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DesignNews

Mastering Zephyr RTOS

DAY 5 : Debugging, Logging, and Best Practices

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THE SPEAKER

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jacobbeningo

Beningo Embedded Group – CEO / Founder

Focus: Software Architecture, Processes, and Dev Skills

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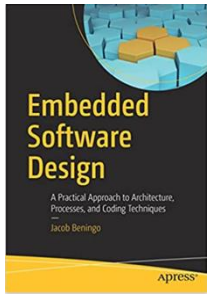

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Debugging

01

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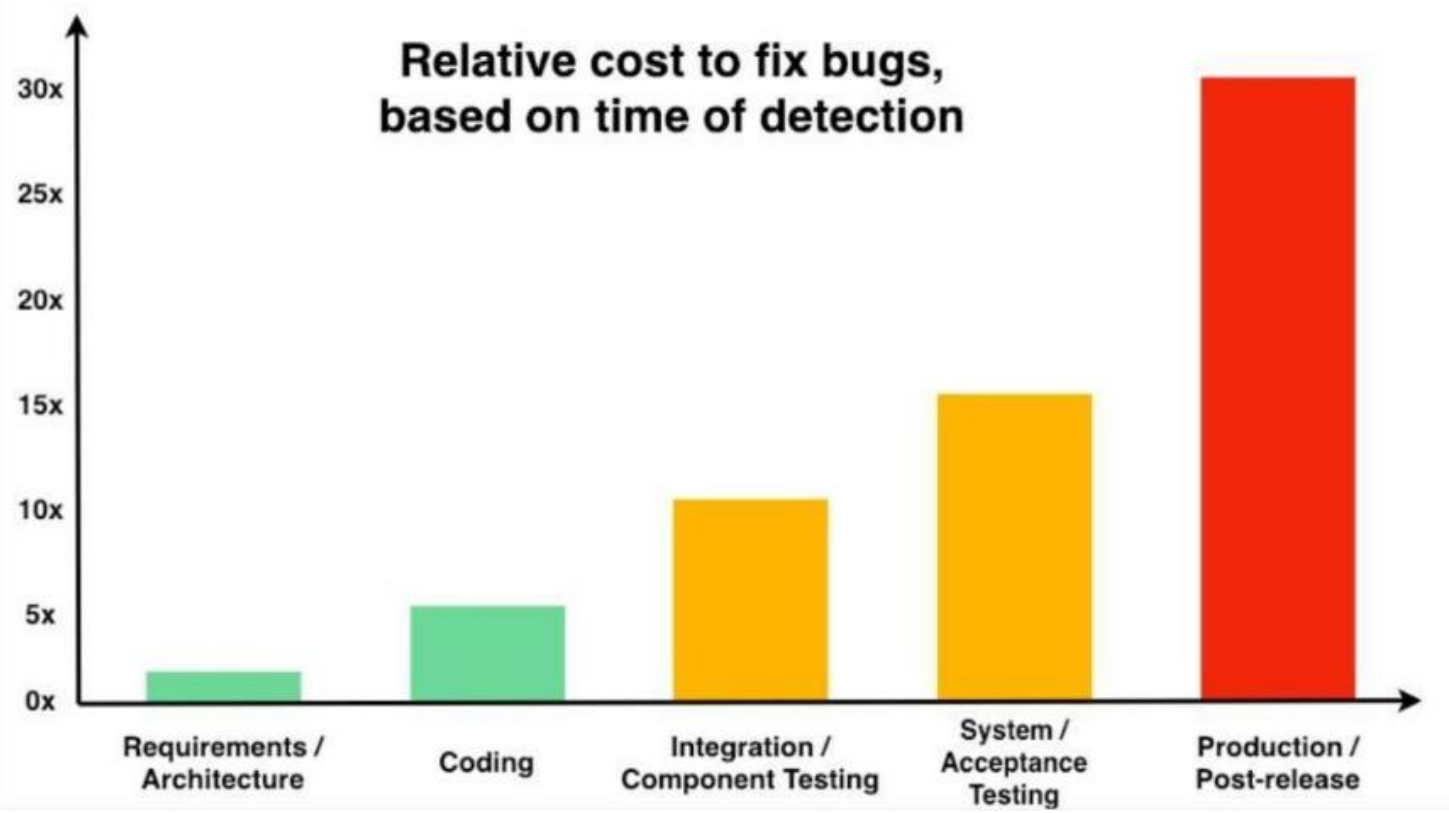
Bugging is Expensive!



