# STM32WL5 – IMX

Interconnect Matrix

Revision 1.0

Hello and welcome to this presentation of the STM32 Interconnect Matrix. It covers the main features of this matrix, which is widely used to connect various internal peripherals between each other.

# Overview

- Provides direct connections between peripherals.

| Source |
| --- |
| Timers |
| ADC |
| Temperature sensor |
| Supply |
| Oscillators |
| GPIO External interrupt |
| RTC |
| COMP |
| System errors |

| Destination |
| --- |
| Timers |
| ADC |
| DAC |
| COMP |
| DMAMUX |
| IRTIM |
| SUBGHZSPI |

## Application benefits

- Time-predictable operations
- Decreased power consumption
- Reduced GPIO usage

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2

The Interconnect Matrix integrated inside STM32 products provides direct connections between peripherals. Applications benefit from these interconnections to ensure time-predictable operations, to decrease power consumption by avoiding complex management of peripheral communications through reading/writing registers using CPU instructions and, in some cases, reducing the need to loop the signal from a source to a destination through a dedicated GPIO.

# Key features

- Direct, autonomous connections between peripherals
  - Removes latency regarding to software handling
  - Saves CPU resources
  - Removes the need for looping signals through a dedicated GPIO
- Can operate during Low-power mode (depending on peripheral)

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The Interconnect Matrix offers two main features. First, it ensures direct and autonomous connections between peripherals, allowing the removal of latencies regarding software handling, thus saving GPIO and CPU resources. Second, the interconnection between certain peripherals can even operate during low-power modes.

# Sources and destinations

- **Plenty of interconnect possibilities available**

- Source peripherals
  - Timers: TIMx, LPTIMx, RTC
  - Analog IPs: ADCx, COMPx, VrefInt, VBAT, Temp Sensor
  - Clocks: HSE, LSE, MSI, HSI16, LSI, MCO
  - GPIO EXTI mux
  - System error
- Destination peripherals
  - Timers: TIMx, LPTIMx, IRTIM
  - Analog IPs: ADCx, DACx, COMPx
  - Digital IPs: DMAMUX, SUBGHZSPI

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The main peripherals having direct, autonomous interconnections are timers, analog IPs, clocks, GPIO EXTI mux and System Error for the connection sources.
And timers, analog and digital IPs for the connection destinations.

# Low-power modes

- **Most interconnections are able to work in low-power modes**

- All interconnections work in the following power modes:
  - Run, Sleep, Low-power run and Low-power sleep modes
- Connections from RTC, COMP1, COMP2 to low-power timer (LPTIM1, LPTIM2)
  - Also work in Stop0, and Stop 1 (LPTIM1 only) modes

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5

Peripherals can be interconnected using the Interconnect Matrix even when the circuit is in a low-power mode.
The operating modes that can be used are: Run, Low-power run, Sleep and Low-power sleep modes.
The connections from the real-time clock or comparators to low-power timers can also be used in Stop0 and Stop 1 modes for Low-power Timer 1.

## Application examples

- Timer synchronization or chaining
- Triggering of ADC, DAC, or COMP (by Timer or EXTI)
- Triggering of timers (by ADC, RTC or COMP)
- Calibration of HSI16, MSI, LSI clocks
- Temperature and voltage monitoring
- Protection of timer-driven power switches (System Error to Timer)
- Infrared signal generation (Timer to IRTIM)
- Transferring SUBGHZSPI data via DMAMUX (by LPTIM3)

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6

The Interconnect Matrix is mostly used for:

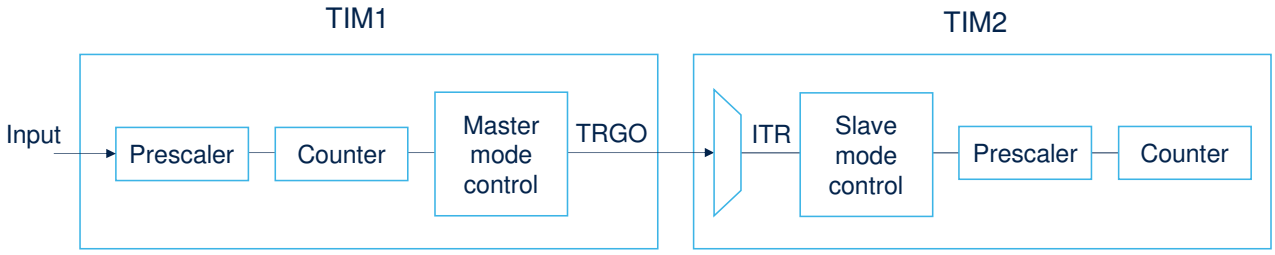
- Synchronizing or chaining timers, for example allowing a master timer to reset or trigger a second slave timer
- Triggering an ADC, DAC, or comparator through a timer event or an external interrupt
- Triggering a timer through an ADC when a predefined threshold value is crossed by the analog input
- Timers can also be triggered based on a comparator output value
- Calibrating HSI16, MSI, LSI clocks, for example measuring the external oscillator LSE frequency by a timer clocked by the calibrated internal oscillator
- Monitoring the temperature of a connected internal temperature sensor or the VBAT to ADC voltage
- Protecting timer-driven power switches through the direct connection of System Error signals to the timer break input
- Infrared pulse modulation signal waveform generation

using 2 timers

- Transferring data on SUBGHZSPI using the DMAMUX and LPTIM3.

# Timer synchronization example

- Timer 1 can act as a pre-scaler for Timer 2

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This slide shows a simple example of timer synchronization. The Timer 1 is used as the Master Timer and can reset, start, stop or clock the Timer 2 configured in Slave mode. In this example, Timer 1 is clocking the Timer 2 so that it acts as a pre-scaler for Timer 2.

# References

- For more details, please refer to:
  - Reference manuals for STM32WL5 microcontrollers

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For more details about the Interconnect Matrix, refer to reference manual for STM32WL5 microcontrollers.