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1. Programmable Peripheral Interconnect 2

1. Programmable Peripheral Interconnect

PPI is used The second part of the laboratory shows how to use the PPI to send the activation information from the button (sw0) directly to the LED (led0). It is possible to set up the hardware connection between the button EVENT signal and the TASK signal for LED. While the output is controlled by the GPIOTE mechanism the normal GPIO writes have no effect. The GPIOTE mechanism is not supported in Zephyr OS, but the driver (NRFX) which is provided directly by Nordic Semiconductor can be used in Zephyr-compatible software. The example provided uses the GPIOTE (GPIO Tasks and Events) to handle signalling. To make it work properly the config file must be changed, enabling the NRFX driver:

CONFIG_NRFX_GPIOTE=y There is a need to disable the general GPIO driver:

CONFIG_GPIO=n Additionally, we can use the logging mechanism to receive log messages from the software. To do this we enable logging with: CONFIG_LOG=y The resulting config file prj.conf looks like this:

CONFIG_GPIO=n CONFIG_SERIAL=y CONFIG_NRFX_GPIOTE=y CONFIG_LOG=y To do the second part of the laboratory take the following steps: Modify the prj.conf file. Replace main.c with the code included below. Modify the code to turn the LED on with one button, and off with another button. To make point 3 of the exercise it is essential to know that one GPIO can have three TASK signals: SET - to write the high state CLEAR - to write the low state OUT - to specify behaviour in the configuration (set, clear or toggle). The example provided uses the OUT TASK with toggle configuration. There is no need to configure SET or CLEAR tasks, but there is a need to create separate PPI channels, one for setting LED with one button, and another for clearing it with a second button. While creating channels you can use the functions for resolving the TASKs handlers addresses:

nrfx_gpiote_set_task_addr_get(); nrfx_gpiote_clr_task_addr_get(); The initial, unmodified code of the main.c file looks like this: #include <zephyr.h>

#include <nrfx_gpiote.h> #include <helpers/nrfx_gppi.h> #if defined(DPPI_PRESENT) #include <nrfx_dppi.h> #else #include <nrfx_ppi.h> #endif

#include <logging/log.h> LOG_MODULE_REGISTER(nrfx_sample, LOG_LEVEL_INF);

#define INPUT_PIN DT_GPIO_PIN(DT_ALIAS(sw0), gpios) #define INPUT_PIN1 DT_GPIO_PIN(DT_ALIAS(sw1), gpios) #define OUTPUT_PIN DT_GPIO_PIN(DT_ALIAS(led0), gpios) #define OUTPUT_PIN1 DT_GPIO_PIN(DT_ALIAS(led1), gpios)

static void button_handler(nrfx_gpiote_pin_t pin, nrf_gpiote_polarity_t action) {

```
  LOG_INF("GPIO input event callback %d", pin);
```