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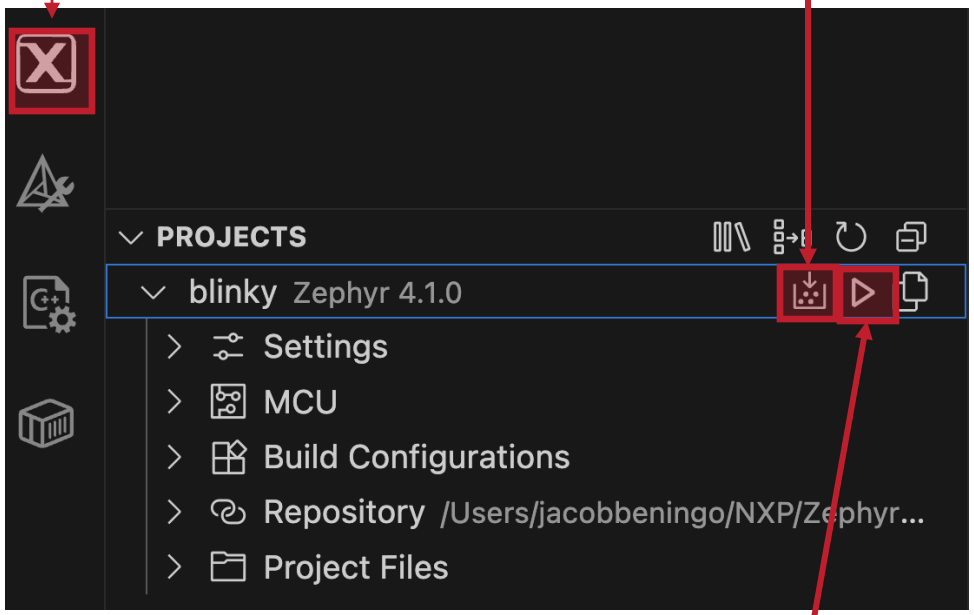
Debug Using VS Code

MCUXpresso for VS Code Extension

Compile



Debug

synchronization > .vscode > {} launch.json > Launch Targets > {} Debug with SEGGER J-Link

```
{
  "configurations": [
    {
      "type": "mcuxpresso-debug",
      "name": "Debug with SEGGER J-Link",
      "request": "launch",
      "cwd": "${workspaceFolder}",

      "executable": "${workspaceFolder}/build/zephyr/zephyr.elf",
      "stopAtSymbol": "main",
      "probeSerialNumber": "505100646",
      "isAttach": false,
      "probeType": "SEGGER",
      "skipBuildBeforeDebug": false,
      "skipPreFlashActions": false,

      "gdbInitCommands": [
        "set remotetimeout 600",
        "set debug-file-directory",
        "set non-stop off"
      ],
```

