

# EMBEDDED SYSTEM COURSE

## **LECTURE 3: GETTING STARTED WITH KL46 FREEDOM BOARD**

# Learning Goals

- Introduce about the FRD-KL46Z boards and its peripherals
- Introduce about the Keil uVision IDE

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- FRDM-KL46Z Overview
- FRDM-KL46Z Hardware Description
- Development Tool chain Overview (KEIL)
- FRDM-KL46Z Started Project.
- Summary

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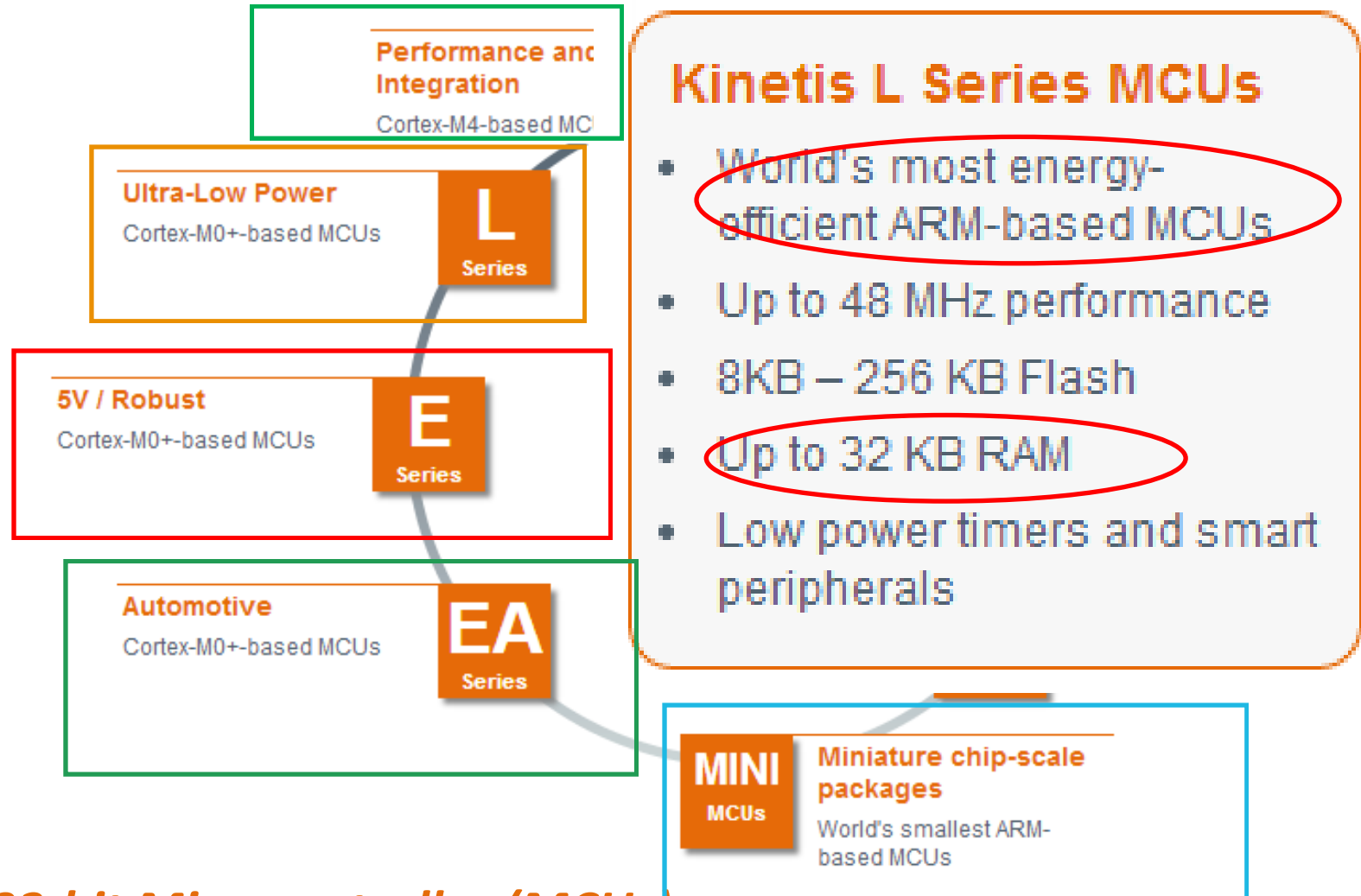
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# FRDM-KL46Z Overview

## Freescal Introduction:

- Freescale is a leader in embedded processing solutions for the automotive, consumer, industrial and networking markets.
- 2010: Freescale announced more than 200 ultra-low-power 32-bit Kinetis MCU. It represents the most scalable portfolio of ARM<sup>®</sup> Cortex<sup>™</sup> microprocessors in the industry with comprehensive enablement for consumer and industrial applications.

