Programmable PWM

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Motivation Programmable PWM (PPWM)

- Pulse Width Modulation (PWM) to control the average active power
- Within a fixed time window, the ration between on and off state is used to control the average output
- Typically used as a peripheral in a microcontroller
- To change the behavior, the CPU needs to interact with the peripheral and set a new pulse width
- Timers and interrupts are used to make this change over time

A lot of work for the CPU, can we offload it?

Idea PPWM

- A new PWM peripheral with its own control logic
- Use a program and an execution unit to manipulate the duty cycle independently

Challenge:

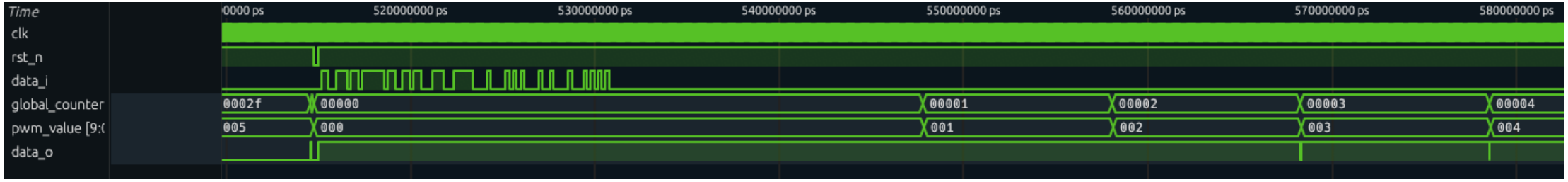
- Small number of instruction types
- Reduced width of instruction size
- Restricted program length

PPWM Implementation

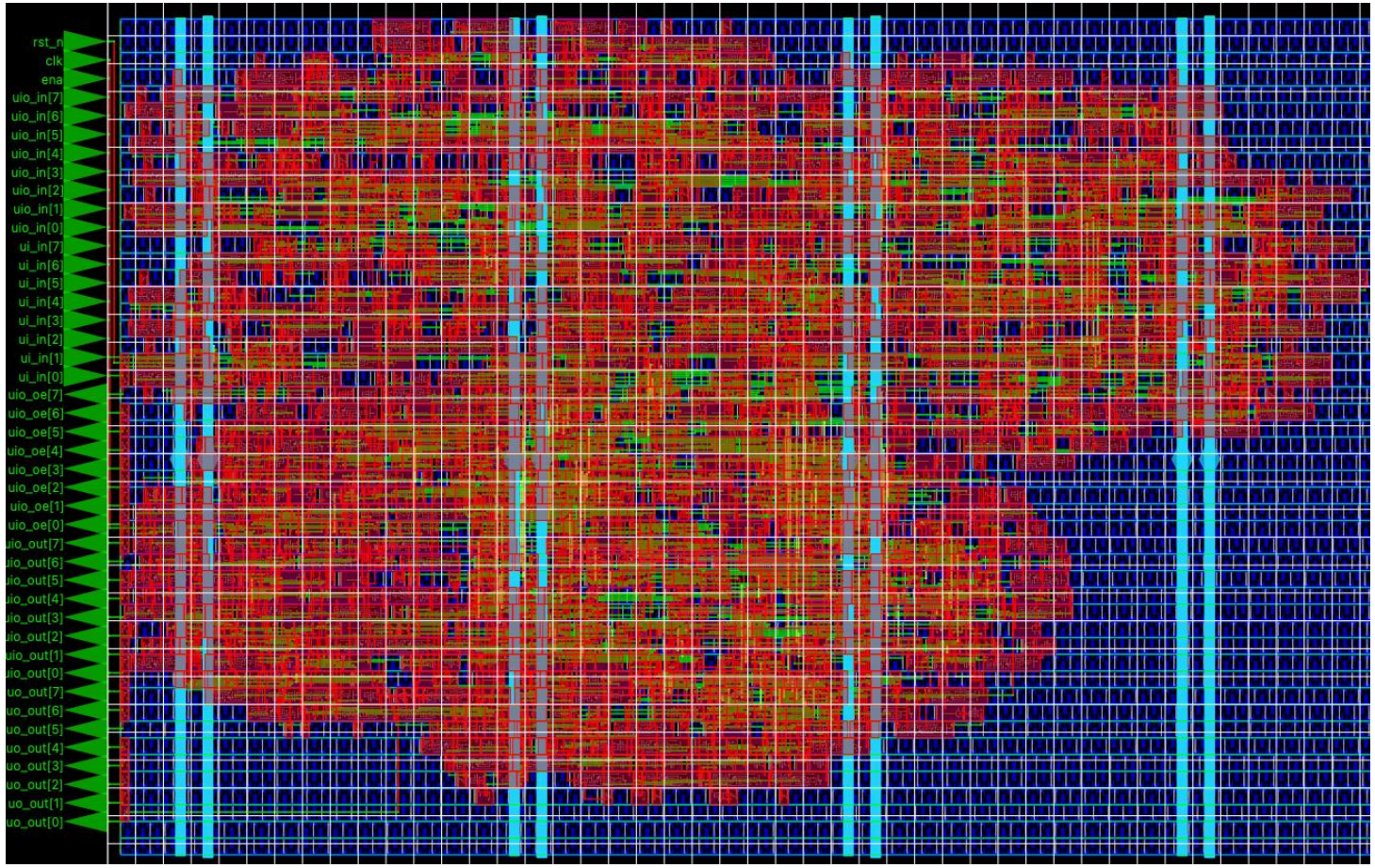
- 8 different instructions
- Program length 16 (stored in registers on-chip)
- Global counter for long-term timing comparison
- 1 output signal (PWM)
- 2 input signals (data and clock to program the memory)

Testbench

```
0b011_1_001,      # 0 set reg, 3
0b11_1_1_011,     # 1 shift reg left
0b00_1_1_011,     # 2 shift reg left
0b00_1_1_011,     # 3 shift reg left
0b0_001_110,      # 4 cmp global counter < reg
0b0011_111,       # 5 branch #8
0b0_000_100,      # 6 mv reg to pwm
0b0010_101,       # 7 jump +2
0b0_100_100,      # 8 mv global counter l to pwm
0b0001_000,       # 9 ctrl wait
0b1010_101,       # a jump #4
```



Layout


rst_n
clk
ena
uio_in[7]
uio_in[6]
uio_in[5]
uio_in[4]
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uio_in[2]
uio_in[1]
uio_in[0]
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