blinky > src > C main.c > main(void)

```
61
49      while (1) {
50          gpio_pin_set_dt(&led0, led_state);
51          gpio_pin_set_dt(&my_led, led_state);
52
53          printk("Blink! LED0 and myLED state: %s\n", led_state ?
54
55          led_state = !led_state;
56          k_msleep(SLEEP_TIME_MS);
57      }
58
59      return 0;
60  }
```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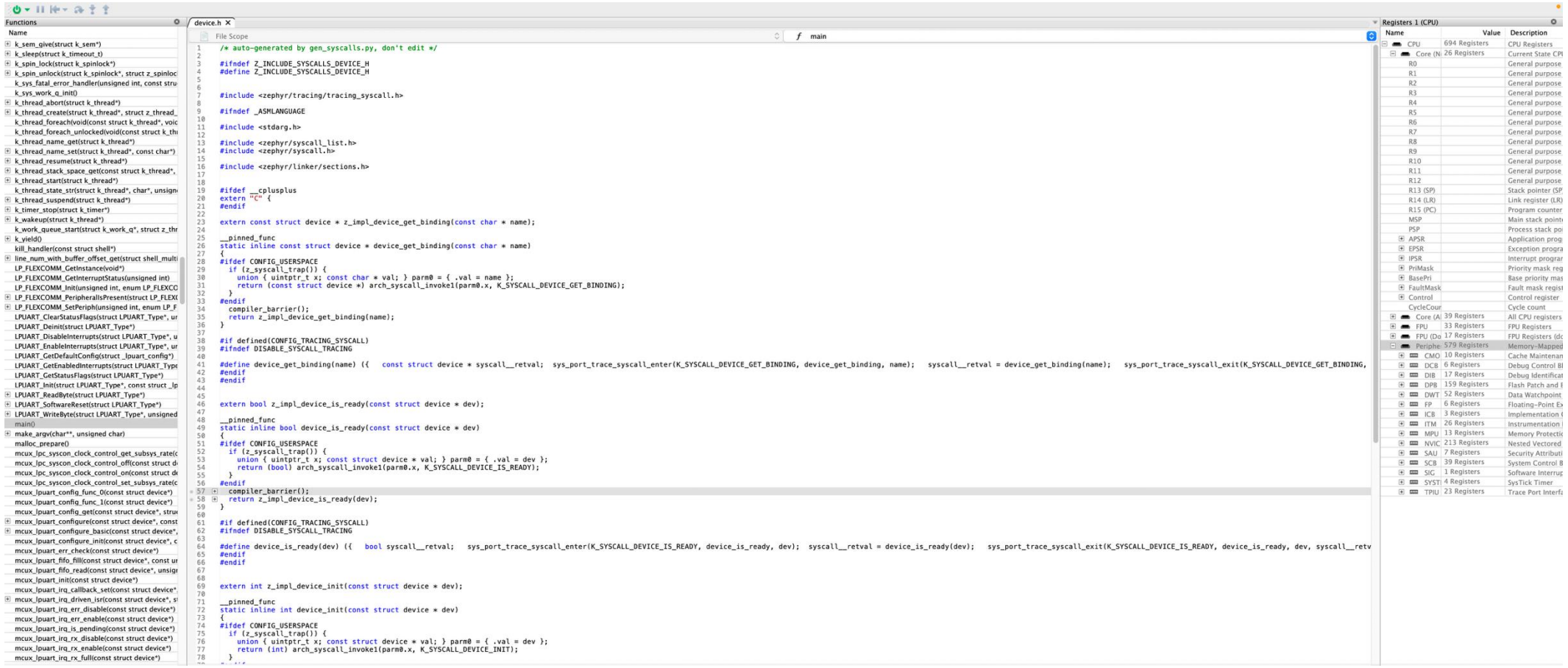
SEGGER Ozone



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Audience POLL Question

What is your preference for debugging your Zephyr RTOS applications?

a) Using raw gdb with west debug
b) Using Visual Studio Code
c) Using SEGGER Ozone
d) Using run-time capabilities like logs, the shell, etc

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Debug Trace

02

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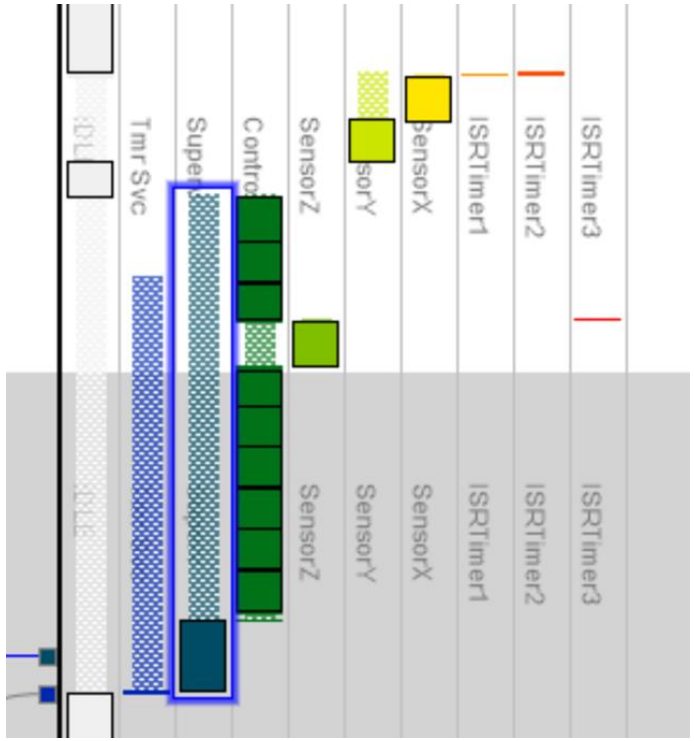
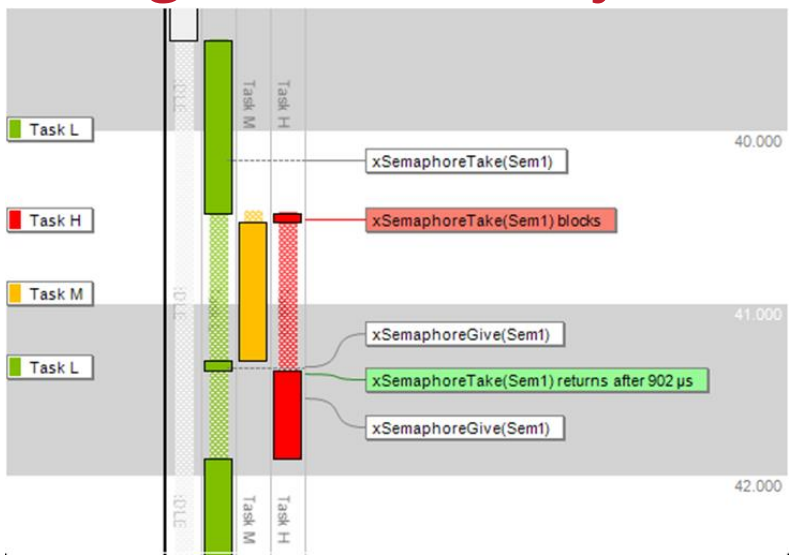
The Power of Tracing

