Introduction to Microcontroller World

XMC™ Microcontrollers

March 2016

Agenda

1. What is a Microcontroller
2. CPU
3. Co Processor
4. On Chip Memories
5. Communication Peripherals
6. Analog Peripherals
7. Timers with pulse width modulation capability

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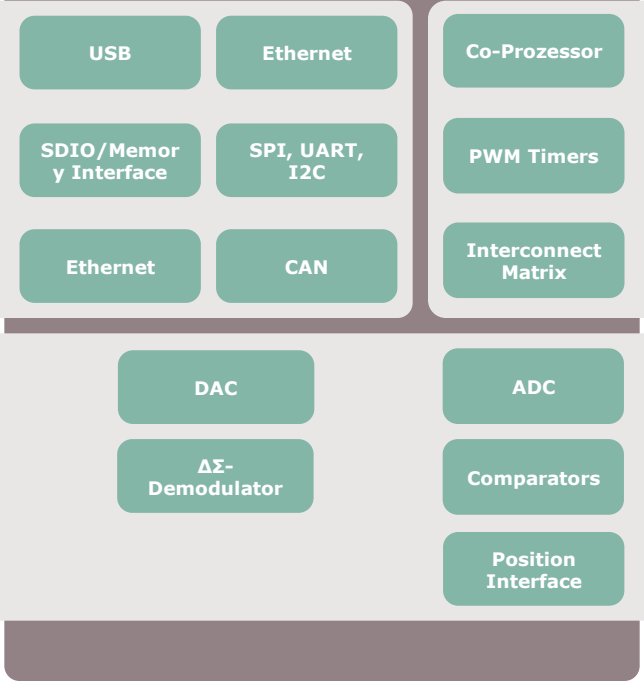
What is a Microcontroller?

Processor + Peripherals



Connectivity

› Connect your module to the external world (IOT)

Drivers

› Gate Drivers
› MOSFETS
› IGBT's

Sensors

› Temperature, Pressure, Acceleration,…

Feedback Loops

› Hall Sensors
› Encoders
› Current Measurement

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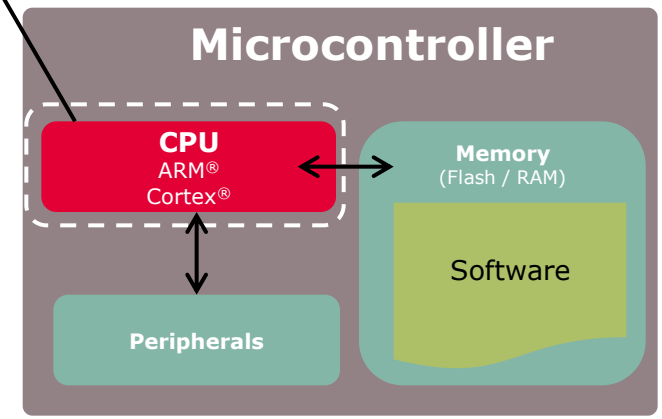
CPU

What is the role of CPU in a Microcontroller?

- CPU stands for Centre Processing Unit which is the brain of the overall Microcontroller system.
- The CPU will execute instruction sets (software) from the memory (Flash/RAM) and command other peripherals for specific tasks or process incoming data.
- For embedded system of this generation CPUs are considered to be 32-bit. This means that the related instruction sets, address and data bus are accessed in 32-bit format.
- There are various CPU processing speed to cater for different needs and the CPU speed is specified in MHz frequency.
- The CPU needs to be driven by an external or internal oscillator also known as the clock source.

