LPTIM device tree configuration

Contents

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A quality version of this page, accepted on *15 October 2019*, was based off this revision.

Contents

1 Article purpose

The purpose of this article is to explain how to configure the low-power timer (*LPTIM*)[1] **when the peripheral is assigned to Linux®OS**, and in particular:

- how to configure the LPTIM **peripheral** to enable PWM, trigger, event counter and quadrature encoder
- how to configure the **board**, e.g. LPTIM input/output pins

The configuration is performed using the **device tree mechanism**[2].

It is used by the LPTIM Linux driver that registers relevant information in PWM and IIO frameworks.

2 DT bindings documentation

The LPTIM[1] is a multifunction device (MFD).

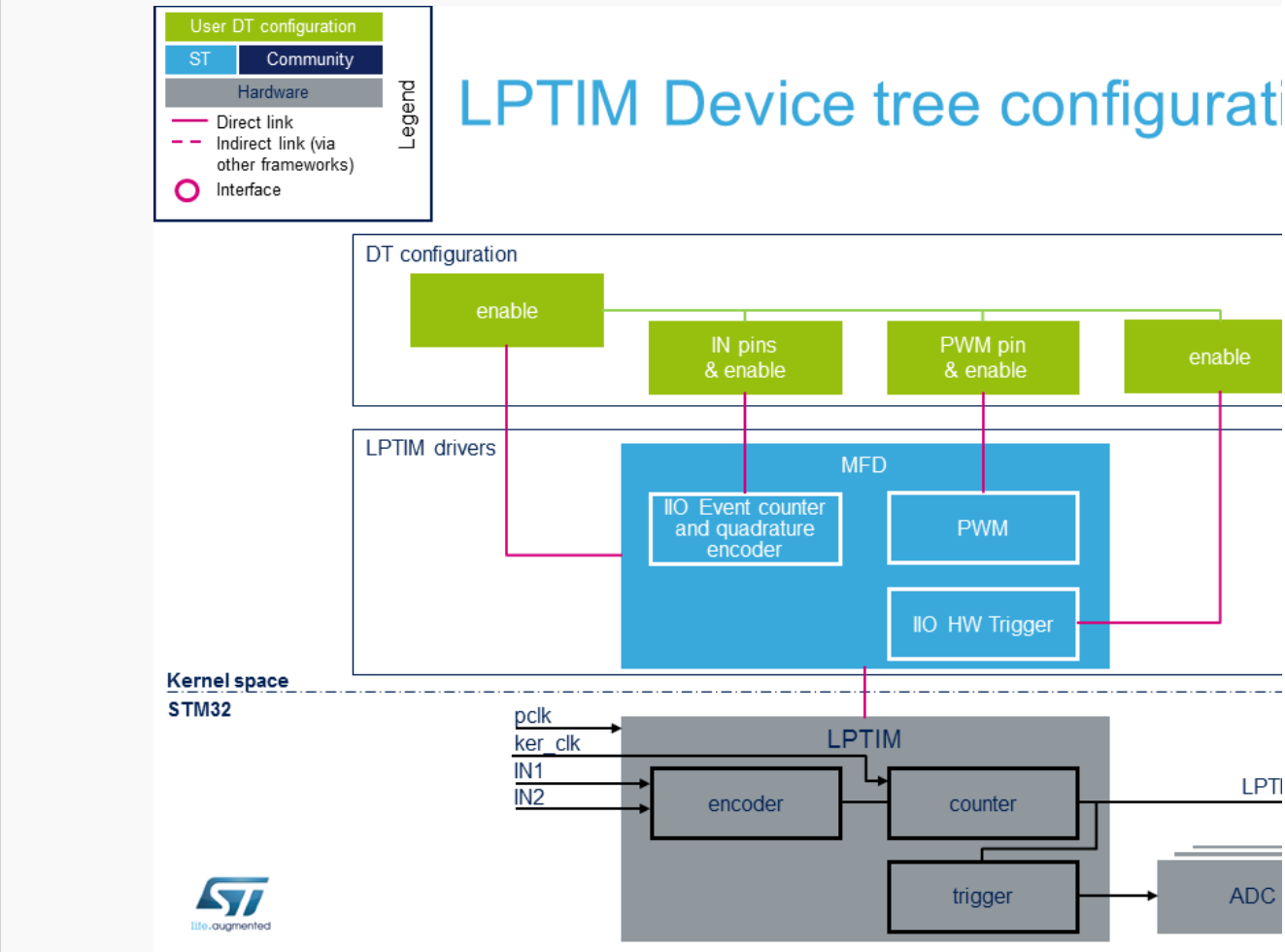
Each function is represented by a separate binding document:

- *STM32 LPTIM MFD device tree bindings*[3] deals with core resources (e.g. registers, clock)
- *STM32 LPTIM PWM device tree bindings*[4] deals with **PWM** interface resources (e.g. PWM pins)
- *STM32 LPTIM trigger device tree bindings*[5] deals with **LPTIM triggers** resources (e.g. trigger output connected to other STM32 internal peripherals)
- *STM32 LPTIM counter device tree bindings*[6] deals with **LPTIM counter and quadrature encoder** resources (e.g. counter/encoder IN[1..2] pins)

3 DT configuration

This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                        /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";                 /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";        /* trigger part of LPTIM
*/
                reg = <0>;                                      /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";        /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
- Configure the pins in use via pinctrl, with **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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For additional information, refer to the following links:

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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

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Contents

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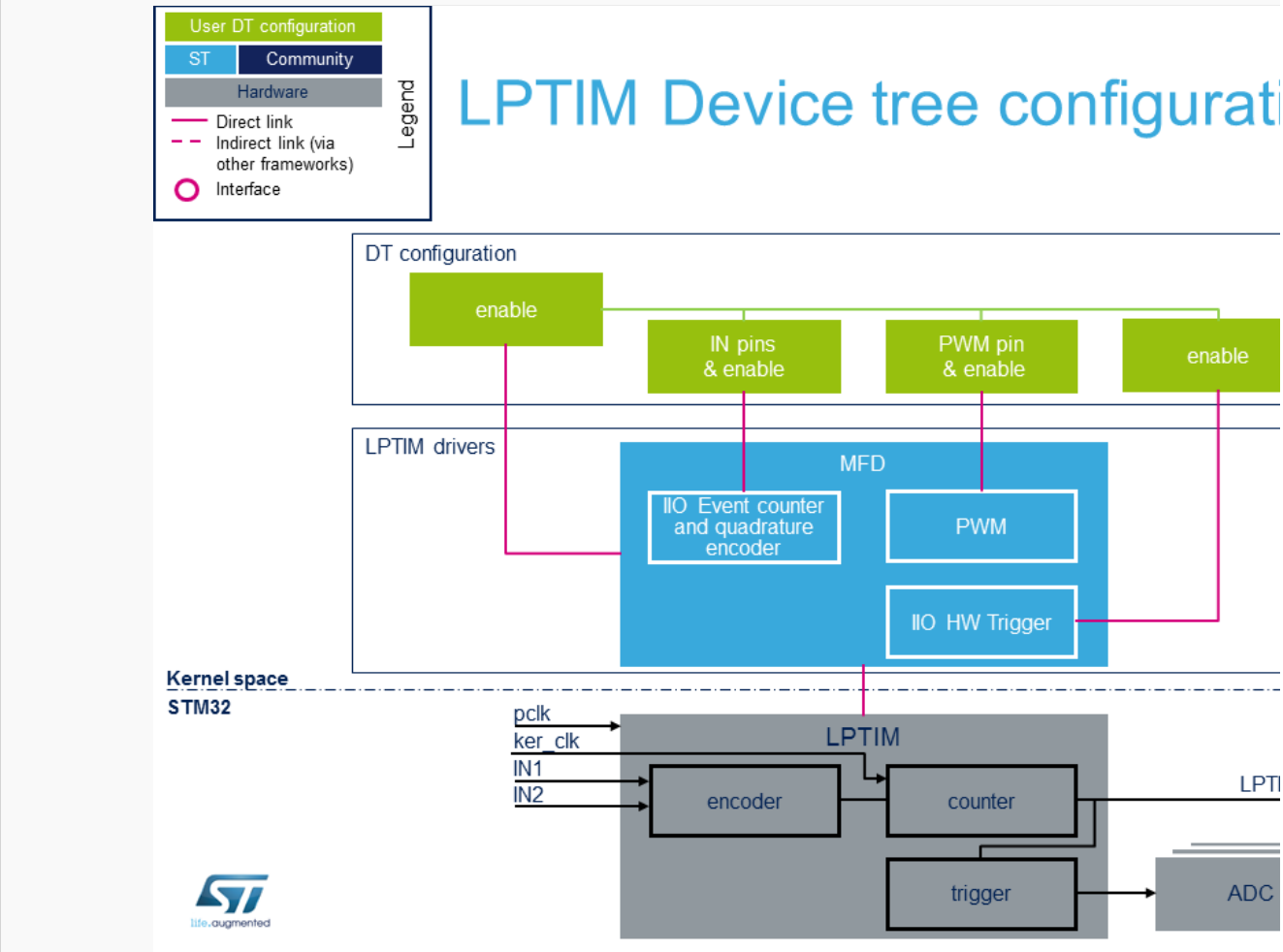