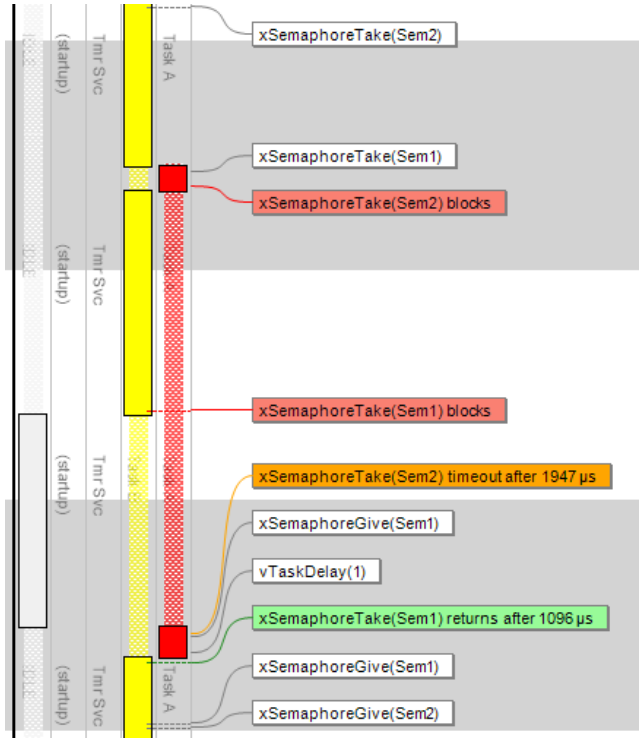
Danger #1 – Task



Danger #2 – Priority



Danger #3 - Deadlock



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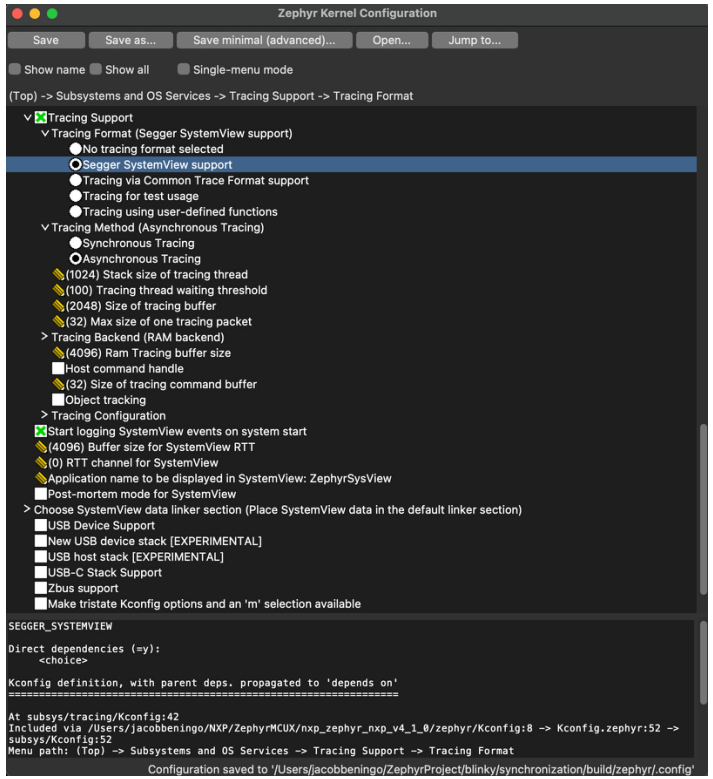
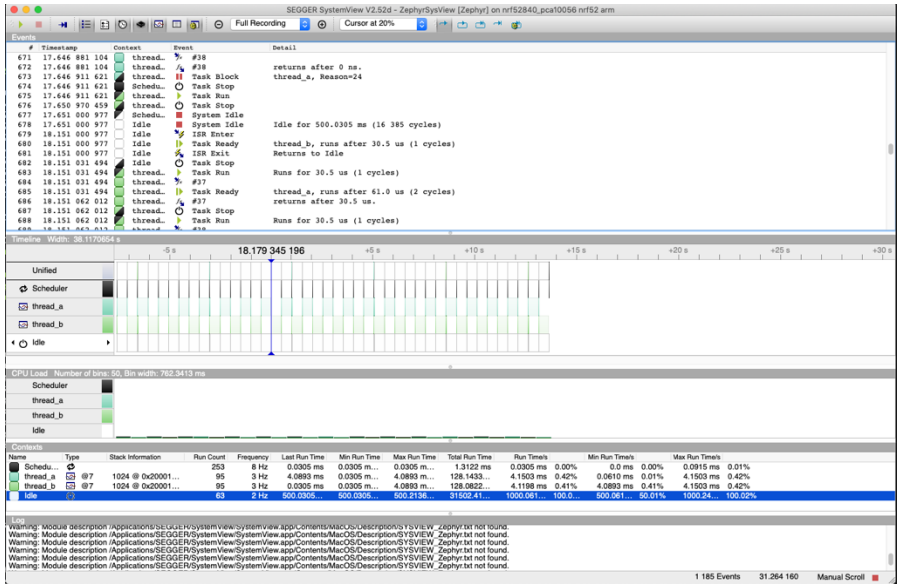
SEGGER SystemView




```
CONFIG_STDOUT_CONSOLE=y
CONFIG_THREAD_NAME=y
CONFIG_SEGGER_SYSTEMVIEW=y
CONFIG_USE_SEGGER_RTT=y
CONFIG_TRACING=y
```