# FRDM-KL46Z Overview



*Kinetis 32-bit Microcontroller (MCUs)*

# FRDM-KL46Z Overview

- The FRDM-KL46Z is an ultra-low-cost development platform.
- Features include easy access to MCU I/O, battery-ready, low-power operation, a standard-based form factor with expansion board options and a built-in debug interface for flash programming and run-control.

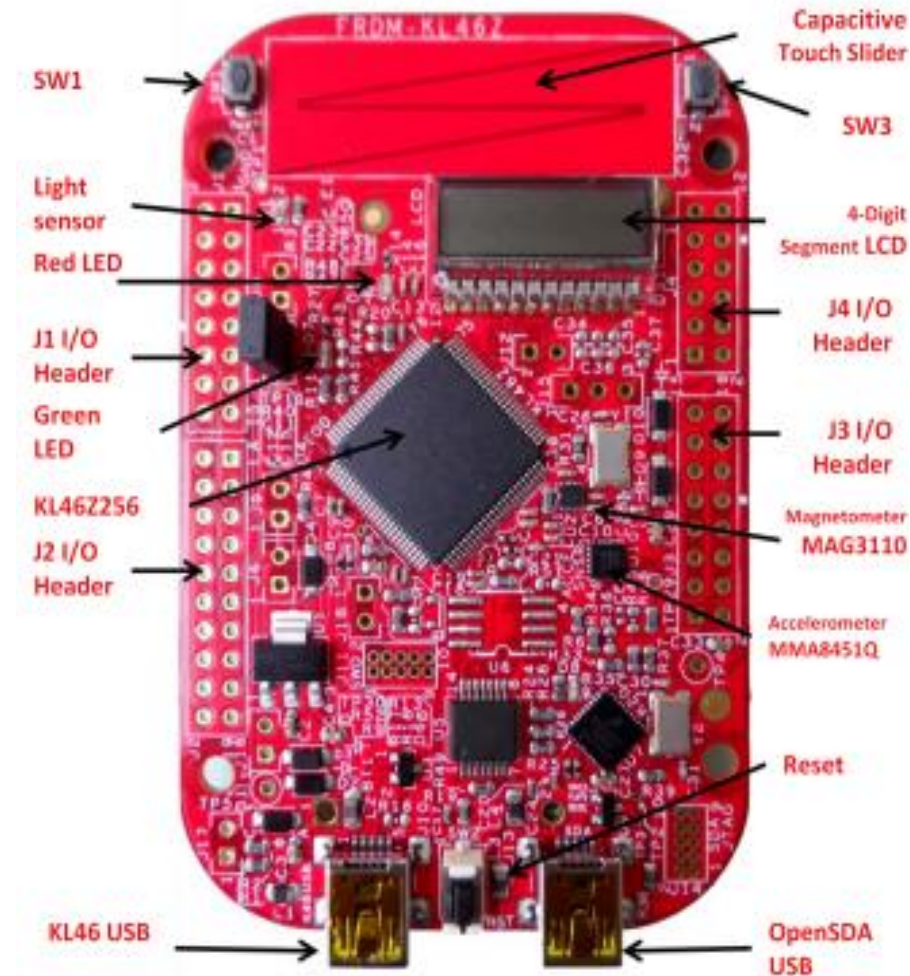


Figure 2. FRDM-KL46Z main components placement.