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DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

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- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
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```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
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                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

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low-power timer (STM32 specific)

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

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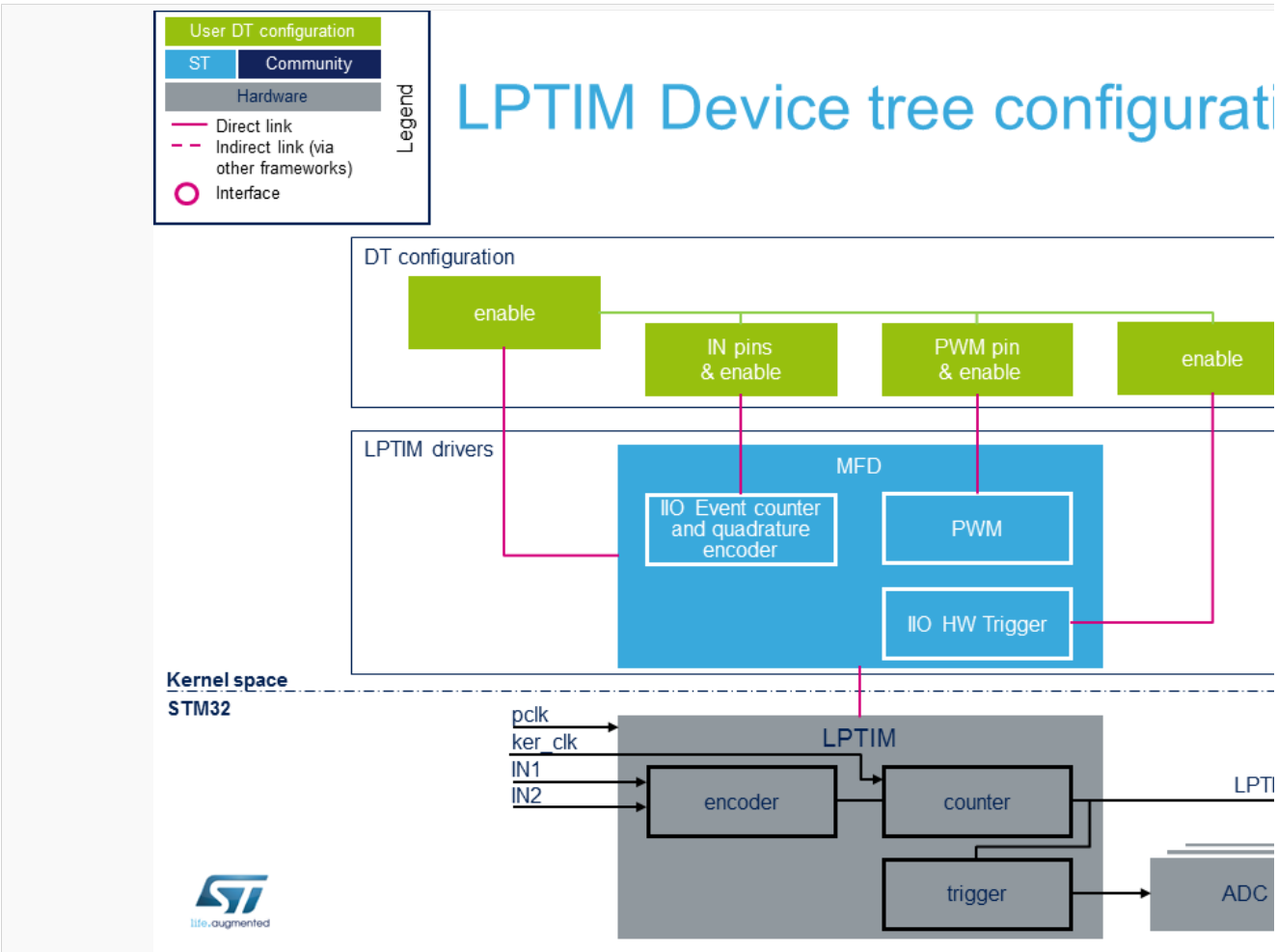

LPTIM DT configuration

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```
lptimer1: timer@40009000 {
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        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
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```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
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                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
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                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

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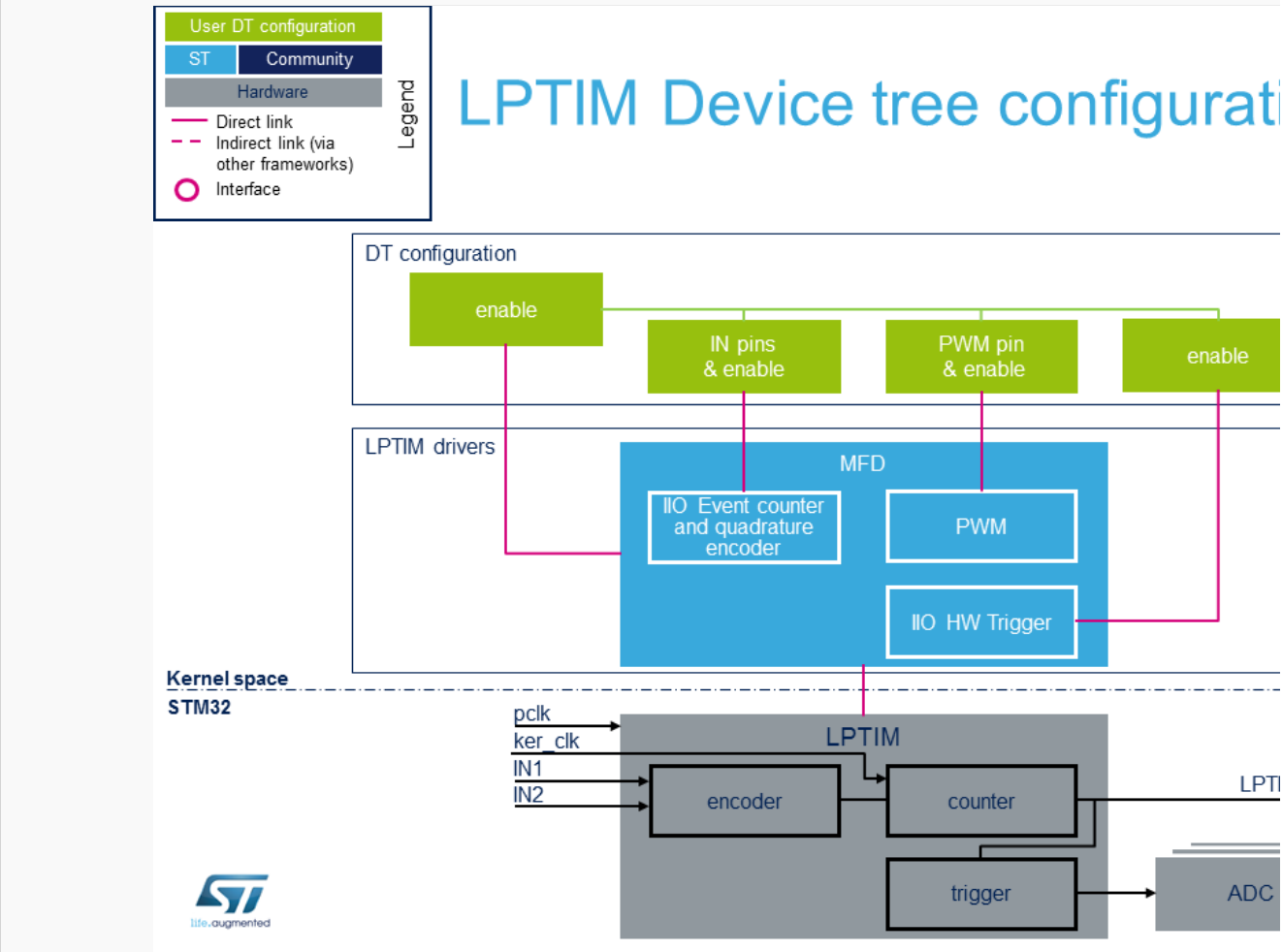