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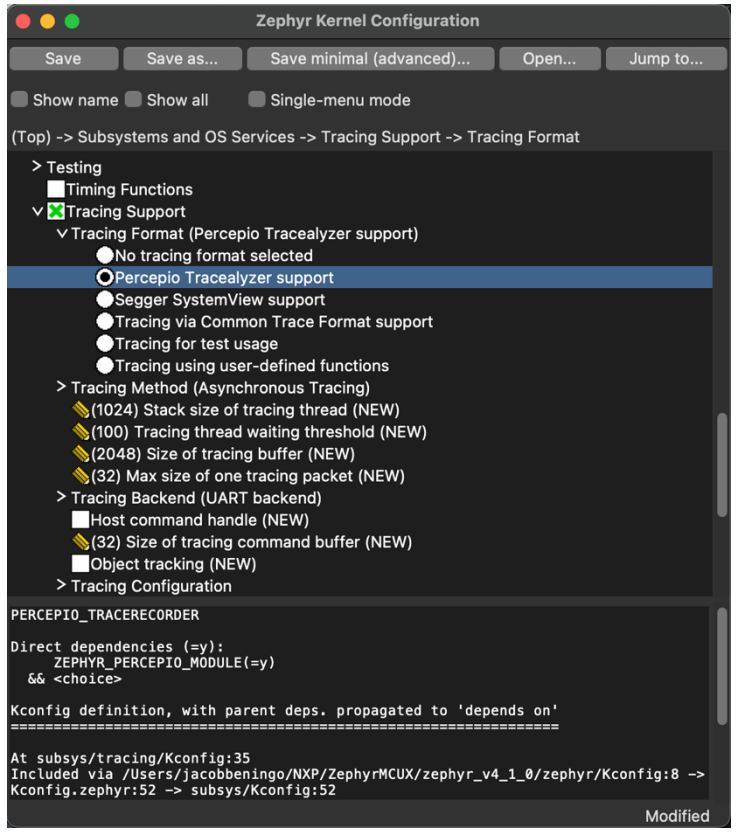
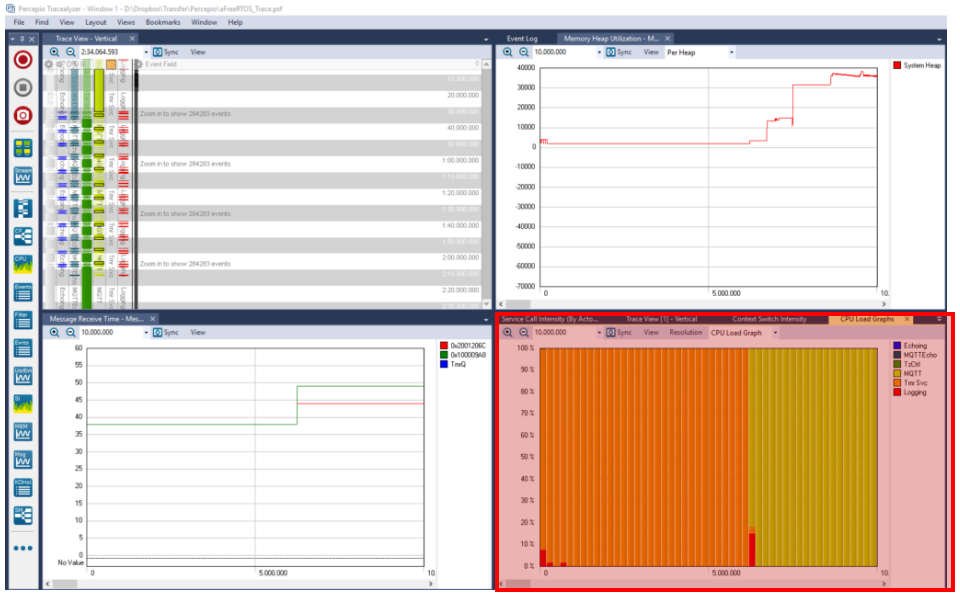
Percepio TraceView




```
CONFIG_TRACING=y

CONFIG_PERCEPIO_TRACERECORDER=y
```



