Brief Updates on Interrupt Handling in TF-M

Kevin Peng
August 2021

Agenda

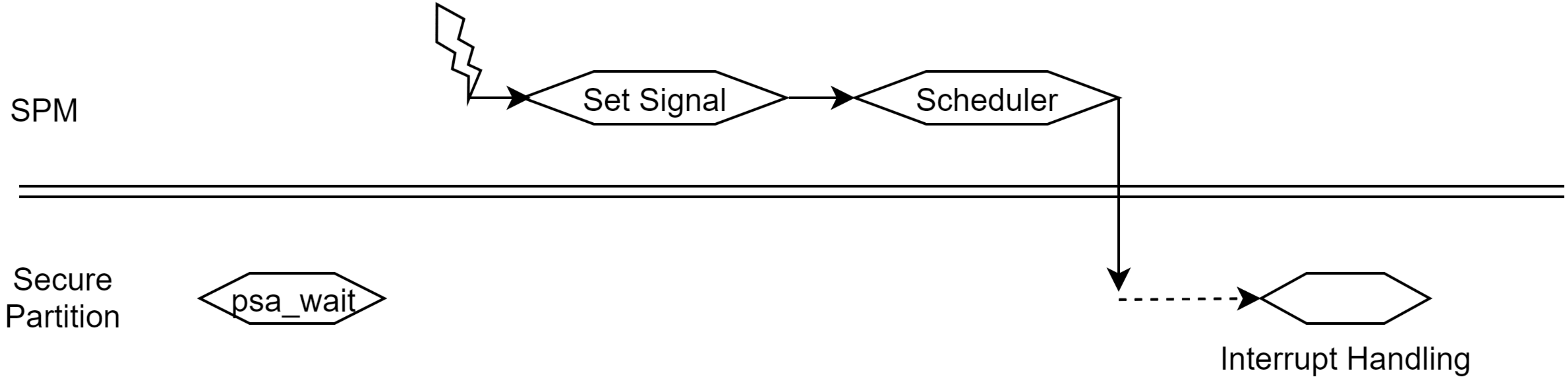
- Interrupt Handling Support in TF-M
- High-Level Implementation Details
- How to Enable an Interrupt in TF-M
- Q & A

Interrupt Handling Support

- Both interrupt handling types defined in FF-M v1.1 are supported
  - Second-Level Interrupt Handling (SLIH)
    - Stable maintenance
  - First-Level Interrupt Handling (FLIH)
    - Initial support
    - Subject to change

