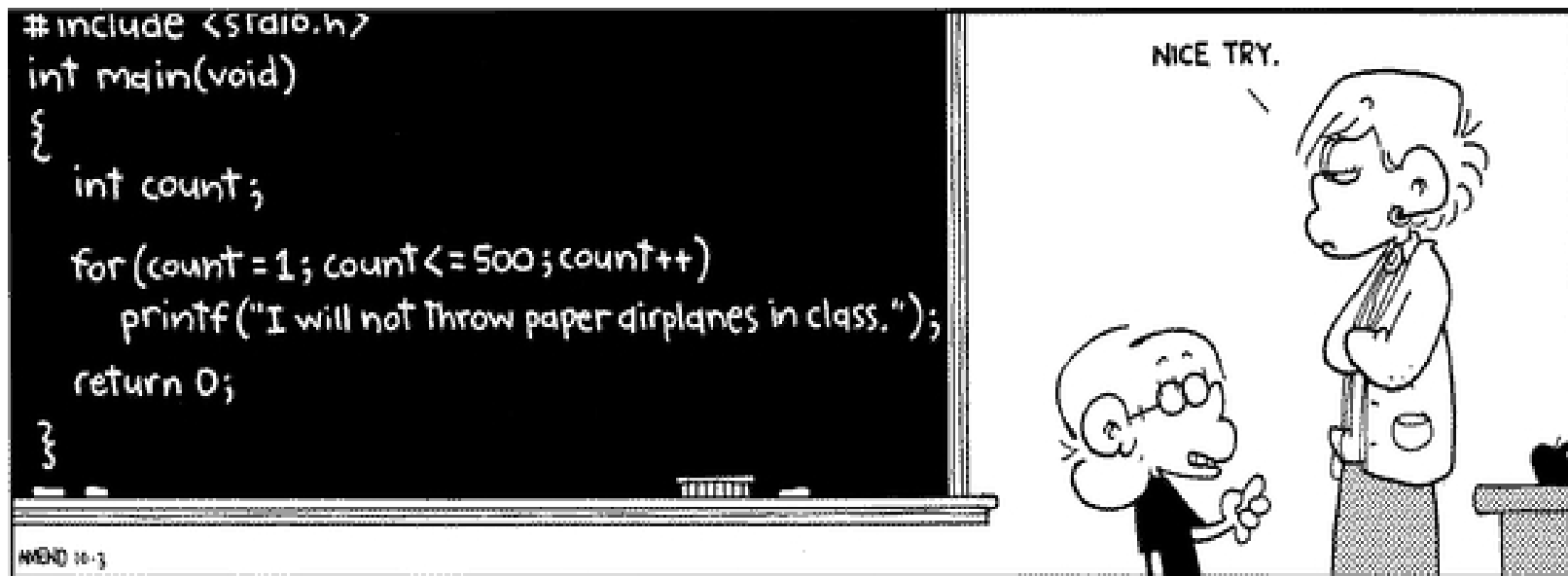


Lack of official pwm driver

- [Www.kernel.org](http://www.kernel.org) - no official accepted pwm driver
- Userspace program's (latency, security)
- Bcm2835 library (c/c++)
- Python raspberry pi pwm support (pwm_py)
- No uniform way of using PWM

Lack of official pwm driver

- Is it possible to write a accepted device driver as a human?



PWM hardware – pinmux

GPIO Numbers

Raspberry Pi B
Rev 1 P1 GPIO Header

	Pin No.		
3.3V	1	2	5V
GPIO0	3	4	5V
GPIO1	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18
GPIO21	13	14	GND
GPIO22	15	16	GPIO23
3.3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7

Raspberry Pi A/B
Rev 2 P1 GPIO Header

	Pin No.		
3.3V	1	2	5V
GPIO2	3	4	5V
GPIO3	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18
GPIO27	13	14	GND
GPIO22	15	16	GPIO23
3.3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7