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Audience POLL Question

Which of the following best describes the purpose of tracing in an embedded system running Zephyr RTOS?

a) To encrypt communication between tasks and peripherals
b) To monitor and record system events for debugging and performance analysis
c) To configure GPIO pins dynamically during runtime
d) To allocate stack memory for kernel threads

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Logging

03

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What is logging?

A structured way to report system messages like errors, warnings, info, and debug output.

Key Features in Zephyr Logging:

- LOG_ERR(), LOG_WRN(), LOG_INF(), LOG_DBG() macros
- Module-based: LOG_MODULE_REGISTER(main)
- Adjustable log levels per module
- Deferred or immediate logging modes
- Output backends: UART, RTT, memory

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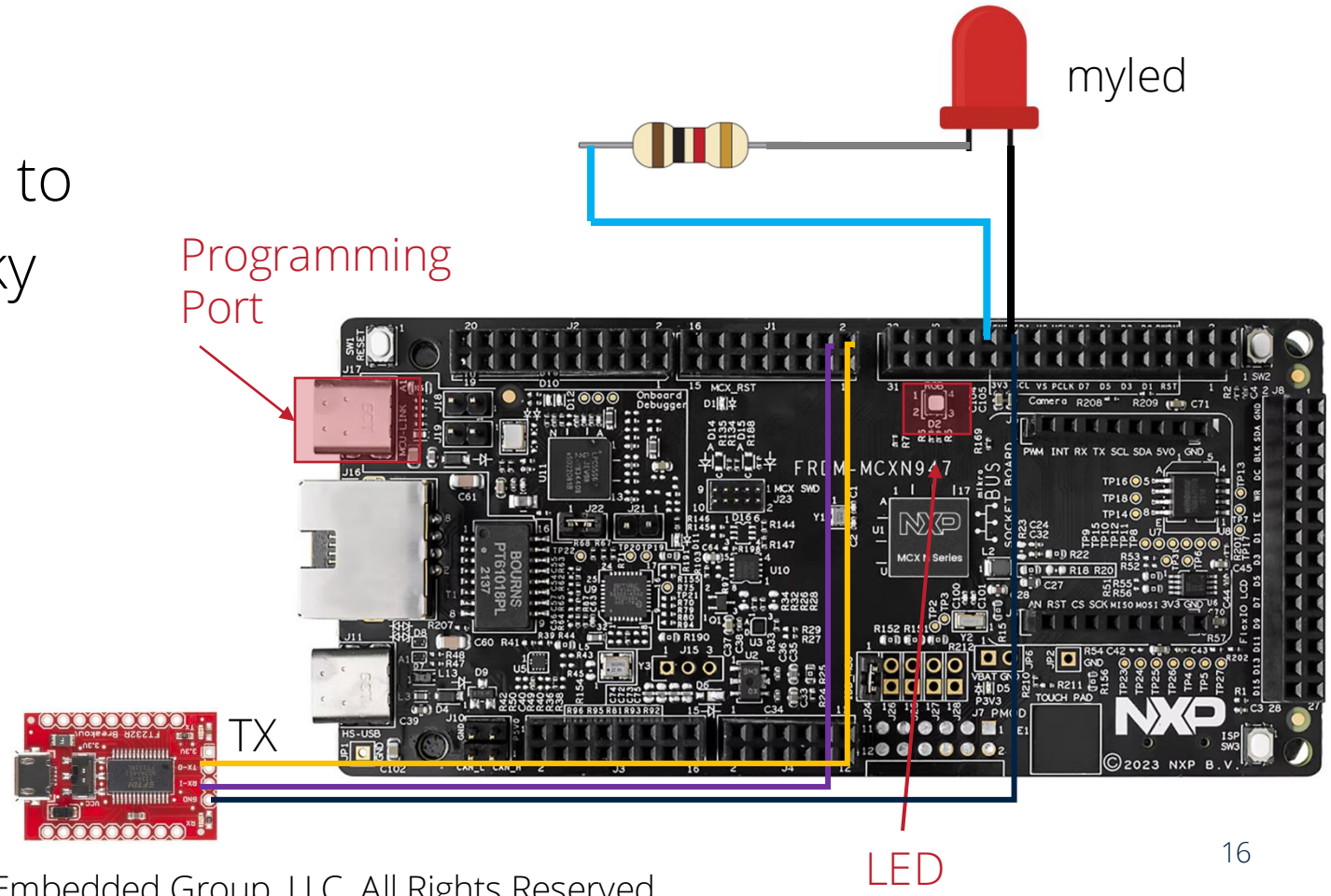
Goals and Hardware Setup