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        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
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};
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This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
- Configure the pins in use via pinctrl, with **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

5 References

For additional information, refer to the following links:

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- Documentation/devicetree/bindings/iio/timer/stm32-lptimer-trigger.txt , STM32 LPTIM trigger device tree bindings
- Documentation/devicetree/bindings/iio/counter/stm32-lptimer-cnt.txt , STM32 LPTIM counter/encoder device tree bindings
- STM32MP157C device tree file
- ADC internal peripheral
- DAC internal peripheral
- DFSDM internal peripheral

low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

Device Tree

Multifunction device

also known as

Analog-to-digital converter. The process of converting a sampled analog signal to a digital code that represents the amplitude of the original signal sample.

Digital-to-analog converter (Electronic circuit that converts a binary number into a continuously varying value.)

Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

Stable: 04.02.2020 - 07:47 / Revision: 04.02.2020 - 07:34

Contents

1 Article purpose

The purpose of this article is to explain how to configure the low-power timer (*LPTIM*)[1] **when the peripheral is assigned to Linux®OS**, and in particular:

- how to configure the LPTIM **peripheral** to enable PWM, trigger, event counter and quadrature encoder
- how to configure the **board**, e.g. LPTIM input/output pins

The configuration is performed using the **device tree mechanism**[2].

It is used by the LPTIM Linux driver that registers relevant information in PWM and IIO frameworks.

2 DT bindings documentation

The LPTIM[1] is a multifunction device (MFD).

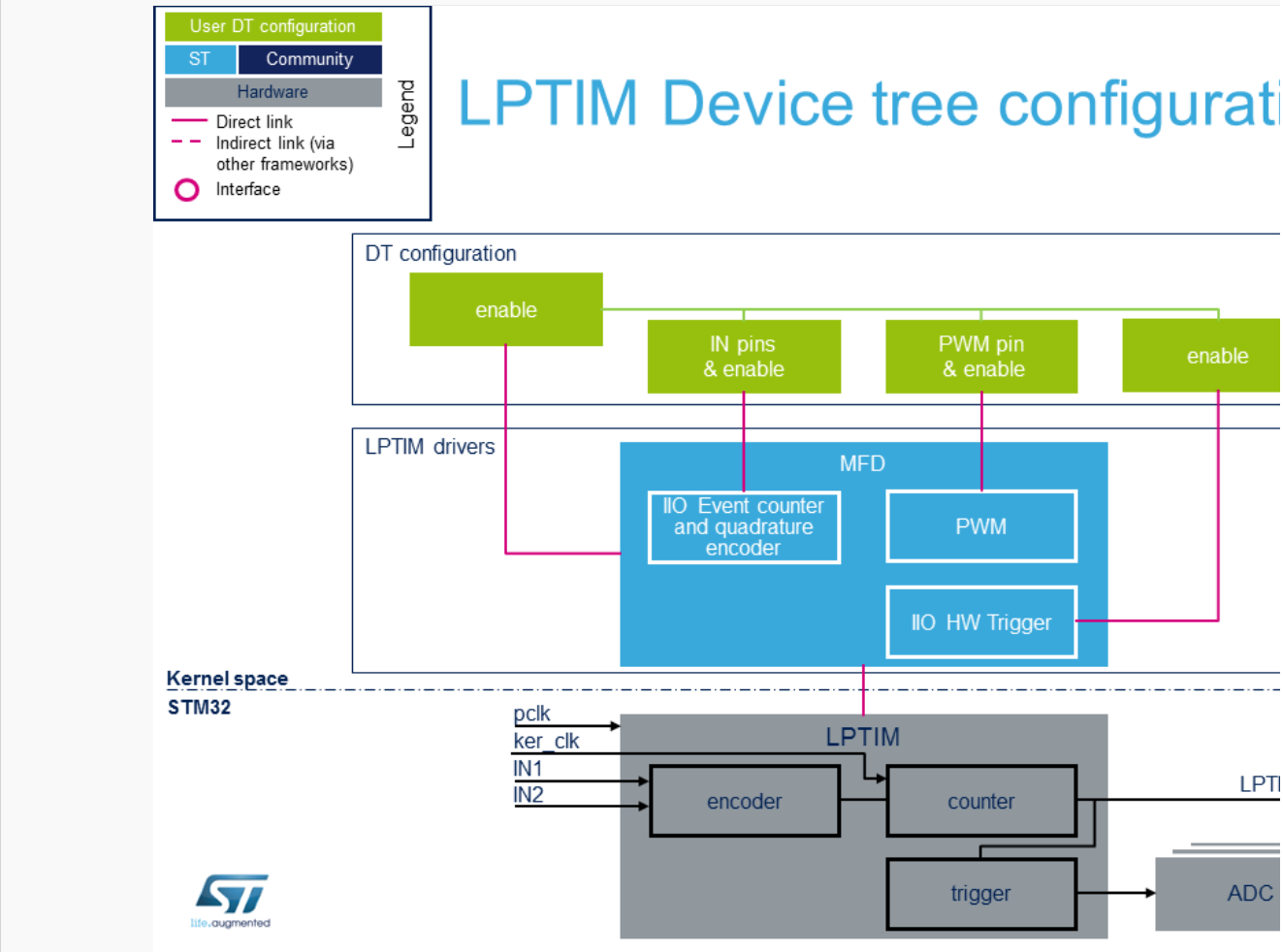
Each function is represented by a separate binding document:

- *STM32 LPTIM MFD device tree bindings*[3] deals with core resources (e.g. registers, clock)
- *STM32 LPTIM PWM device tree bindings*[4] deals with **PWM** interface resources (e.g. PWM pins)
- *STM32 LPTIM trigger device tree bindings*[5] deals with **LPTIM triggers** resources (e.g. trigger output connected to other STM32 internal peripherals)
- *STM32 LPTIM counter device tree bindings*[6] deals with **LPTIM counter and quadrature encoder** resources (e.g. counter/encoder IN[1..2] pins)

3 DT configuration

This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
- Configure the pins in use via pinctrl, with **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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- Documentation/devicetree/bindings/iio/counter/stm32-lptimer-cnt.txt , STM32 LPTIM counter/encoder device tree bindings
- STM32MP157C device tree file
- ADC internal peripheral
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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

Device Tree

Multifunction device

also known as

Analog-to-digital converter. The process of converting a sampled analog signal to a digital code that represents the amplitude of the original signal sample.

Digital-to-analog converter (Electronic circuit that converts a binary number into a continuously varying value.)

Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

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Contents

1 Article purpose

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- how to configure the **board**, e.g. LPTIM input/output pins

The configuration is performed using the **device tree mechanism**[2].

It is used by the LPTIM Linux driver that registers relevant information in PWM and IIO frameworks.

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The LPTIM[1] is a multifunction device (MFD).

