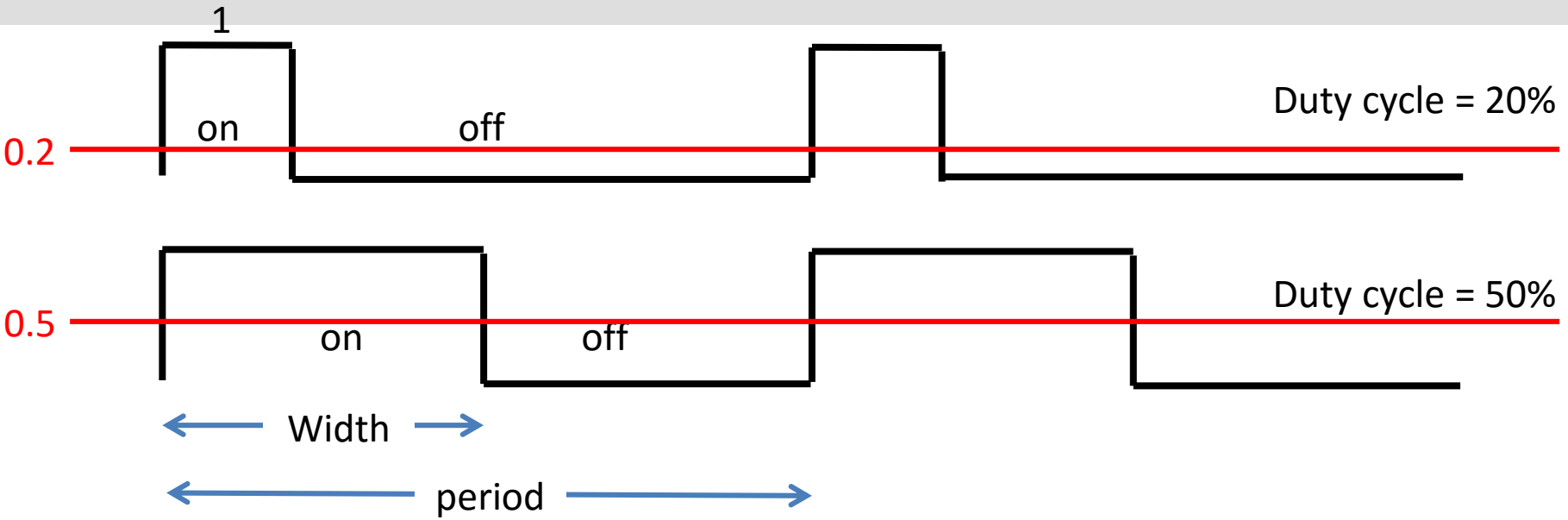
Introduction to Pulse Width Modulation (PWM)

What is PWM

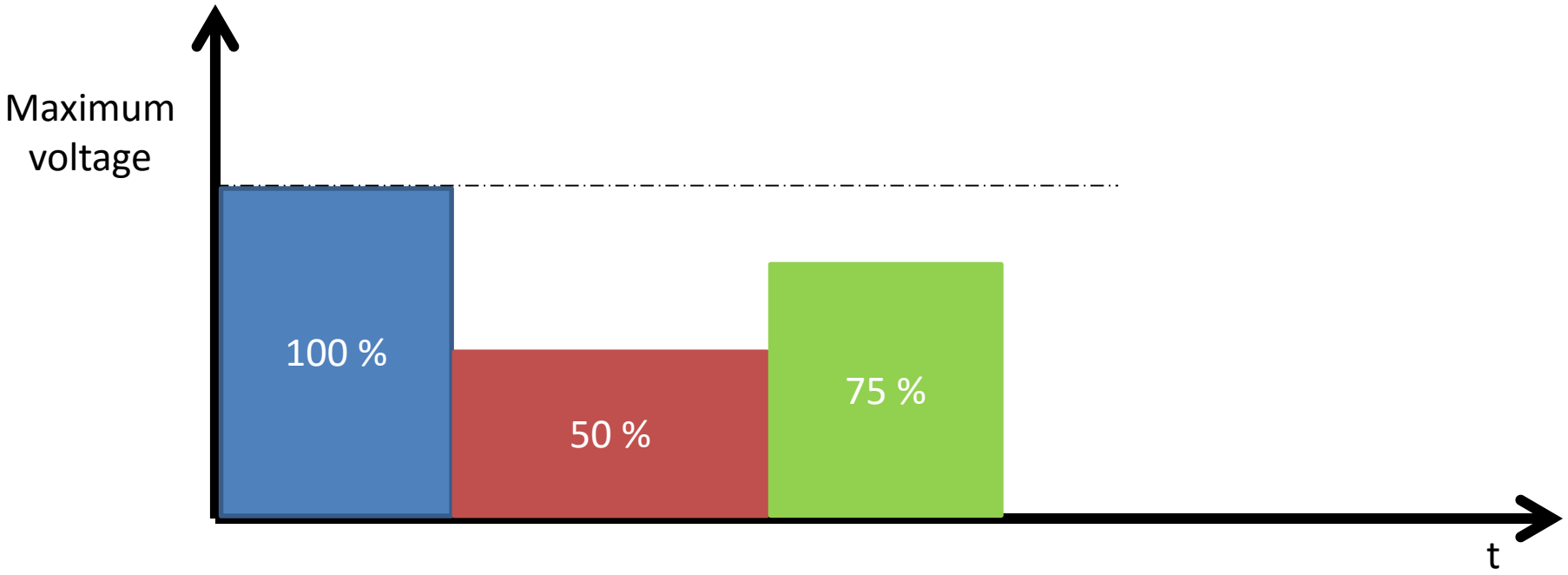
- Output signal alternates between on and off within specified period.
- Control the power received by a device.
- The voltage seen by the load is directly proportional to the source voltage.