The purpose of this example is to modify the samples/basic/blinky example to:

- Display log info on USART2
- Keep the Shell on USART4
- Explore Log messages



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Enabling Logging

app.overlay

```
/ {
    chosen {
        zephyr,console = &flexcomm2_lpuart2;
        zephyr,shell-uart = &flexcomm4_lpuart4;
        zephyr,uart-mcumgr = &flexcomm2_lpuart2;
    };

    leds {
        compatible = "gpio-leds";

        my_led: my_led {
            gpios = <&gpio1 22 GPIO_ACTIVE_LOW>;
            label = "My Custom LED";
        };
    };

    aliases {
        myled = &my_led;
    };
};
```

prj.conf

```
# Required for printk on UART2 (console)
CONFIG_SERIAL=y
CONFIG_PRINTK=y
CONFIG_CONSOLE=y
CONFIG_UART_CONSOLE=y

# Logging configuration - use UART2 for logs
CONFIG_LOG=y
CONFIG_LOG_BACKEND_UART=y
CONFIG_LOG_MODE_DEFERRED=y
CONFIG_LOG_MODE_IMMEDIATE=n
CONFIG_LOG_DEFAULT_LEVEL=3
CONFIG_LOG_BACKEND_UART_AUTOSTART=y

# Disable RTT backend if you don't need it
CONFIG_LOG_BACKEND_RTT=n

# Shell configuration - use UART4 for shell
CONFIG_SHELL=y
CONFIG_SHELL_BACKEND_SERIAL=y
CONFIG_DEVICE_SHELL=y
CONFIG_KERNEL_SHELL=y

# Shell configuration
CONFIG_SHELL_PROMPT_UART="shell>"
CONFIG_SHELL_CMD_BUFF_SIZE=128
CONFIG_SHELL_HISTORY_BUFFER=512
CONFIG_SHELL_VT100_COLORS=n
CONFIG_SHELL_VT100_COMMANDS=n
CONFIG_SHELL_CMDS=y
CONFIG_THREAD_MONITOR=y

# Important: Disable shell log backend to prevent logs from appearing on shell
CONFIG_SHELL_LOG_BACKEND=n

# Disable colored log output
CONFIG_LOG_BACKEND_FORMAT_TIMESTAMP=y
CONFIG_LOG_BACKEND_SHOW_COLOR=n
```


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The Code

```c
#include <zephyr/kernel.h>
#include <zephyr/drivers/gpio.h>
#include <zephyr/logging/log.h>
#include <zephyr/shell/shell.h>

LOG_MODULE_REGISTER(main);  // Register the logging module
```

```c
int main(void)
{
    int ret;
    bool led_state = true;

    if (!gpio_is_ready_dt(&led0)) {
        LOG_ERR("led0 device not ready");
        return 0;
    }

    if (!gpio_is_ready_dt(&my_led)) {
        LOG_ERR("myLED device not ready");
        return 0;
    }
```

```c
    LOG_INF("Starting LED blink loop...");

    while (1) {
        gpio_pin_set_dt(&led0, led_state);
        gpio_pin_set_dt(&my_led, led_state);

        LOG_INF("Blink! LED0 and myLED state: %s", led_state ? "ON" : "OFF");

        led_state = !led_state;
        k_msleep(SLEEP_TIME_MS);
    }

    return 0;
```