Each function is represented by a separate binding document:

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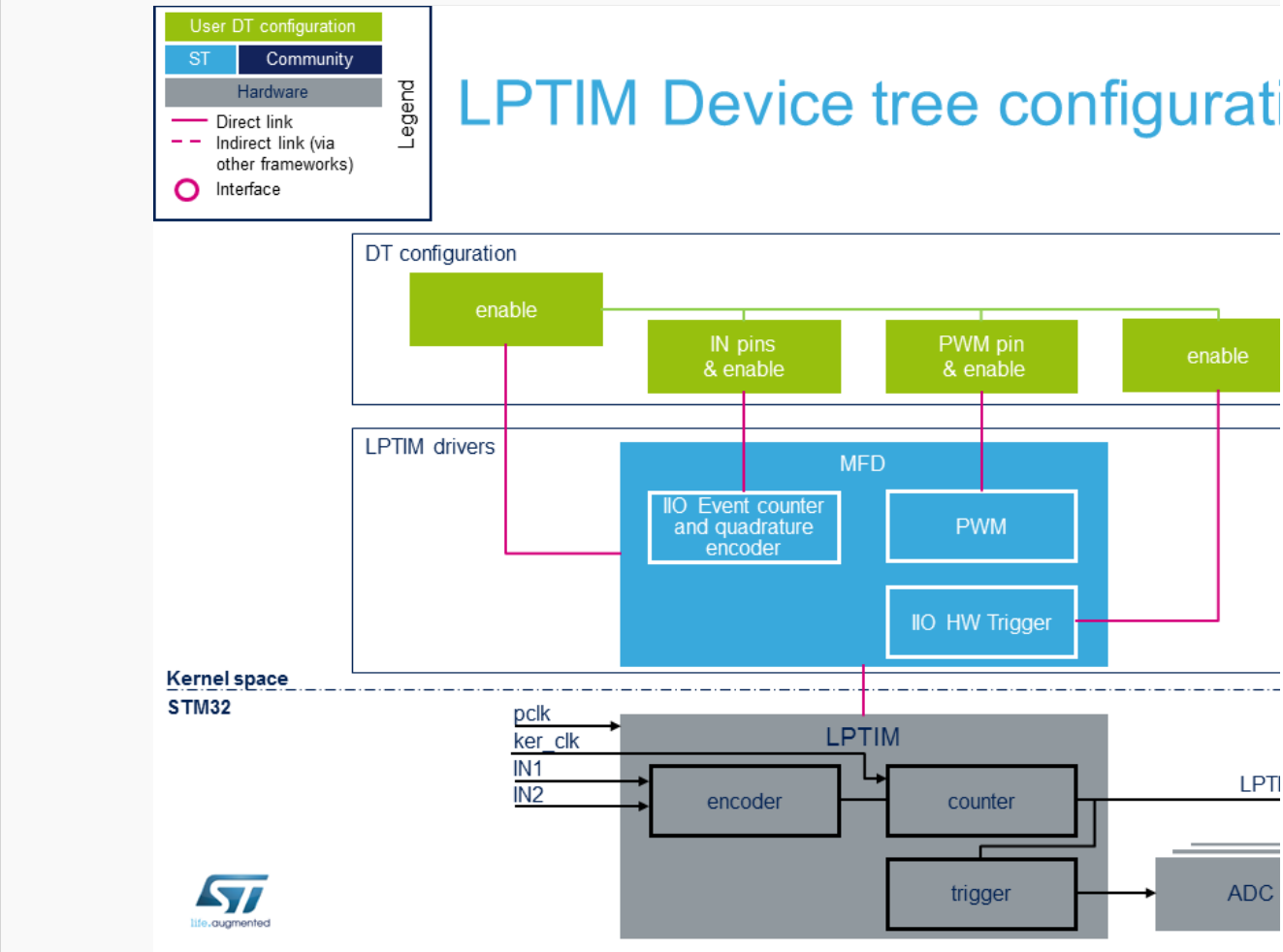
3 DT configuration

This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
- Configure the pins in use via pinctrl, with **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

Stable: 11.06.2020 - 09:03 / Revision: 10.06.2020 - 15:17

Contents

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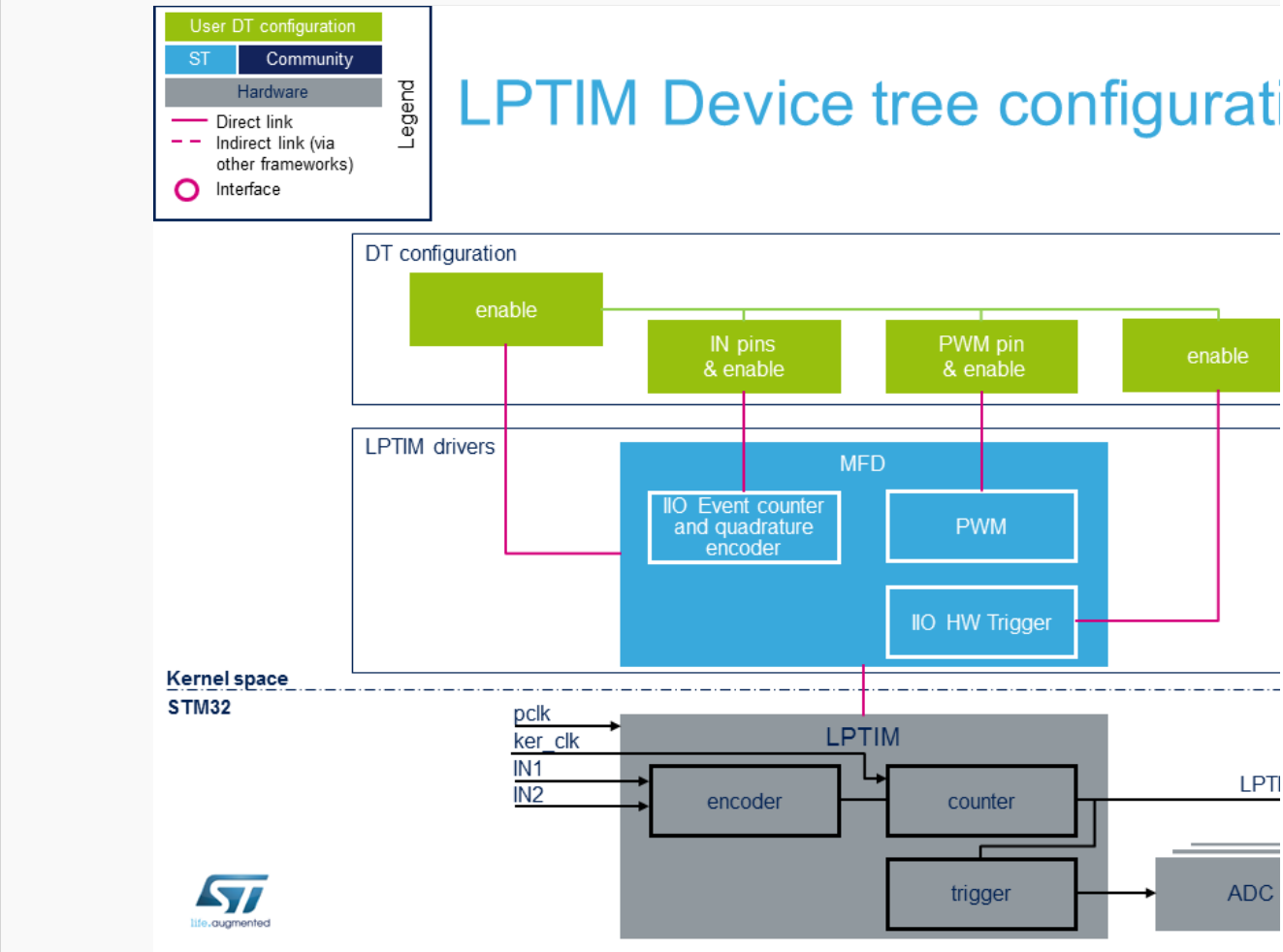

LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

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- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
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- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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- Documentation/devicetree/bindings/iio/timer/stm32-lptimer-trigger.txt , STM32 LPTIM trigger device tree bindings
- Documentation/devicetree/bindings/iio/counter/stm32-lptimer-cnt.txt , STM32 LPTIM counter/encoder device tree bindings
- STM32MP157C device tree file
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- DAC internal peripheral
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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

Device Tree

Multifunction device

also known as

Analog-to-digital converter. The process of converting a sampled analog signal to a digital code that represents the amplitude of the original signal sample.