}

void main(void) {

```
  LOG_INF("nrfx_gpiote sample on %s", CONFIG_BOARD);
```

```
nrfx_err_t err;
```

```
/* Connect GPIOTE_0 IRQ to nrfx_gpiote_irq_handler */
IRQ_CONNECT(DT_IRQN(DT_NODELABEL(gpiote)),
        DT_IRQ(DT_NODELABEL(gpiote), priority),
        nrfx_isr, nrfx_gpiote_irq_handler, 0);
```

```
/* Initialize GPIOTE (the interrupt priority passed as the parameter
 * here is ignored, see nrfx_glue.h).
 */
err = nrfx_gpiote_init(0);
if (err != NRFX_SUCCESS) {
    LOG_ERR("nrfx_gpiote_init error: %08x", err);
    return;
}
```

```
nrfx_gpiote_in_config_t const in_config = {
    .sense = NRF_GPIOTE_POLARITY_HITOLO,
    .pull = NRF_GPIO_PIN_PULLUP,
    .is_watcher = false,
    .hi_accuracy = true,
    .skip_gpio_setup = false,
};
```

```
/* Initialize input pin to generate event on high to low transition
 * (falling edge) and call button_handler()
 */
err = nrfx_gpiote_in_init(INPUT_PIN, &in_config, button_handler);
if (err != NRFX_SUCCESS) {
    LOG_ERR("nrfx_gpiote_in_init error: %08x", err);
    return;
}
```

```
err = nrfx_gpiote_in_init(INPUT_PIN1, &in_config, button_handler);
if (err != NRFX_SUCCESS) {
    LOG_ERR("nrfx_gpiote_in_init error: %08x", err);
    return;
}
```

```
nrfx_gpiote_out_config_t const out_config = {
    .action = NRF_GPIOTE_POLARITY_TOGGLE,
    //.action = NRF_GPIOTE_POLARITY_HITOLO,
    .init_state = 1,
    .task_pin = true,
};
```

```
nrfx_gpiote_out_config_t const out_config1 = {
    .action = NRF_GPIOTE_POLARITY_TOGGLE,
    //.action = NRF_GPIOTE_POLARITY_LOTOHI,
    .init_state = 0,
```

```
    .task_pin = true,
};
```

```
/* Initialize output pin. SET task will turn the LED on,
 * CLR will turn it off and OUT will toggle it.
 */
err = nrfx_gpiote_out_init(OUTPUT_PIN, &out_config);
if (err != NRFX_SUCCESS) {
    LOG_ERR("nrfx_gpiote_out_init error: %08x", err);
    return;
}
```

```
err = nrfx_gpiote_out_init(OUTPUT_PIN1, &out_config1);
if (err != NRFX_SUCCESS) {
    LOG_ERR("nrfx_gpiote_out1_init error: %08x", err);
    return;
}
```

```
nrfx_gpiote_in_event_enable(INPUT_PIN, true);
nrfx_gpiote_in_event_enable(INPUT_PIN1, true);
nrfx_gpiote_out_task_enable(OUTPUT_PIN);
nrfx_gpiote_out_task_enable(OUTPUT_PIN1);
```

```
LOG_INF("nrfx_gpiote initialized %d", 0);
```

```
/* Allocate a (D)PPI channel. */
```

#if defined(DPPI_PRESENT)

```
uint8_t channel;
err = nrfx_dppi_channel_alloc(&channel);
```

#else

```
nrf_ppi_channel_t channel;
nrf_ppi_channel_t channel1;
err = nrfx_ppi_channel_alloc(&channel);
err = nrfx_ppi_channel_alloc(&channel1);
```

#endif

```
if (err != NRFX_SUCCESS) {
    LOG_ERR("(D)PPI channel allocation error: %08x", err);
    return;
}
```

```
/* Configure endpoints of the channel so that the input pin event is
 * connected with the output pin OUT task. This means that each time
 * the button is pressed, the LED pin will be toggled.
 */
```

```
  nrfx_gppi_channel_endpoints_setup(channel,
      nrfx_gpiote_in_event_addr_get(INPUT_PIN),
      nrfx_gpiote_out_task_addr_get(OUTPUT_PIN));
```

```
  nrfx_gppi_channel_endpoints_setup(channel1,
      nrfx_gpiote_in_event_addr_get(INPUT_PIN1),
      nrfx_gpiote_out_task_addr_get(OUTPUT_PIN1));
```

```
  /* Enable (D)PPI channel. */
```

#if defined(DPPI_PRESENT)

```
  err = nrfx_dppi_channel_enable(channel);
```

#else

```
  err = nrfx_ppi_channel_enable(channel);
  err = nrfx_ppi_channel_enable(channel1);
```

#endif

```
  if (err != NRFX_SUCCESS) {
      LOG_ERR("Failed to enable (D)PPI channel, error: %08x", err);
      return;
  }
```

```
  LOG_INF("(D)PPI configured, leaving main() %d", 0);
```

}

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