Infineon XMC™ Microcontroller speed

Available from 48 MHz to 144 MHz



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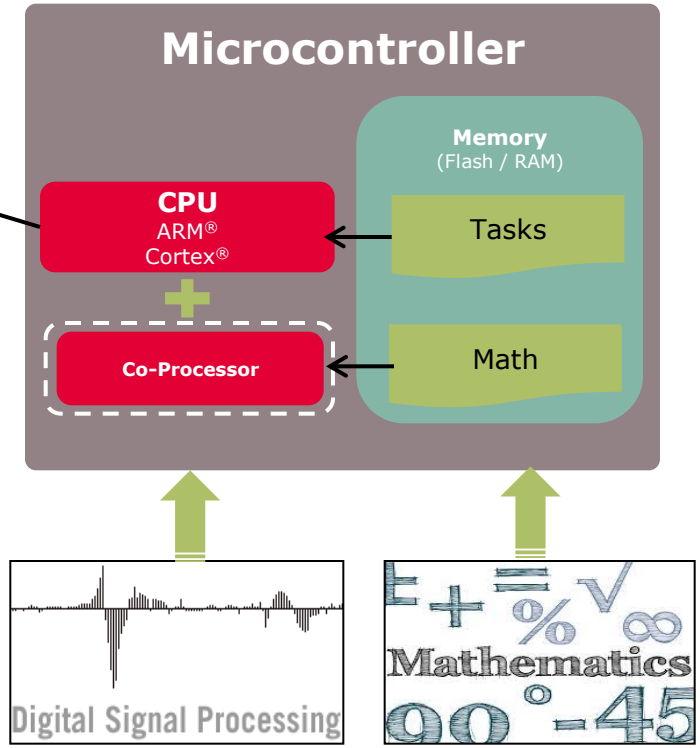
Co Processor

What is the role of the Co Processor?

- The Co Processor is a computer processor used to supplement the functions of the primary processor (the CPU).
- Operations performed by the **Co Processor** may be floating point arithmetic, graphics, signal processing, string processing, encryption or I/O Interfacing with peripheral devices.
- This has the advantage of off loading the CPU to perform time critical task.
- Low end microcontroller does not come with Co Processor, hence complex software algorithm needs to be implemented which makes the overall system less efficient.

Infineon XMC4000
The XMC4000 ARM® Cortex® M4 has got a built in Digital Signal Processor (DSP) or Multiply Accumulate (MAC) to take care of complex arithmetic calculation



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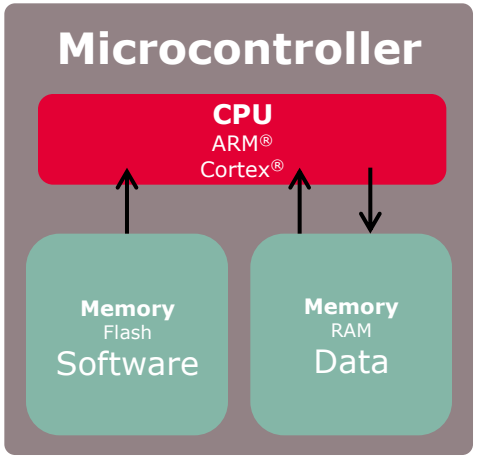
On chip Memories

What is Flash memory?

- Flash is used for the storage of software or commonly known as the firmware in an embedded system.
- Hence firmware can be updated into the flash memory with a newer version by the process of electrically erasing and reprograming the flash.
- Flash memory space range from 64 KB to 2 MB for Infineon XMC™ Microcontrollers.



What is RAM?

- RAM stands for Random Access Memory
- RAM is used as temporary storage of data variables. Unlike flash which contains mostly static instructions or data, RAM data can be frequently changing.
- Example, the below RAM data "Counter" is doing an incrementing operation. And its updated with a different value each time it is incremented.

```
Counter++;
```