Digital-to-analog converter (Electronic circuit that converts a binary number into a continuously varying value.)

Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

Stable: 11.06.2020 - 09:00 / Revision: 10.06.2020 - 15:35

Contents

1 Article purpose

The purpose of this article is to explain how to configure the low-power timer (*LPTIM*)[1] **when the peripheral is assigned to Linux®OS**, and in particular:

- how to configure the LPTIM **peripheral** to enable PWM, trigger, event counter and quadrature encoder
- how to configure the **board**, e.g. LPTIM input/output pins

The configuration is performed using the **device tree mechanism**[2].

It is used by the LPTIM Linux driver that registers relevant information in PWM and IIO frameworks.

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The LPTIM[1] is a multifunction device (MFD).

Each function is represented by a separate binding document:

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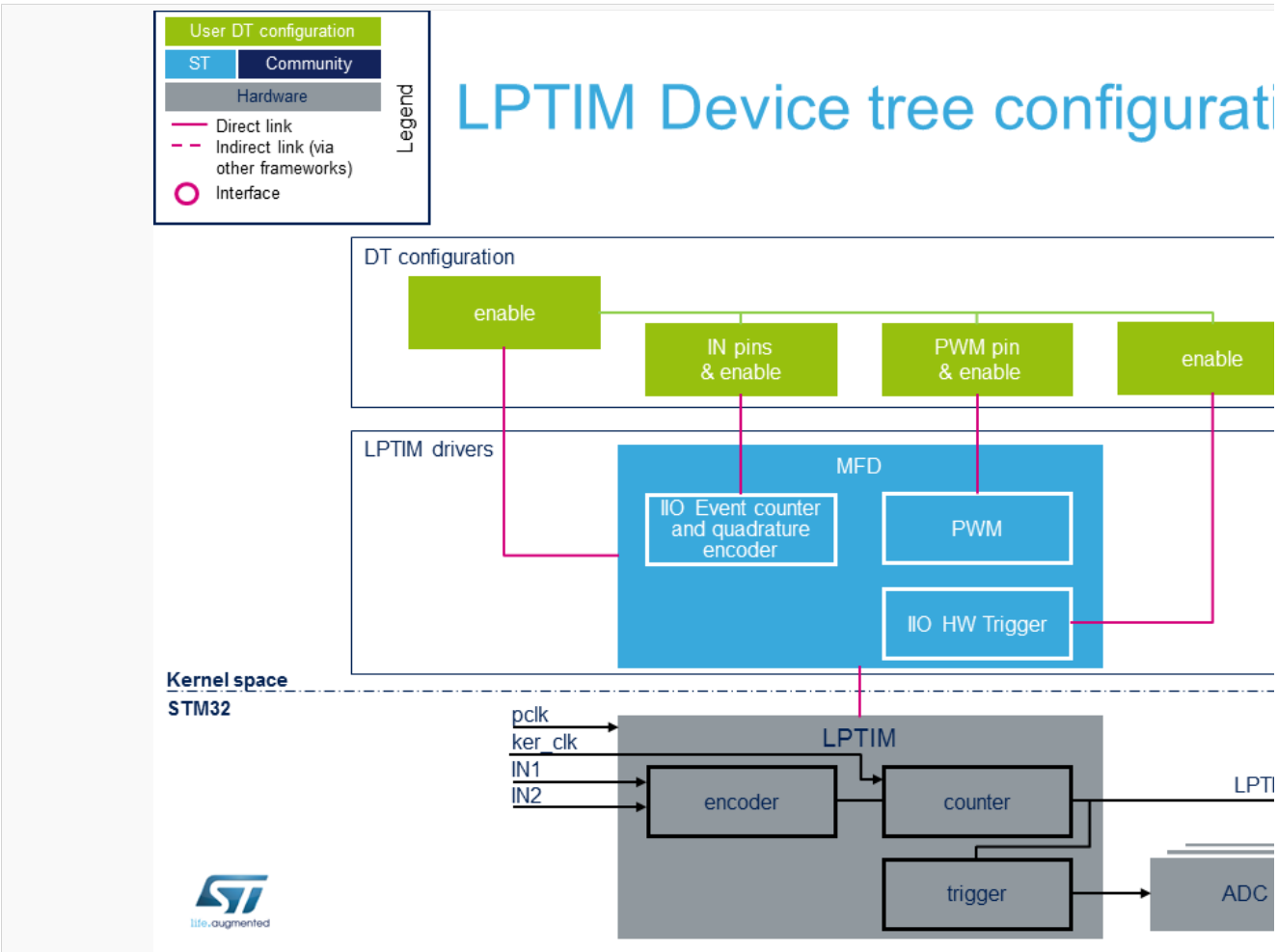
- *STM32 LPTIM PWM device tree bindings*[4] deals with **PWM** interface resources (e.g. PWM pins)
- *STM32 LPTIM trigger device tree bindings*[5] deals with **LPTIM triggers** resources (e.g. trigger output connected to other STM32 internal peripherals)
- *STM32 LPTIM counter device tree bindings*[6] deals with **LPTIM counter and quadrature encoder** resources (e.g. counter/encoder IN[1..2] pins)

3 DT configuration

This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
- Configure the pins in use via pinctrl, with **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

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The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

Stable: 21.02.2020 - 13:04 / Revision: 21.02.2020 - 08:30

Contents

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- how to configure the **board**, e.g. LPTIM input/output pins

The configuration is performed using the **device tree mechanism**[2].

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The LPTIM[1] is a multifunction device (MFD).

Each function is represented by a separate binding document:

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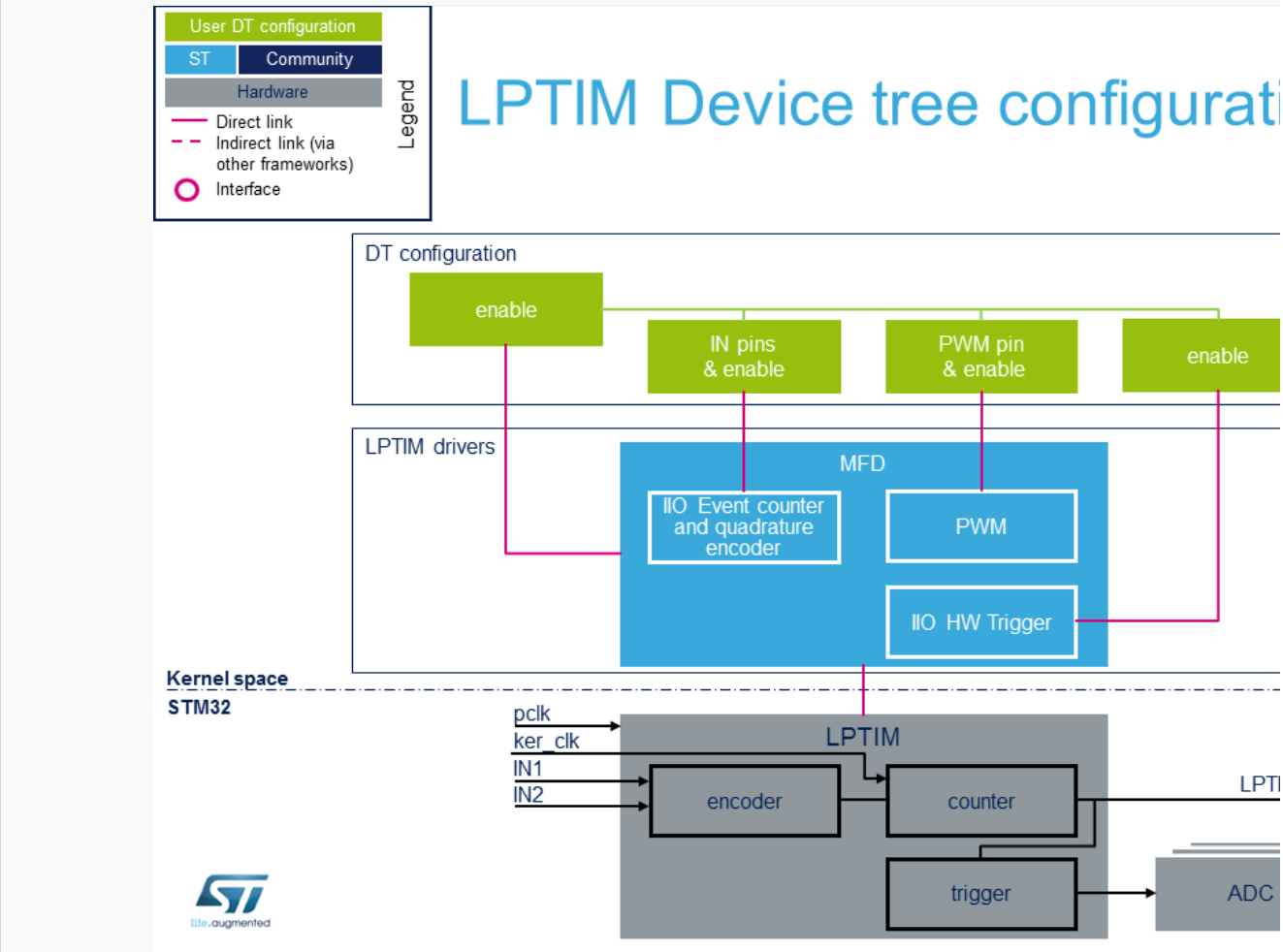
This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