High-Level Implementation Details

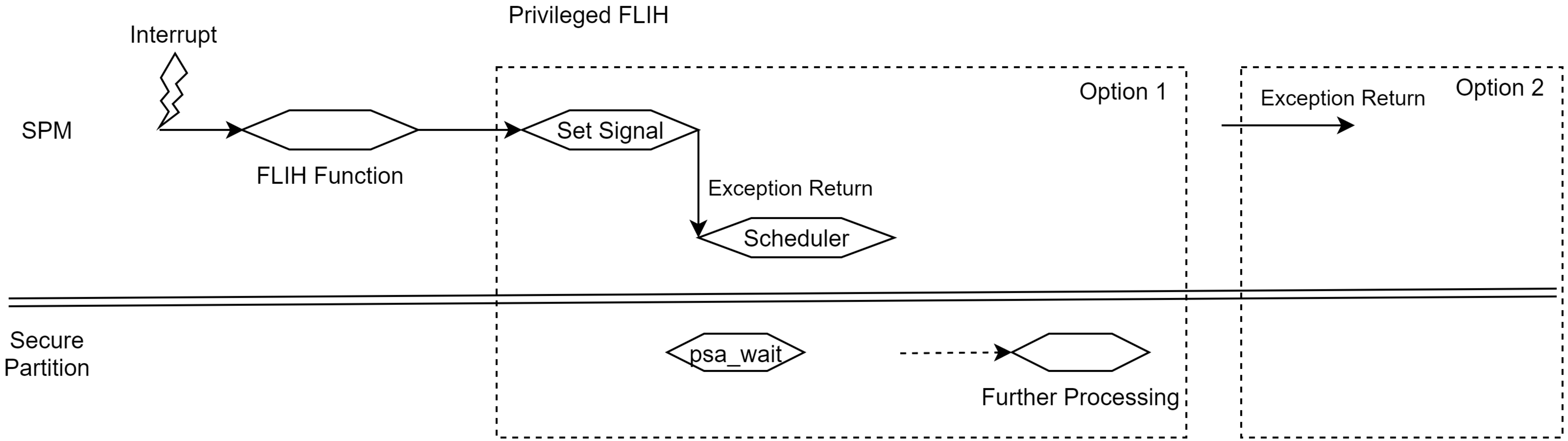
SLIH



High-Level Implementation Details

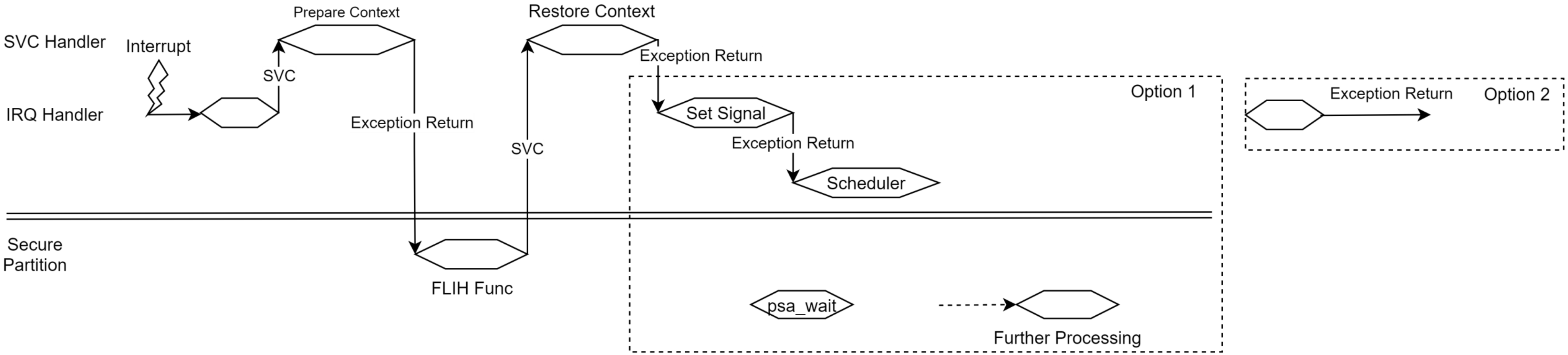
Privileged FLIH

- Applies to Partitions in L1 & PRoT Partitions in L2 and L3



High-Level Implementation Details

De-privileged FLIH



- The first SVC is to retain the Exception priority of the interrupt for the FLIH Function
    - When Exception Return to FLIH Function, it is the SVC who’s cleared while the IRQ keeps active

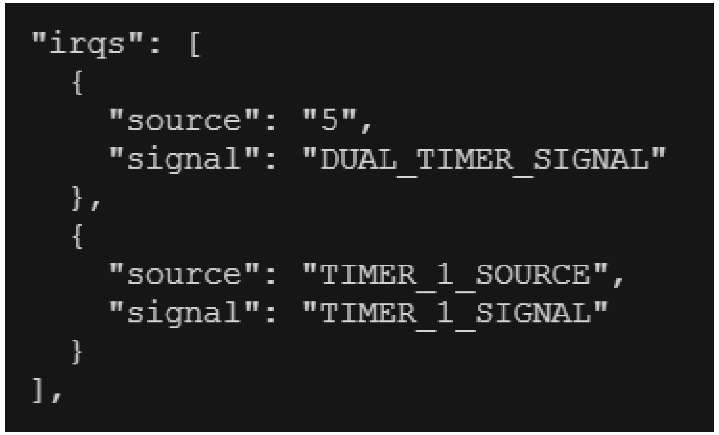
How to Enable an Interrupt in TF-M

- Assigning the interrupt to a Secure Partition.
- Granting the Secure Partition access permissions to the MMIO of the interrupt.
- Configurating the interrupt.
- Integrating the interrupt handling function generated by TF-M to the Vector Table.