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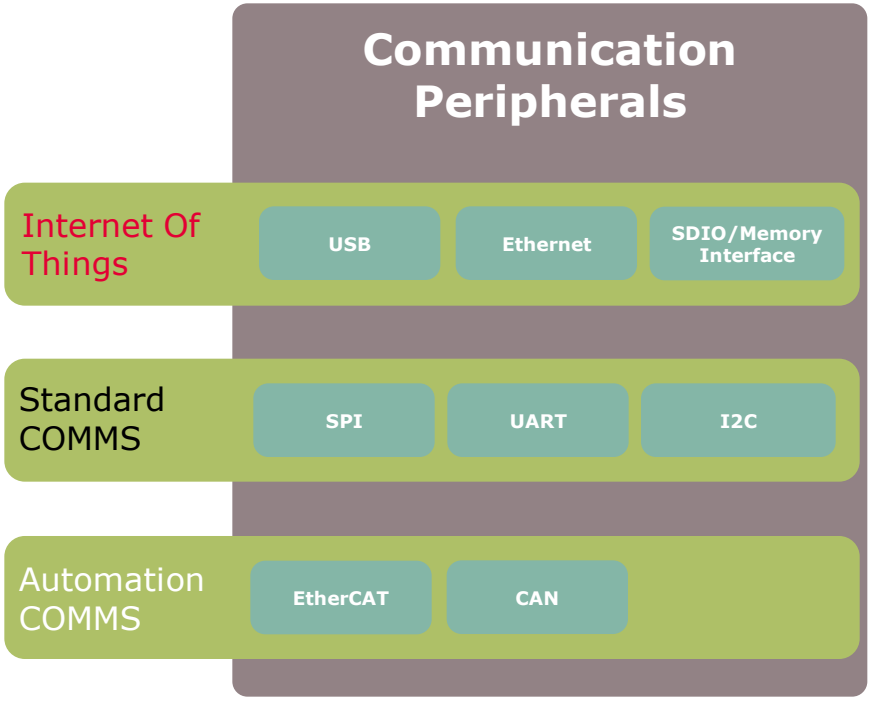
Communication Peripherals

Why MCU needs communication?

- The MCU needs to interact with other external device just like human beings who need to speak different languages.
- Hence there are many different communication protocol (USB, CAN I2C etc.)

Types of Communication Protocol

- In modern communication, Ethernet and USB can be found in most high end microcontroller. (e.g. XMC4000)
- Standard communication protocol such as UART, SPI, I2C or EBU can be found in most general microcontroller.
- For Automation purposes, CAN bus is usually used.
- Lately Ethernet is used in Automation for better performance, therefore EtherCAT® (**Ether**net for **C**ontrol **A**utomation **T**echnology) is introduced in Infineon XMC4800.



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Analog Peripherals

What are the Analog Peripherals?

› The Analog Peripherals refers to the Analog to Digital Converter (ADC), Digital to Analog Converter (DAC) and Comparator.

Analog to Digital Converter (ADC)

› ADC is used to convert analog voltage level to digital data. Such that this data can be used by the software to determine the next course of action.

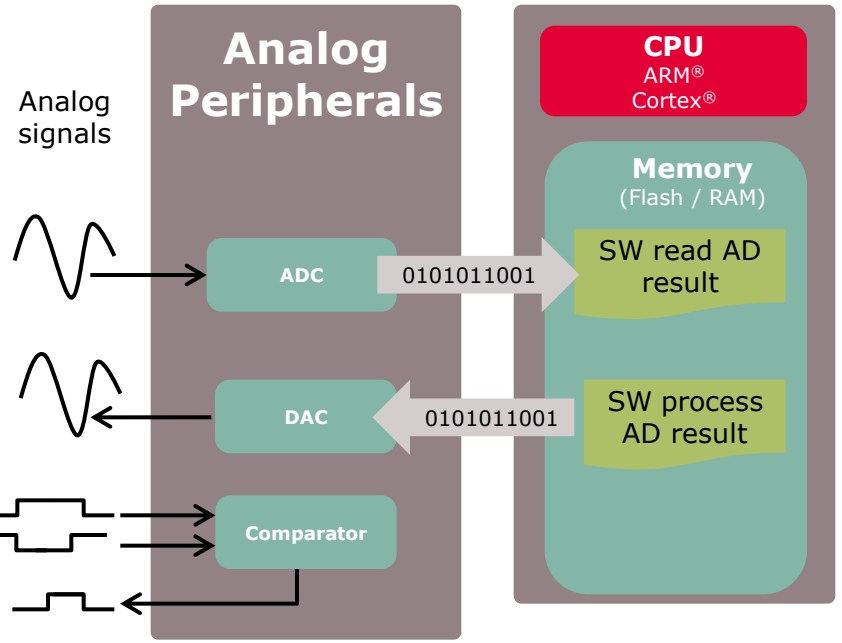
› Usually sensors (e.g. temperature sensor) can be connected to a ADC channel as a close loop feedback system.

Digital to Analog Converter

› The DAC is function that convert digital data into an analog signal usually a specific voltage level.

Comparator

› The comparator is used to compare 2 analog voltage input. The result is an output voltage level high or low.