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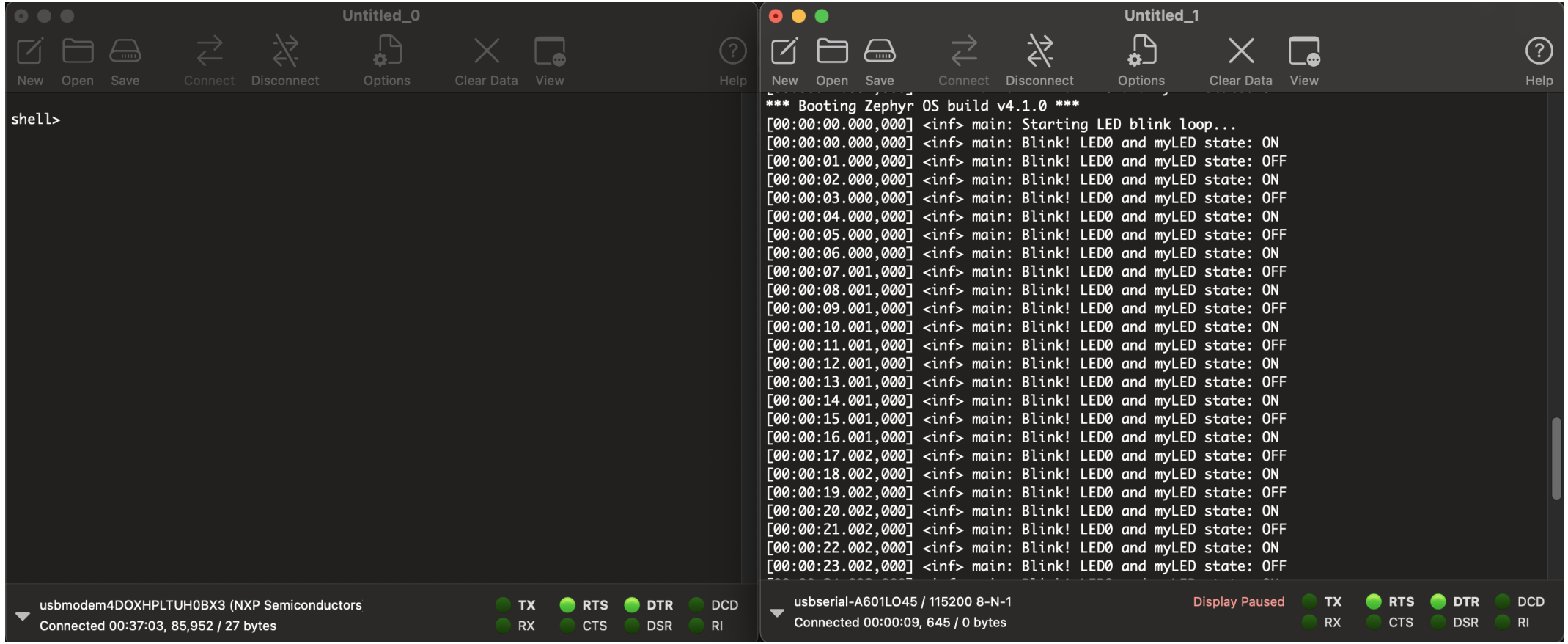
Result



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Audience POLL Question

What is the most important configuration to ensure your log messages don't end up on all your UART devices?

a) CONFIG_LOG_MODE_DEFERRED=y
b) CONFIG_SHELL_LOG_BACKEND=n
c) CONFIG_SHELL_LOG_BACKEND=n
d) CONFIG_LOG_BACKEND_RTT=n

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Next Steps

04

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Going Further

Download the extra resources:

- https://beningo.short.gy/jVGeiDNZephyrLP

Zephyr Documentation:

- Tracing Documentation
- Logging Documentation

Downloadable Resources:

- West Cheat Sheet (High-Resolution)
- RTOS Performance Guide
- Application Code Examples
- Zephyr Docker Container
- VS Code Debug Launch Script

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Additional Resources

Please consider the resources below:

- Jacob's Blogs
- Jacob's CEC courses
- Embedded Software Academy

- Embedded Bytes Newsletter
  - http://bit.ly/1BAHYXm

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Next Steps

- Welcome to Zephyr RTOS
- Build Systems, Kconfig, and Device Tree
- Threads, Scheduling, and RTOS Primitives
- Drivers, Peripherals, and Customization
- Debugging, Logging, and Best Practices

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