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DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
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- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

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The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

*Stable: **Not stable** / Revision: 12.06.2020 - 13:25*

Contents

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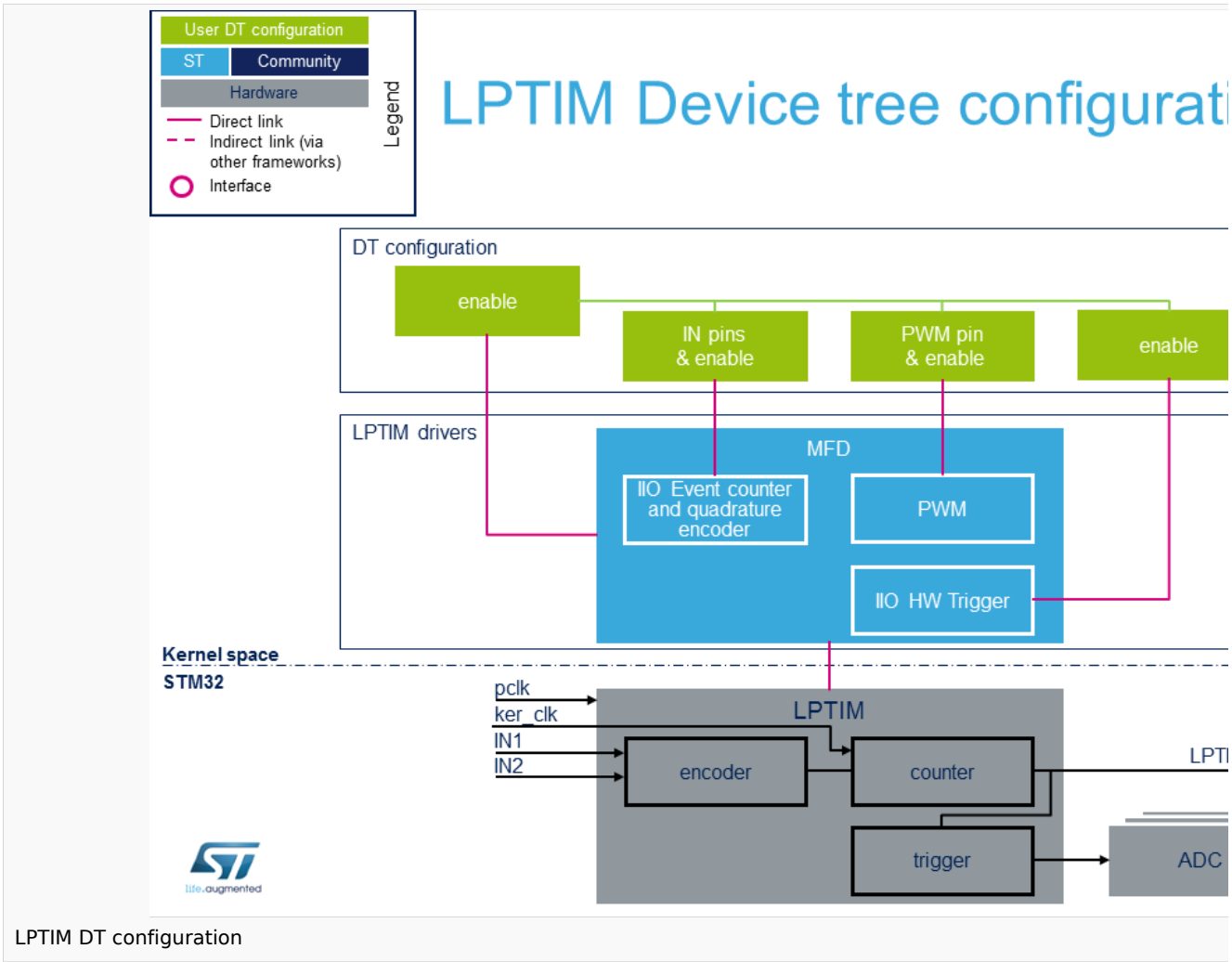

LPTIM DT configuration

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                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
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```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
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                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
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low-power timer (STM32 specific)

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Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

Stable: 12.03.2020 - 13:05 / Revision: 12.02.2020 - 16:31

Contents

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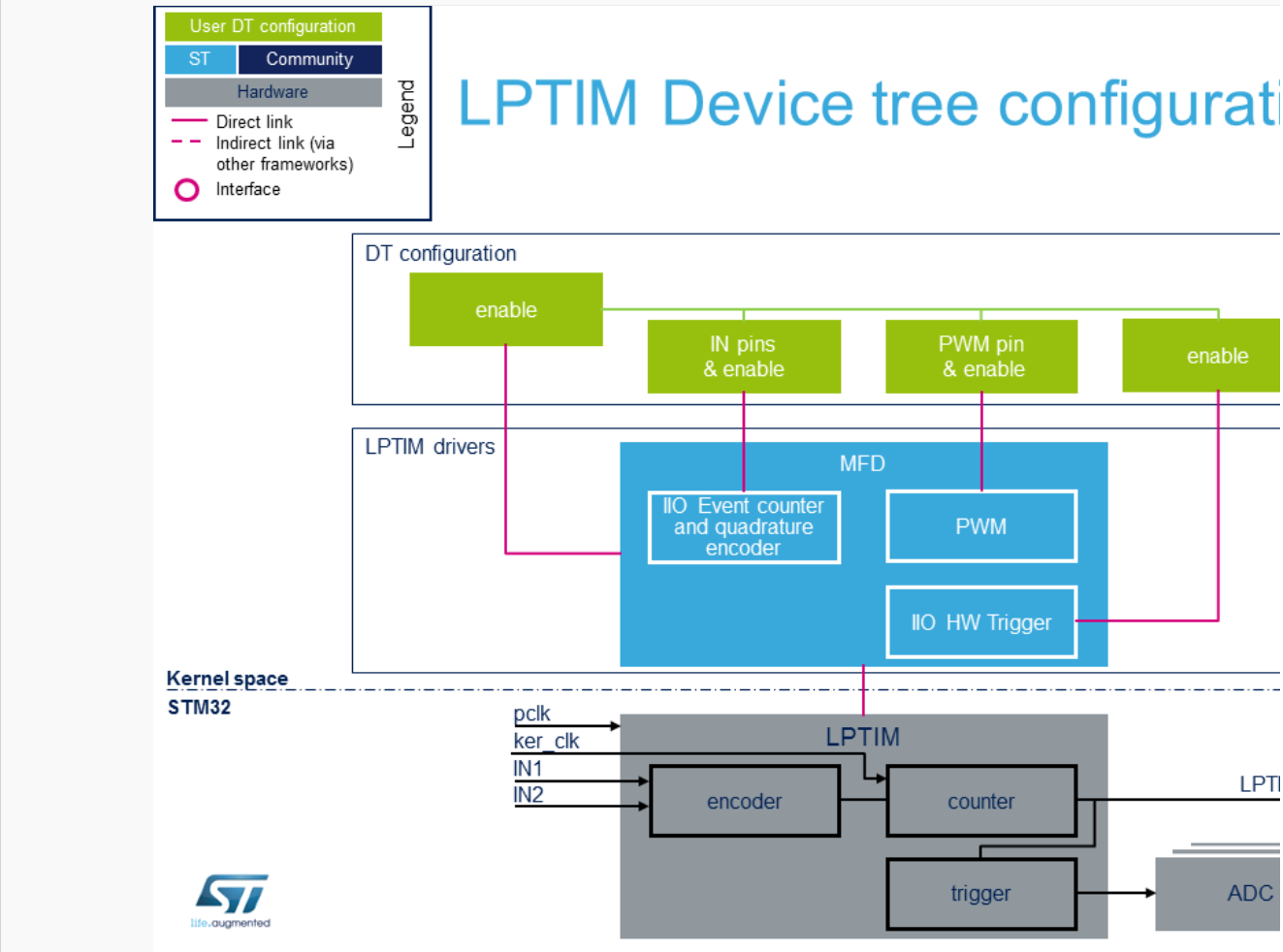
This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
- Configure the pins in use via pinctrl, with **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