Raspberry Pi B+
B+ J8 GPIO Header

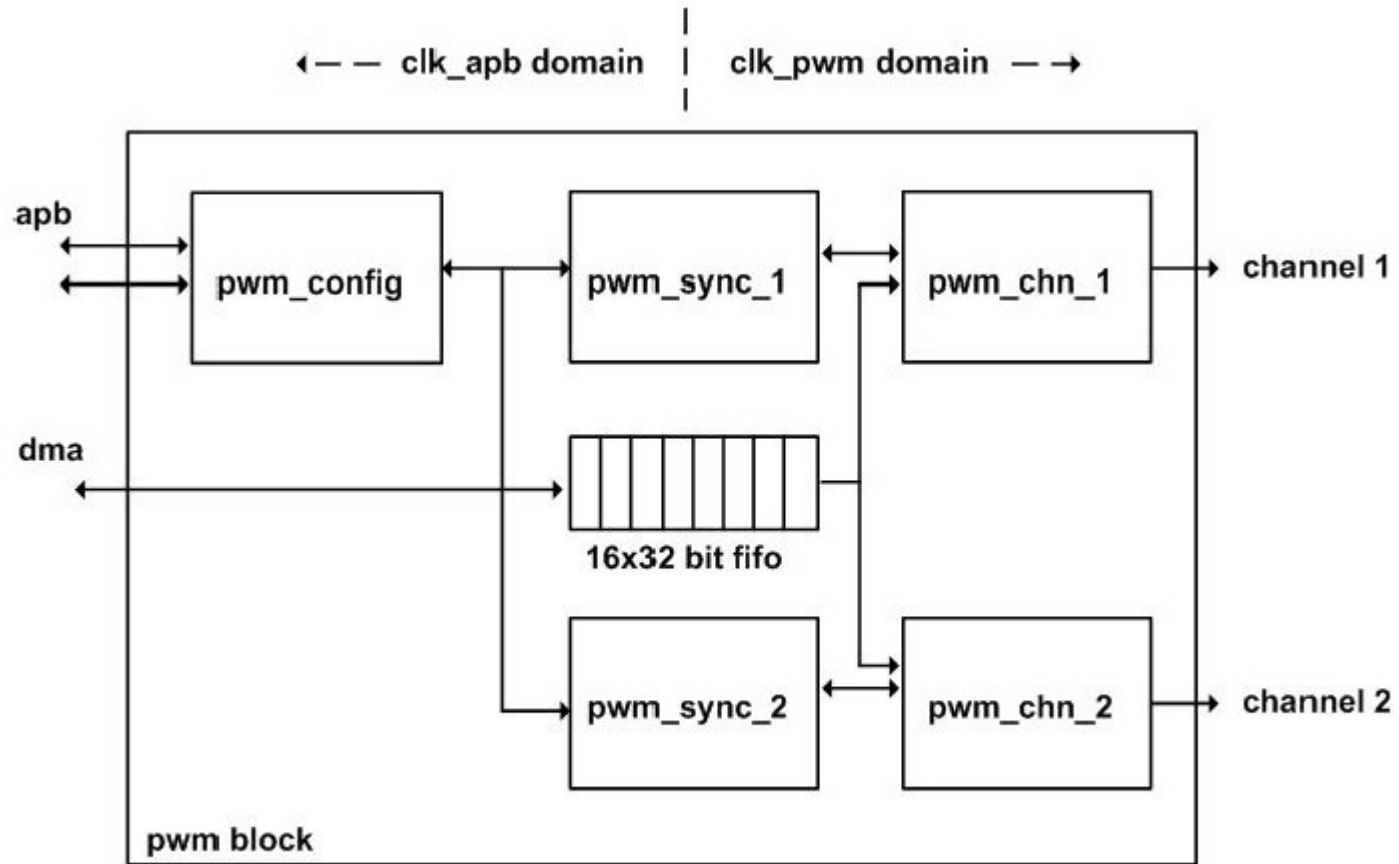
	Pin No.		
3.3V	1	2	5V
GPIO2	3	4	5V
GPIO3	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18
GPIO27	13	14	GND
GPIO22	15	16	GPIO23
3.3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7
DNC	27	28	DNC
GPIO5	29	30	GND
GPIO6	31	32	GPIO12
GPIO13	33	34	GND
GPIO19	35	36	GPIO16
GPIO26	37	38	GPIO20
GND	39	40	GPIO21

Key

Power +	UART
GND	SPI
I²C	GPIO

	PWM0	PWM1
GPIO 12	Alt Fun 0	-
GPIO 13	-	Alt Fun 0
GPIO 18	Alt Fun 5	-
GPIO 19	-	Alt Fun 5
GPIO 40	Alt Fun 0	-
GPIO 41	-	Alt Fun 0
GPIO 45	-	Alt Fun 0
GPIO 52	Alt Fun 1	-
GPIO 53	-	Alt Fun 1

PWM hardware – 2 channel PWM



PWM subsystem

- PWM kernel module

```
Device Drivers --->  
  <*> Pulse Width Modulation(PWM) Support
```

- BCM2835 driver

```
<M> BCM2835 PWM support
```


PWM driver description

pwm-bcm2835.c

```
tristate "BCM2835 PWM support"
```

```
depends on ARCH_BCM2835  
help
```

PWM framework driver for BCM2835 controller (Raspberry Pi)

To compile this driver as a module, choose M here: the module will be called pwm-bcm2835


First commit

- 3 Apr 2014 - first commit of patch to lkml
- 14 Apr 2014 - comment by serveral kernel developers
- 25 Apr 2014 - first big improvement commited
- 25 Aug 2015 - comment by PWM maintainer
- 22 Sept 2015 - commited by Linus Torvalds into kernel tree

Conclusion

- A very instructive process of writing software
- Working together with several developers
- Add functionality to the linux kernel
- Help people to get pwm working on Raspberry Pi

Result



```
1 /*
2  * Copyright 2014 Bart Tanghe <bart.tanghe@thomasmore.be>
3  *
4  * This program is free software; you can redistribute it and/or modify
5  * it under the terms of the GNU General Public License as published by
6  * the Free Software Foundation; version 2.
7  */
8
9 #include <linux/clock.h>
10 #include <linux/err.h>
11 #include <linux/io.h>
12 #include <linux/module.h>
13 #include <linux/of.h>
14 #include <linux/platform_device.h>
15 #include <linux/pwm.h>
16
17 #define PWM_CONTROL          0x000
18 #define PWM_CONTROL_SHIFT(x) ((x) * 8)
19 #define PWM_CONTROL_MASK    0xff
20 #define PWM_MODE             0x80      /* set timer in PWM mode */
21 #define PWM_ENABLE           (1 << 0)
22 #define PWM_POLARITY         (1 << 4)
23
24 #define PERIOD(x)            (((x) * 0x10) + 0x10)
25 #define DUTY(x)              (((x) * 0x10) + 0x14)
```