How to Enable an Interrupt in TF-M

Assigning the interrupt to a Secure Partition

IRQ items in FF-M v1.0

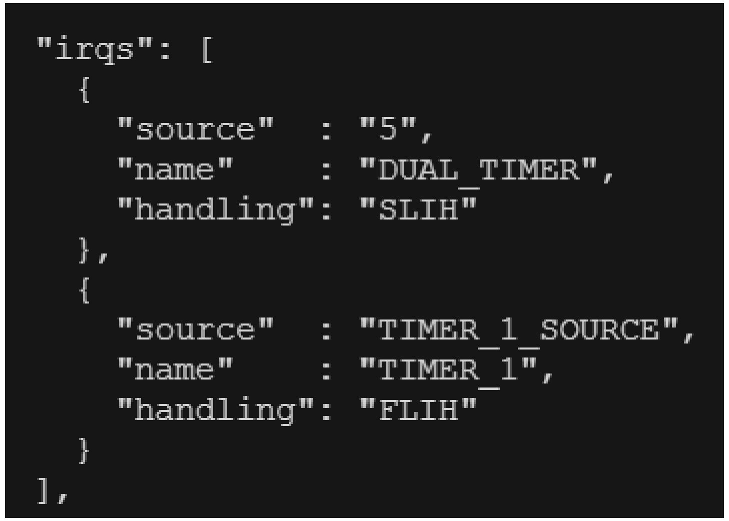


```
"irqs": [
  {
    "source": "5",
    "signal": "DUAL_TIMER_SIGNAL"
  },
  {
    "source": "TIMER_1_SOURCE",
    "signal": "TIMER_1_SIGNAL"
  }
],
```

Build System

#define {{signal}} <value>

IRQ items in FF-M v1.1

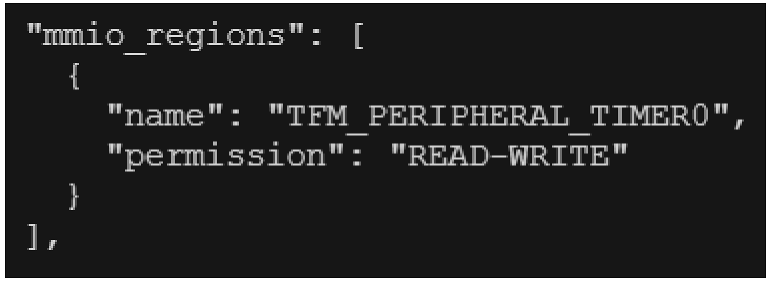


```
"irqs": [
  {
    "source"  : "5",
    "name"    : "DUAL_TIMER",
    "handling": "SLIH"
  },
  {
    "source"  : "TIMER_1_SOURCE",
    "name"    : "TIMER_1",
    "handling": "FLIH"
  }
],
```

Build System

#define {{name}}_SIGNAL <value>
psa_flih_result_t {{name}}_flih(void)

MMIO Regions



```
"mmio_regions": [
  {
    "name": "TFM_PERIPHERAL_TIMER0",
    "permission": "READ-WRITE"
  }
],
```

#define TFM_PERIPHERAL_TIMER0
(&tfm_peripheral_timer0)

```
struct platform_data_t {
  uint32_t periph_start;
  uint32_t periph_limit;
  int16_t periph_ppc_bank;
  int16_t periph_ppc_loc;
};
```

tfm_spm_hal_configure_default_isolation

How to Enable an Interrupt in TF-M

Granting the Secure Partition access permissions to the device of the interrupt.

- The MMIO Regions
- The Device Drivers
  - *target_sources(some_partition_lib*
    PRIVATE
    some_driver_code.c)

How to Enable an Interrupt in TF-M

Configurating the interrupt.

- Setting Priority
  - The priority value must be less than the value of ``PendSV`` (0x80) and greater than the value of ``SVC`` (0x0).
  - HAL API:
    - *enum tfm_plat_err_t tfm_spm_hal_set_secure_irq_priority(IRQn_Type irq_line);*
- Targeting Interrupts to Secure
  - HAL API:
    - *enum irq_target_state_t tfm_spm_hal_set_irq_target_state(IRQn_Type irq_line, enum irq_target_state_t target_state);*

How to Enable an Interrupt in TF-M

Integrating the interrupt handling function generated by TF-M to the Vector Table.

- TF-M generates interrupt handling functions for each interrupt assigned to Secure Partitions in building
  - *void irq_{{source}}_Handler(void) or*
  - *void {{irq.source}}_Handler(void)*
    - *-> spm_interrupt_handler*
- Platforms integrate the handling functions in their own manner

References

- Secure IRQ Integration guide - Docs: Add Secure IRQ integration guide (Patch in review)
- FLIH Test Partition: https://git.trustedfirmware.org/TF-M/tf-m-tests.git/tree/test/test_services/tfm_flih_test_service
- SLIH Test Partition: https://git.trustedfirmware.org/TF-M/tf-m-tests.git/tree/test/test_services/tfm_slih_test_service

Q & A

Thank You
Danke
Gracias
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה

arm