5 References

For additional information, refer to the following links:

- 1.01.1 LPTIM internal peripheral
- Device tree
- Documentation/devicetree/bindings/mfd/stm32-lptimer.txt , STM32 LPTIM MFD device tree bindings
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- Documentation/devicetree/bindings/iio/timer/stm32-lptimer-trigger.txt , STM32 LPTIM trigger device tree bindings
- Documentation/devicetree/bindings/iio/counter/stm32-lptimer-cnt.txt , STM32 LPTIM counter/encoder device tree bindings
- STM32MP157C device tree file
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- DFSDM internal peripheral

low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

Device Tree

Multifunction device

also known as

Analog-to-digital converter. The process of converting a sampled analog signal to a digital code that represents the amplitude of the original signal sample.

Digital-to-analog converter (Electronic circuit that converts a binary number into a continuously varying value.)

Digital Filter for Sigma-Delta Modulator

LPTIM device tree configuration

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Contents

1 Article purpose

The purpose of this article is to explain how to configure the low-power timer (*LPTIM*)[1] **when the peripheral is assigned to Linux®OS**, and in particular:

- how to configure the LPTIM **peripheral** to enable PWM, trigger, event counter and quadrature encoder
- how to configure the **board**, e.g. LPTIM input/output pins

The configuration is performed using the **device tree mechanism**[2].

It is used by the LPTIM Linux driver that registers relevant information in PWM and IIO frameworks.

2 DT bindings documentation

The LPTIM[1] is a multifunction device (MFD).

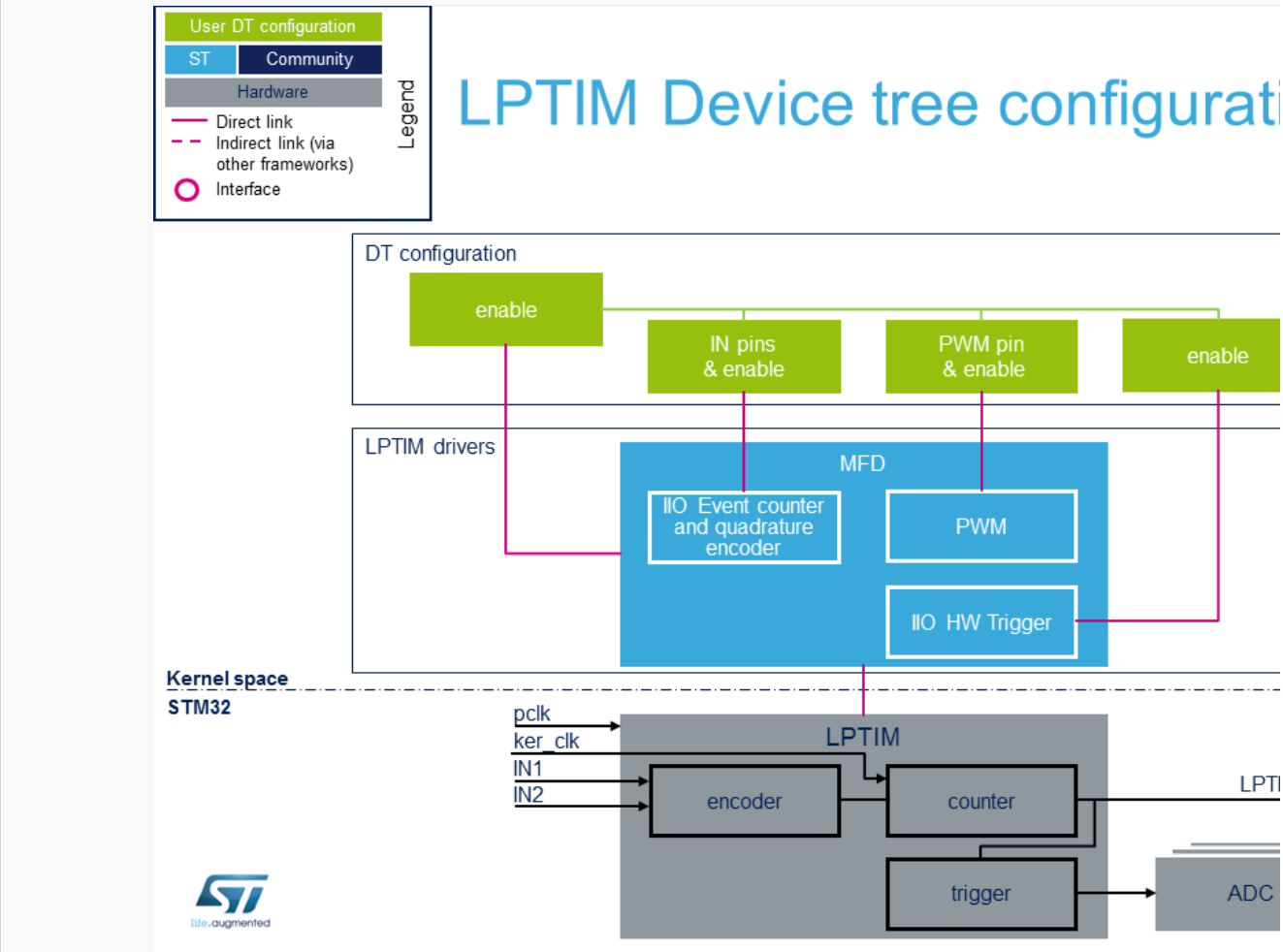
Each function is represented by a separate binding document:

- *STM32 LPTIM MFD device tree bindings*[3] deals with core resources (e.g. registers, clock)
- *STM32 LPTIM PWM device tree bindings*[4] deals with **PWM** interface resources (e.g. PWM pins)
- *STM32 LPTIM trigger device tree bindings*[5] deals with **LPTIM triggers** resources (e.g. trigger output connected to other STM32 internal peripherals)
- *STM32 LPTIM counter device tree bindings*[6] deals with **LPTIM counter and quadrature encoder** resources (e.g. counter/encoder IN[1..2] pins)

3 DT configuration

This hardware description is a combination of STM32 microprocessor and board device tree files. See Device tree for more explanations on device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to How to configure the DT using STM32CubeMX for more details.



LPTIM DT configuration

3.1 DT configuration (STM32 level)

LPTIM nodes are declared in stm32mp157c.dtsi[7].

DT root node (aka lptimer1, ..., lptimer5) and **DT child nodes** describe the LPTIM features such as:

- PWM
- trigger
- event counter and quadrature encoder.

