Phil Nevins
ECE 373
Assignment #3

I. PART 1: Digging for Details

1. **Atomic Motherboards (go boom)**
   a. Realtek ALC888
   b. Super IO Winbond W83627DHG
   c. 2 LAN devices
      i. GbE LAN1: Intel 82567V
      ii. GbE LAN2: Intel 82583V
   d. 6 serial ports. In the specification section we can see it has 3 rear IO 3 (2 of RS-232,1 of RS-232/422/485) serial ports. And it also has 3 (RS-232) internal serial ports.

2. **Network Noodling**
   LAN2 Intel 822583V
   a.

Signal	Pin
LED0	31
LED1	30
LED2	33

   b. Device Control Register offset - 0x00000 / 0x00004
   c. Bit 26 (400000_hex)

3. **Winken, Blinken, and Nod**

   9.2.2.14 **LED Control** - LEDCTL (0x00E00; RW)

Field	Bit(s)	Initial Value	Description
LED0_MODE	3:0	0010b[1]	LED0 (LINK_UP_N) Mode This field specifies the control source for the LED0 output. An initial value of 0010b selects LINK_UP indication.
Reserved	4	0b	Reserved Read-only as 0b. Write as 0b for future compatibility.
GLOBAL_BLINK_MODE	5	0b[1]	Global Blink Mode This field specifies the blink mode of all LEDs. 0b = Blink at 200 ms on and 200 ms off. 1b = Blink at 83 ms on and 83 ms off.
LED0_IVRT	6	0b[1]	LED0 (LINK_UP_N) Invert This field specifies the polarity/ inversion of the LED source prior to output or blink control. 0b = Do not invert LED source. 1b = Invert LED source.
LED0_BLINK	7	0b[1]	LED0 (LINK_UP_N) Blink This field specifies whether to apply blink logic to the (inverted) LED control source prior to the LED output. 0b = do not blink asserted LED output. 1b = blink asserted LED output.

   a.
   LED Control – LEDCTL 0x00E00

			LED1 (ACTIVITY_N) Mode
LED1_MODE	11:8	0011b[1]	This field specifies the control source for the LED1 output. An initial value of 0011b selects ACTIVITY indication.

b.

1110	LED_ON	Always asserted.
1111	LED_OFF	Always de-asserted.

From the above screenshot we can see we write a 1111-bit pattern to the LED1_MODE register bits 11:8 this will turn off LED1 until we write a 1110 to turn the LED1 back on.

Field	Bit(s)	Initial Value	Description
LED2_MODE	19:16	0110b[1]	LED2 (LINK_100_N) Mode This field specifies the control source for the LED2 output. An initial value of 0110b selects LINK_100 indication.
Reserved	20	0b	Reserved Read-only as 0b. Write as 0b for future compatibility.
LED2_BLINK_MODE	21	0b[1]	LED2 (LINK_100_N) Blink Mode This field needs to be configured with the same value as GLOBAL_BLINK_MODE, it specifies the blink mode of the LED. 0b = Blink at 200 ms on and 200 ms off. 1b = Blink at 83 ms on and 83 ms off.
LED2_IVRT	22	0b[1]	LED2 (LINK_100_N) Invert.
LED2_BLINK	23	0b[1]	LED2 (LINK_100_N) Blink
Reserved	31:24	0x0	Reserved

c.

Here we can see we would want to set the LED2_MODE first for constant on we would write 1110 we would then want to set the LED blink mode by writing to LED2_BLINK_MODE bit 21 to set blink timing 1 for 83ms blink and 0 for 200 ms blink then we would write to LED2_BLINK bit 23 and we would write a 1 to turn the led blinking on.

II.   PART 2: Make it Blink

Source code, typescript file (attempt3) and makefile are in zipped folder with this document

```
root@Linux-Unbuntu-22:/home/pnevins/Document: writing 0000000e to the driver to turn on LED0
00:03 LEDs:   . . . . . .                      Writing 0000000f to the driver to turn off LED0
                                               pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
                                               The value from the driver is 0000000f
                                               Writing 0000000e to the driver to turn on LED0
                                               Writing 0000000f to the driver to turn off LED0
                                               pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
                                               The value from the driver is 0000000f
                                               Writing 0000000e to the driver to turn on LED0
                                               Writing 0000000f to the driver to turn off LED0
                                               pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
                                               The value from the driver is 0000000f
                                               Writing 0000000e to the driver to turn on LED0
                                               SWriting 0000000f to the driver to turn off LED0
                                               pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
```

Before running userspacehw3 (previous ones were tests)

LED signaled on (by the left most 0)

```
hw3_pci_driver.c    hw3_pci_driver.mod.o  led
hw3_pci_driver.ko   hw3_pci_driver.o      led
root@Linux-Unbuntu-22:/home/pnevins/Document
00:03 LEDs:    0 . . . . .
```

```
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
Writing 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
Writing 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
SWriting 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
```


