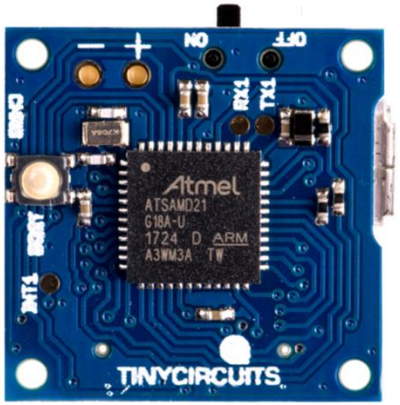
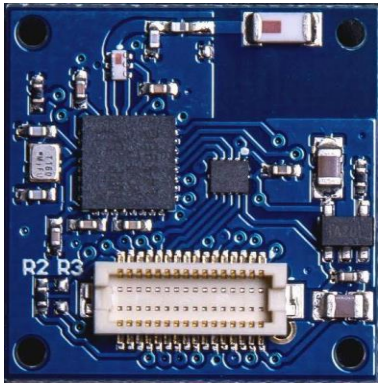
CSE190 Winter 2025



Lecture 6

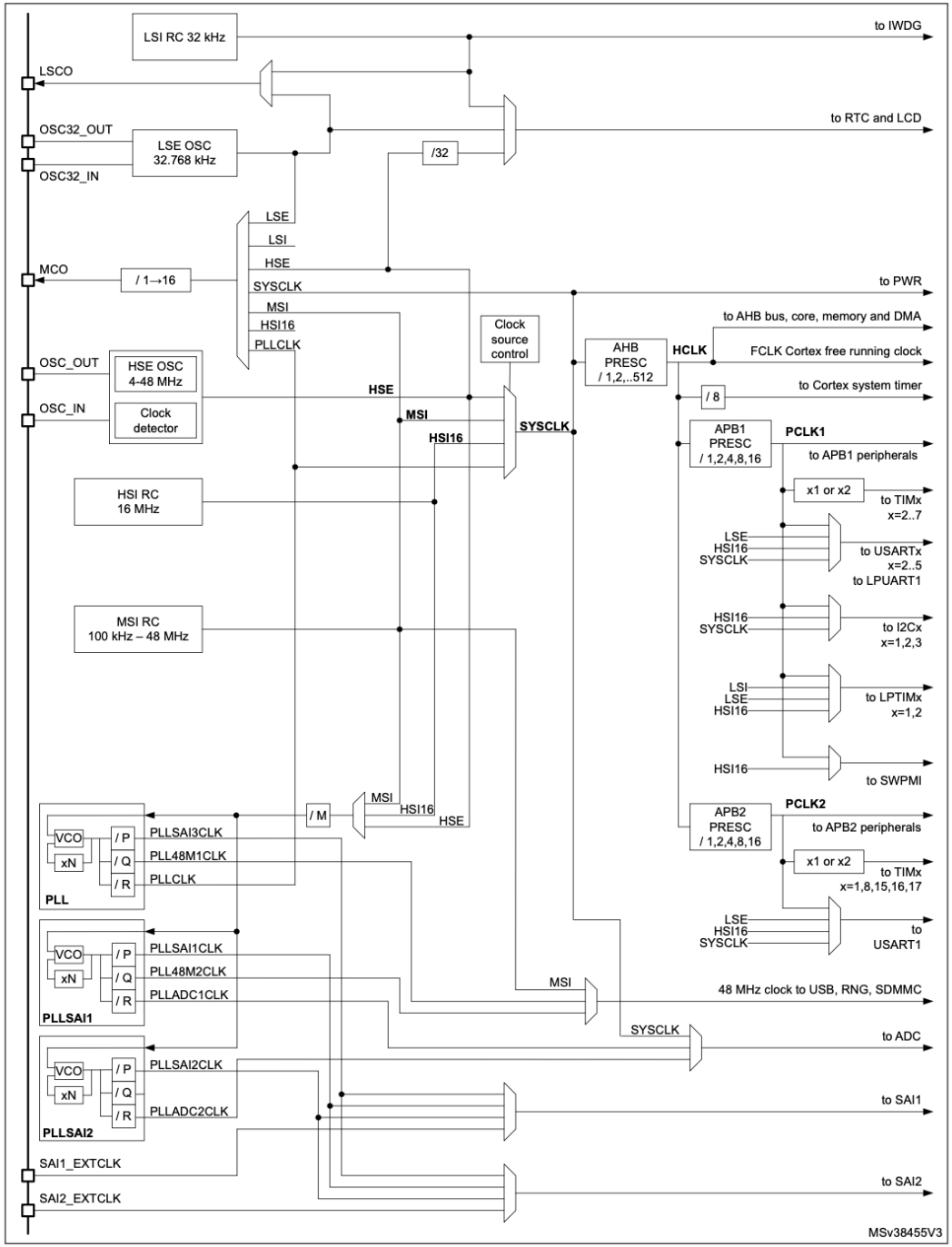
Time



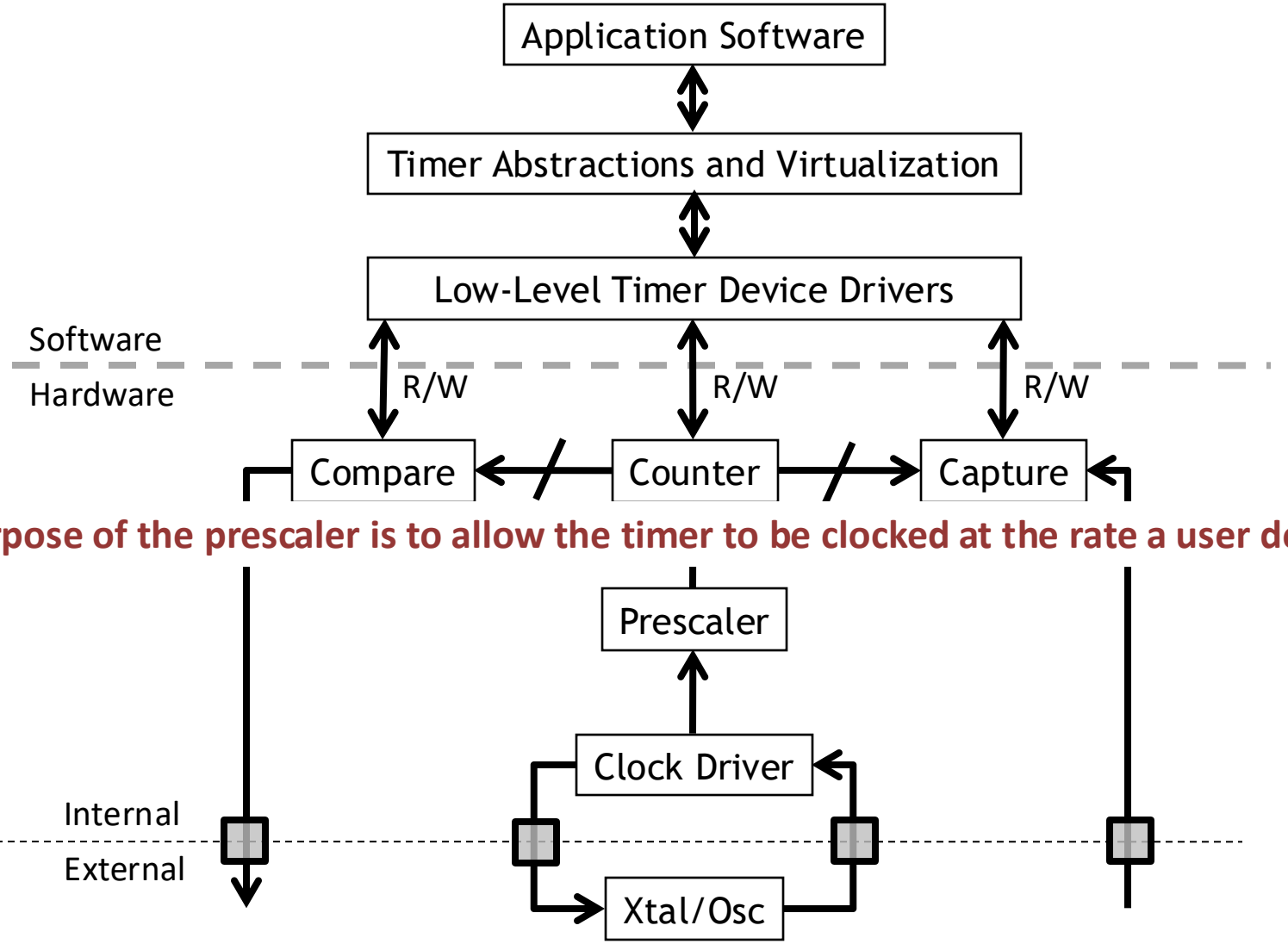
Wireless Embedded Systems

Aaron Schulman

Figure 15. Clock tree (for STM32L47x/L48x devices)



Timer: A peripheral for tracking time



The purpose of the prescaler is to allow the timer to be clocked at the rate a user desires.

Frequency depends on the attached oscillator device

Figure adapted from Prabal Dutta's EE373 slides

Timers, why do we need them?

In the first project, what do we need timers for?

- Determining when to change LEDs
  - 20 Hz means change LED bits every 50 milliseconds
  - How to measure 50 ms?
  - Option 1: Use the timer hardware to let you know when 50 ms has passed.
  - Option 2: Count how many processor cycles it would take to equal 50 ms.

How does the number in the counter register correspond to wall clock time?

Frequency (Hz) = Cycles / Second

1 / Frequency (Hz) = Seconds / Cycle

The counter is incremented once per cycle.

You read 100 from the counter register which is clocked by a 1 MHz oscillator. How much time has passed since the counter was reset?

How should we choose the OSC frequency?

For timers, there will often be a tradeoff between resolution (high resolution requires a high clock rate) and range (high clock rates cause the timer to overflow more quickly).

1MHz OSC: resolution = 1 / 1e6 second = 1us
10MHz OSC: resolution = 1/10e6 second = 0.1us

16-bits timer:
1MHz OSC: max range = 1 / 1e6 * 2^16 = 65.536ms
10MHz OSC: max range = 1/10e6 * 2^16 = 6.5536ms

How does a firmware developer use the capture register?

1. Stop the timer
2. Setup the timer to capture when a particular event occurs (e.g., change of GPIO pin)
3. Reset the counter
4. Start the timer
5. Wait for the counter to reach a capture event
   (via interrupt or check status reg)