They also describe hardware parameters such as register addresses and clock.

```
lptimer1: timer@40009000 {
        compatible = "st,stm32-lptimer";                    /* lptimer's common
resources */
        ...
        pwm {
                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
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3.3 DT configuration examples

3.3.1 LPTIM1 configured as PWM and trigger source

The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

4 How to configure the DT using STM32CubeMX

The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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low-power timer (STM32 specific)

Operating System

Pulse Width Modulation

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Digital Filter for Sigma-Delta Modulator

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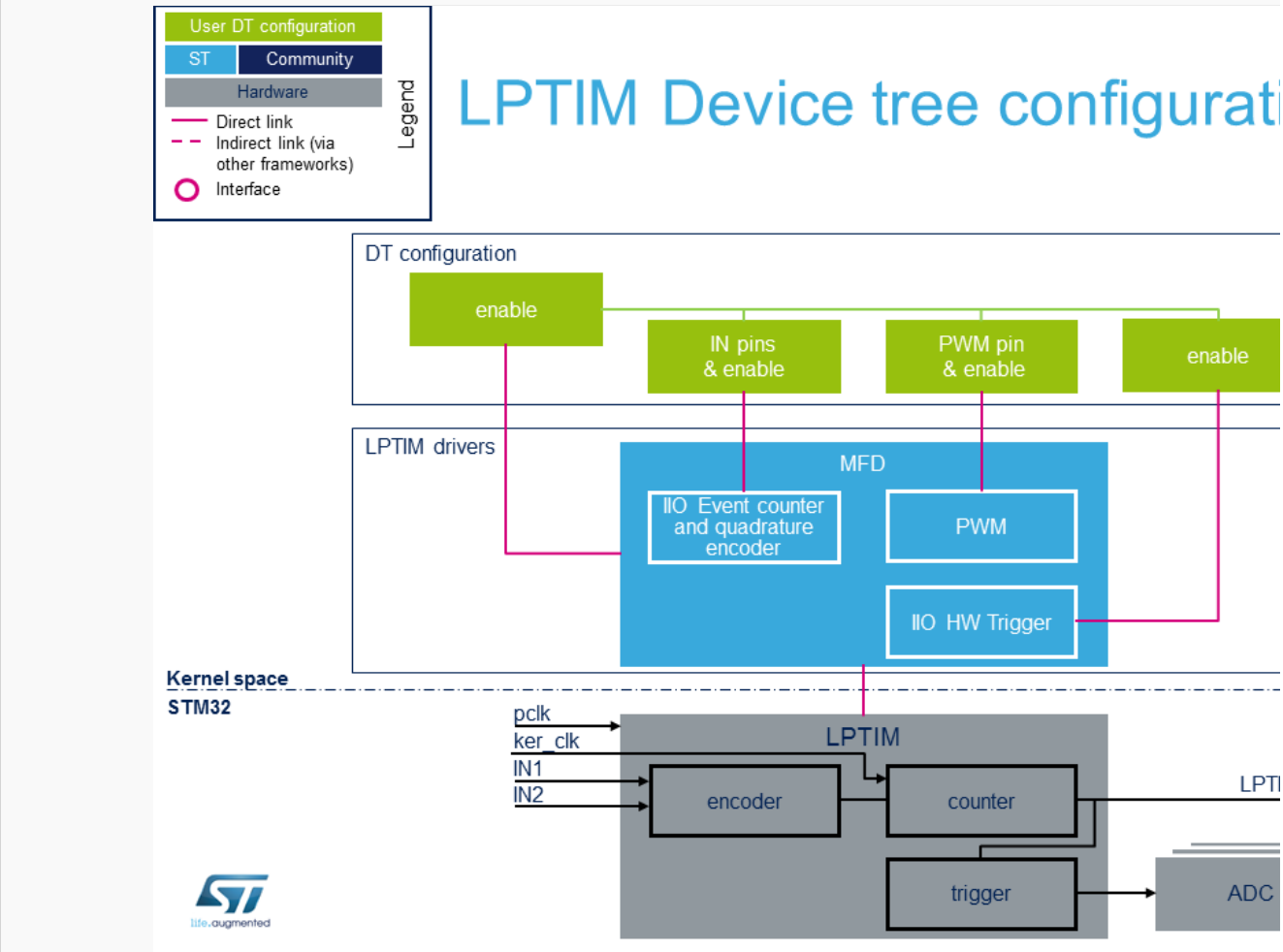

LPTIM DT configuration

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```
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                compatible = "st,stm32-pwm-lp";             /* PWM part of LPTIM */
        };
        trigger@0 {
                compatible = "st,stm32-lptimer-trigger";    /* trigger part of LPTIM
*/
                reg = <0>;                                  /* trigger identifier (e.
g. 0 for LPTIM1 trigger, 1 for LPTIM2... */
        };
        counter {
                compatible = "st,stm32-lptimer-counter";    /* quadrature encoder &
event counter part of LPTIM */
        };
};
```

This device tree part is related to STM32 microprocessors. It should be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

Follow the below sequence to configure and enable the LPTIM on your board STM32MP15 microprocessor:

- Enable **DT root node** for the LPTIM instance in use (e.g lptimer1, ..., lptimer5), with **status = "okay";**
- Enable **DT child node(s)** for the feature(s) in use (PWM output, trigger, event counter and quadrature encoder), with **status = "okay";**
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The example below shows how to configure LPTIM1 to act as:

- PWM output on PG13 (See pinctrl device tree configuration and GPIO internal peripheral)
- trigger source (in Synchronous mode with PWM) for other internal peripherals such as ADC[8], DAC[9], and DFSDM [10]

```
lppwm1_pins_a: lppwm1-0 {
         pins {
                 pinmux = <STM32_PINMUX('G', 13, AF1)>;    /* configure 'PG13' as
alternate 1 for LPTIM1_OUT mode of operation */
                 bias-pull-down;
                 drive-push-pull;
                 slew-rate = <0>;
         };
};
```

```
lppwm1_sleep_pins_a: lppwm1-sleep-0 {
        pins {
                pinmux = <STM32_PINMUX('G', 13, ANALOG)>; /* configure 'PG13' as
analog for low power mode */
        };
};
```

```
&lptimer1 {
        status = "okay";
        pwm {
                pinctrl-0 = <&lppwm1_pins_a>;              /* configure PWM on
LPTIM1_OUT */
                pinctrl-1 = <&lppwm1_sleep_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable PWM on LPTIM1 */
        };
        trigger@0 {
                status = "okay";                           /* enable LPTIM1_OUT trigger
source */
        };
};
```

3.3.2 LPTIM2 configured as counter and quadrature encoder

The example below shows how to configure LPTIM2 to act as counter and/or quadrature encoder, with LPTIM2_IN1 and LPTIM2_IN2 pins configured as inputs on PD12 and PD11, respectively (See pinctrl device tree configuration and GPIO internal peripheral)

```
# part of pin-controller dt node
lptim2_in_pins_a: lptim2-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, AF3)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, AF3)>; /* LPTIM2_IN2 */
                bias-disabled;
        };
};
lptim2_sleep_in_pins_a: lptim2-sleep-in-pins-0 {
        pins {
                pinmux = <STM32_PINMUX('D', 12, ANALOG)>, /* LPTIM2_IN1 */
                         <STM32_PINMUX('D', 11, ANALOG)>; /* LPTIM2_IN2 */
        };
};
```

```
&lptimer2 {
        status = "okay";
        counter {
                pinctrl-0 = <&lptim2_in_pins_a>;           /* configure LPTIM2 counter
/encoder pins */
                pinctrl-1 = <&lptim2_sleep_in_pins_a>;
                pinctrl-names = "default", "sleep";
                status = "okay";                           /* enable counter/encoder on
LPTIM2 */
        };
};
```

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The STM32CubeMX tool can be used to configure the STM32MPU device and get the corresponding platform configuration device tree files.
The STM32CubeMX may not support all the properties described in the above DT bindings documentation paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to STM32CubeMX user manual for further information.

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