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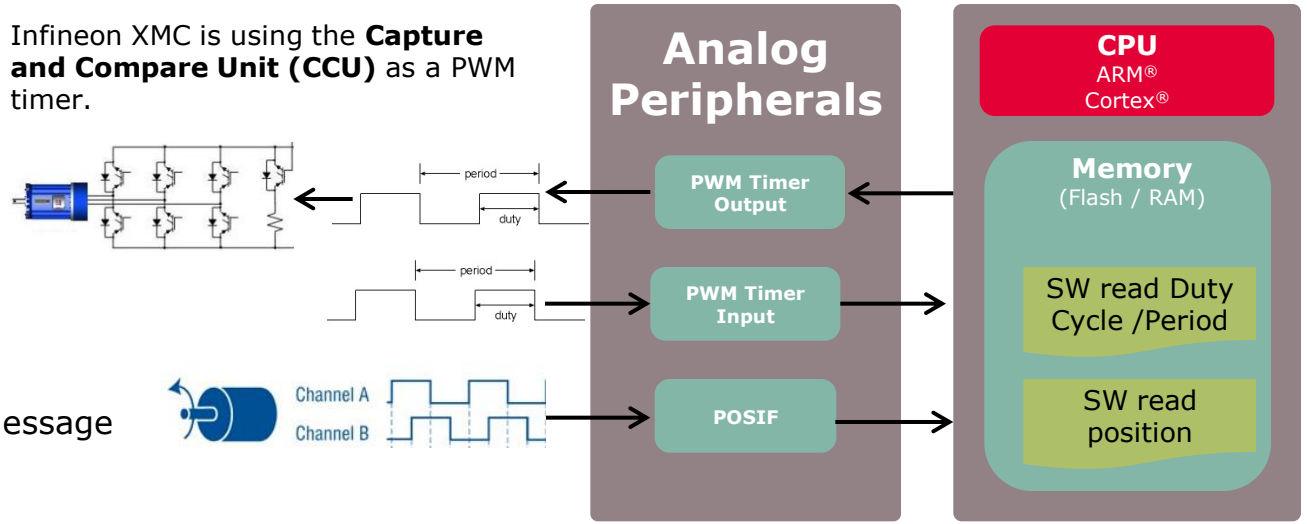
Timers with pulse width modulation capability

Infineon XMC is using the **Capture and Compare Unit (CCU)** as a PWM timer.



Note:

PWM stands for **P**ulse **W**idth **M**odulation, it is a modulation technique used to encode a message into a pulsing signal.

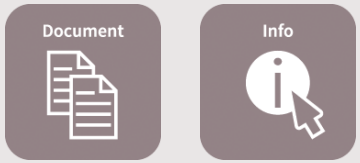
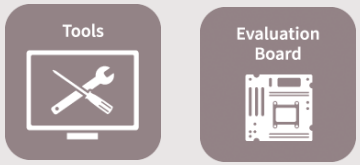
What is the purpose of the PWM timer?

- The timer can be figured to output square waveforms with defined period and duty cycle, allowing for use in motor control applications, for example.
- It is also able to measure a PWM Frequency/Period and Duty cycle base on the rising and falling edge of the waveform.

What is a Position Interface?

- Position interface is used to interface with a rotary Encoder to understand precisely the angular position or motion example of a motor.

Support material

Collaterals and Brochures 	› Product Briefs › Selection Guides › Application Brochures › Presentations › Press Releases, Ads	› www.infineon.com/XMC
Technical Material 	› Application Notes › Technical Articles › Simulation Models › Datasheets, MCDS Files › PCB Design Data	› www.infineon.com/XMC › Kits and Boards › DAVE™ › Software and Tool Ecosystem
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Glossary abbreviations

ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
PWM	Pulse Width Modulation
CPU	Central Processing Unit
RAM	Random Access Memory
I/O	Input and Output Port
UART	Universal Asynchronous Receive and Transmit
USB	Universal Serial Bus
I2C	Inter-Integrated Circuit
CAN	Controlled Area Network

Glossary abbreviations

- EtherCAT® Ethernet for Controlled Automation Technology
- SPI Serial Peripheral Interface
- IoT Internet of Things

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