What is PWM?



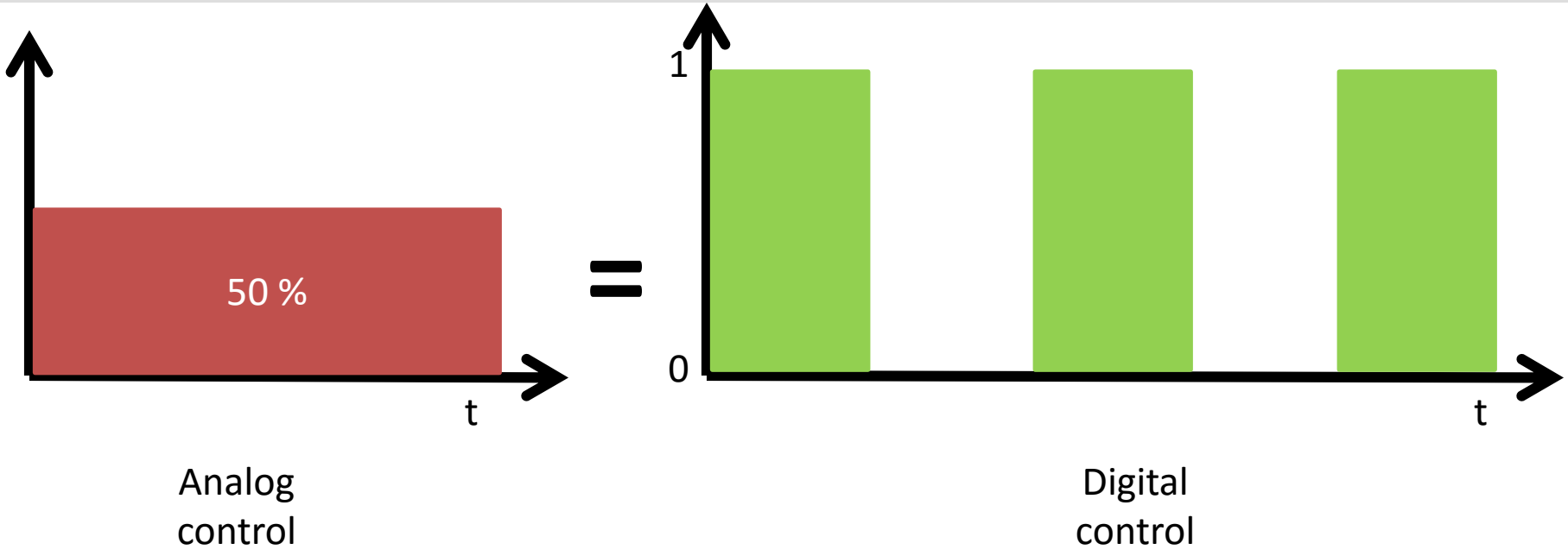
- Depending on the requirement the width of the pulse is modulated (adjusted).
- Duty cycle = t_{on} / (t_{on} + t_{off}).

Why PWM?



- Analog voltage control:
  - Voltage can be changed to control the motor speed
  - Can NIOS change voltage ?

Why PWM?



- Digital voltage control:
  - Can only control ‘1’ and ‘0’
  - X% of maximum analog voltage = X% of duty cycle

How to generate PWM signal ?

- Software method
  - Using counter
    - Count to 100 in a loop
    - Set the output value to 1 in the beginning of the loop
    - Set the output value to 0 as soon as the counter reaches the value of required duty cycle.
    - Continue the process
  - Using interrupt
    - Home work
    - Think about the concept

Your tasks

- Create projects in a usual way using provided SOPCINFO file.
- Type the code in your application project.
- Change duty cycle variable and observe the effect on oscilloscope or LED.
- Using oscilloscope, verify the duty cycle.
  - Is it precise?
  - Is it efficient?

Software PWM

- Output pin:
  - **GPIO_0[0]**
  - Using the manual find out the correct pin and observe the resulting PWM on the oscilloscope
  - In C program, use the following instructions to change the output
    - IOWR(**PIO_0_BASE**, 0, 0); // set output 0
    - IOWR(**PIO_0_BASE**, 0, 1); // set output 1
- Control LED (optional):
  - Apply the PWM signal to LED, observe the intensity

Questions