LED off

```
hw3_pci_driver.ko  hw3_pci_driver.o       led
root@Linux-Unbuntu-22:/home/pnevins/Document
00:03 LEDs:    . . . . . .
```

```
Writing 0000000e to the driver to turn on LED0
Writing 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
Writing 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
SWriting 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$ sudo ./userspacehw3
The value from the driver is 0000000f
Writing 0000000e to the driver to turn on LED0
Writing 0000000f to the driver to turn off LED0
pnevins@Linux-Unbuntu-22:~/Documents/Homework/HW3$
```

9.2.2.14   LED Control - LEDCTL (0x00E00; RW)

Field	Bit(s)	Initial Value	Description
LED0_MODE	3:0	0010b[1]	LED0 (LINK_UP_N) Mode This field specifies the control source for the LED0 output. An initial value of 0010b selects LINK_UP indication.
Reserved	4	0b	Reserved Read-only as 0b. Write as 0b for future compatibility.
GLOBAL_BLINK_MODE	5	0b[1]	Global Blink Mode This field specifies the blink mode of all LEDs. 0b = Blink at 200 ms on and 200 ms off. 1b = Blink at 83 ms on and 83 ms off.
LED0_IVRT	6	0b[1]	LED0 (LINK_UP_N) Invert This field specifies the polarity/ inversion of the LED source prior to output or blink control. 0b = Do not invert LED source. 1b = Invert LED source.
LED0_BLINK	7	0b[1]	LED0 (LINK_UP_N) Blink This field specifies whether to apply blink logic to the (inverted) LED control source prior to the LED output. 0b = do not blink asserted LED output. 1b = blink asserted LED output.
LED1_MODE	11:8	0011b[1]	LED1 (ACTIVITY_N) Mode This field specifies the control source for the LED1 output. An initial value of 0011b selects ACTIVITY indication.
Reserved	12	0b	Reserved Read-only as 0b. Write as 0 for future compatibility.
LED1_BLINK_MODE	13	0b[1]	LED1 (ACTIVITY_N) Blink Mode This field needs to be configured with the same value as GLOBAL_BLINK_MODE, it specifies the blink mode of the LED. 0b = Blink at 200 ms on and 200 ms off. 1b = Blink at 83 ms on and 83 ms off.
LED1_IVRT	14	0b[1]	LED1 (ACTIVITY_N) Invert.
LED1_BLINK	15	1b[1]	LED1 (ACTIVITY_N) Blink

Field	Bit(s)	Initial Value	Description
LED2_MODE	19:16	0110b[1]	LED2 (LINK_100_N) Mode This field specifies the control source for the LED2 output. An initial value of 0110b selects LINK_100 indication.
Reserved	20	0b	Reserved Read-only as 0b. Write as 0b for future compatibility.
LED2_BLINK_MODE	21	0b[1]	LED2 (LINK_100_N) Blink Mode This field needs to be configured with the same value as GLOBAL_BLINK_MODE, it specifies the blink mode of the LED. 0b = Blink at 200 ms on and 200 ms off. 1b = Blink at 83 ms on and 83 ms off.
LED2_IVRT	22	0b[1]	LED2 (LINK_100_N) Invert.
LED2_BLINK	23	0b[1]	LED2 (LINK_100_N) Blink
Reserved	31:24	0x0	Reserved

1. These bits are read from the NVM.

The following mapping is used to specify the LED control source (MODE) for each LED output:

MODE	Selected Mode	Source Indication
0000	LINK_10/1000	Asserted when either 10 or 1000 Mb/s link is established and maintained.
0001	LINK_100/1000	Asserted when either 100 or 1000 Mb/s link is established and maintained.
0010	LINK_UP	Asserted when any speed link is established and maintained.
0011	FILTER_ACTIVITY	Asserted when link is established and packets are being transmitted or received that passed MAC filtering.
0100	LINK/ACTIVITY	Asserted when link is established AND when there is NO transmit or receive activity.
0101	LINK_10	Asserted when a 10 Mb/s link is established and maintained.
0110	LINK_100	Asserted when a 100 Mb/s link is established and maintained.
0111	LINK_1000	Asserted when a 1000 Mb/s link is established and maintained.
1000	Reserved	Reserved
1001	FULL_DUPLEX	Asserted when the link is configured for full-duplex operation.
1010	COLLISION	Asserted when a collision is observed.
1011	ACTIVITY	Asserted when link is established and packets are being transmitted or received.
1100	BUS_SIZE	Asserted when the device detects a 1-lane PCIe connection.
1101	PAUSED	Asserted when the device's transmitter is flow controlled.
1110	LED_ON	Always asserted.
1111	LED_OFF	Always de-asserted.

Notes:

1. When LED blink mode is enabled the appropriate *LED Invert* bit should be set to zero.

2. The dynamic Leds modes (FILTER_ACTIVITY, LINK/ACTIVITY, COLLISION, ACTIVITY, PAUSED) should be used with LED blink mode enabled.

3. When LED blink mode is enabled and CCM PLL is shut, the blinking frequencies are 1/5 of the rates stated in the previous table.