# FRDM-KL46Z Overview

## References:

- FRDM-KL46Z User's Manual
- KL46 Sub-Family Reference Manual
- FRDM-KL46Z Schematic
- FRDM-KL46 Sample Code

([http://www.freescale.com/webapp/sps/site/prod\\_summary.jsp?code=FRDM-KL46Z&fpsp=1&tab=Design Tools Tab](http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=FRDM-KL46Z&fpsp=1&tab=Design%20Tools%20Tab))



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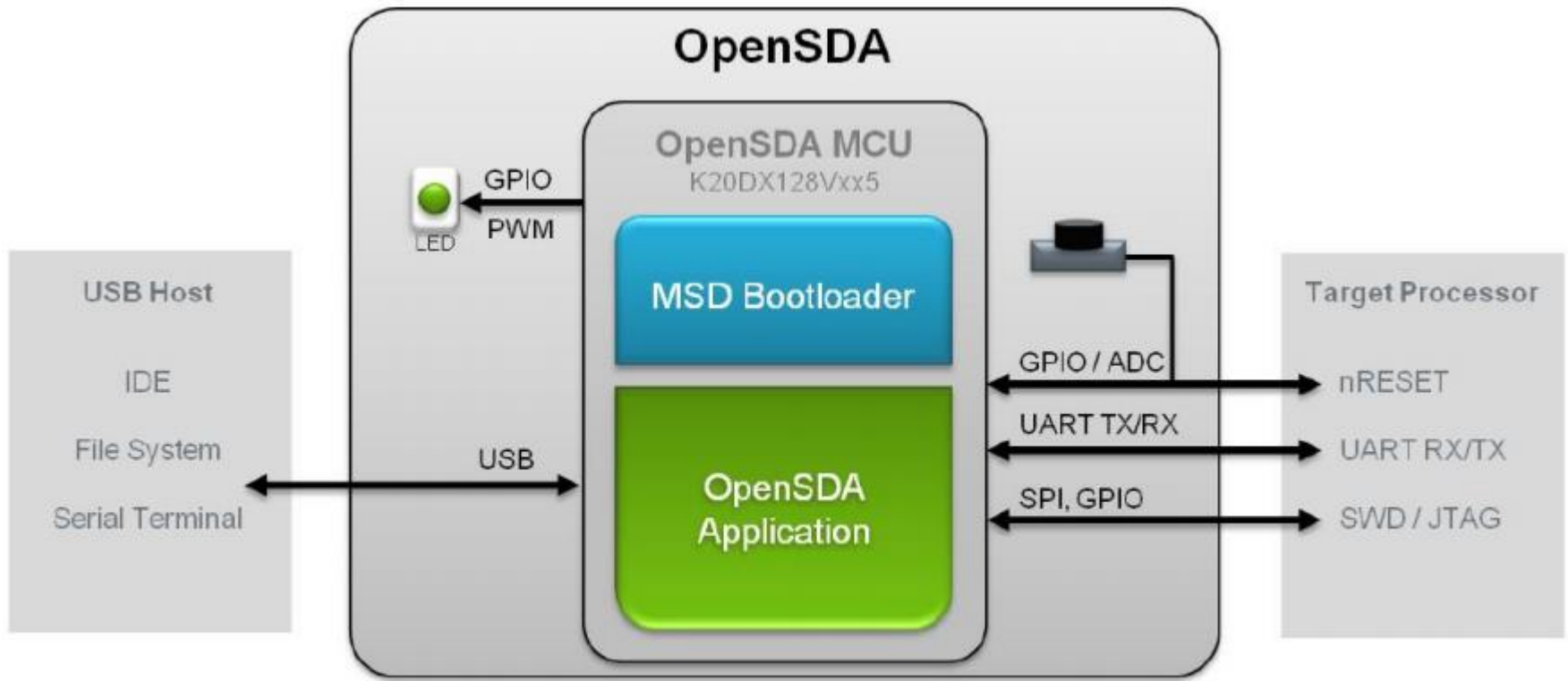
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# FRDM-KL46Z Hardware Description

1. Power Supply
2. OpenSDA
3. MKL46Z4 Microcontroller
4. Clock source
5. USB Interface
6. Serial Port
7. Reset
8. Debug
9. Segment LCD
10. Capacitive Touch Slider
11. Three-axis Accelerometer
12. Three-axis Digital Magnetometer
13. LEDs
14. Visible light sensor
15. Input/Output Connector

# FRDM-KL46Z Hardware Description

## OpenSDA:

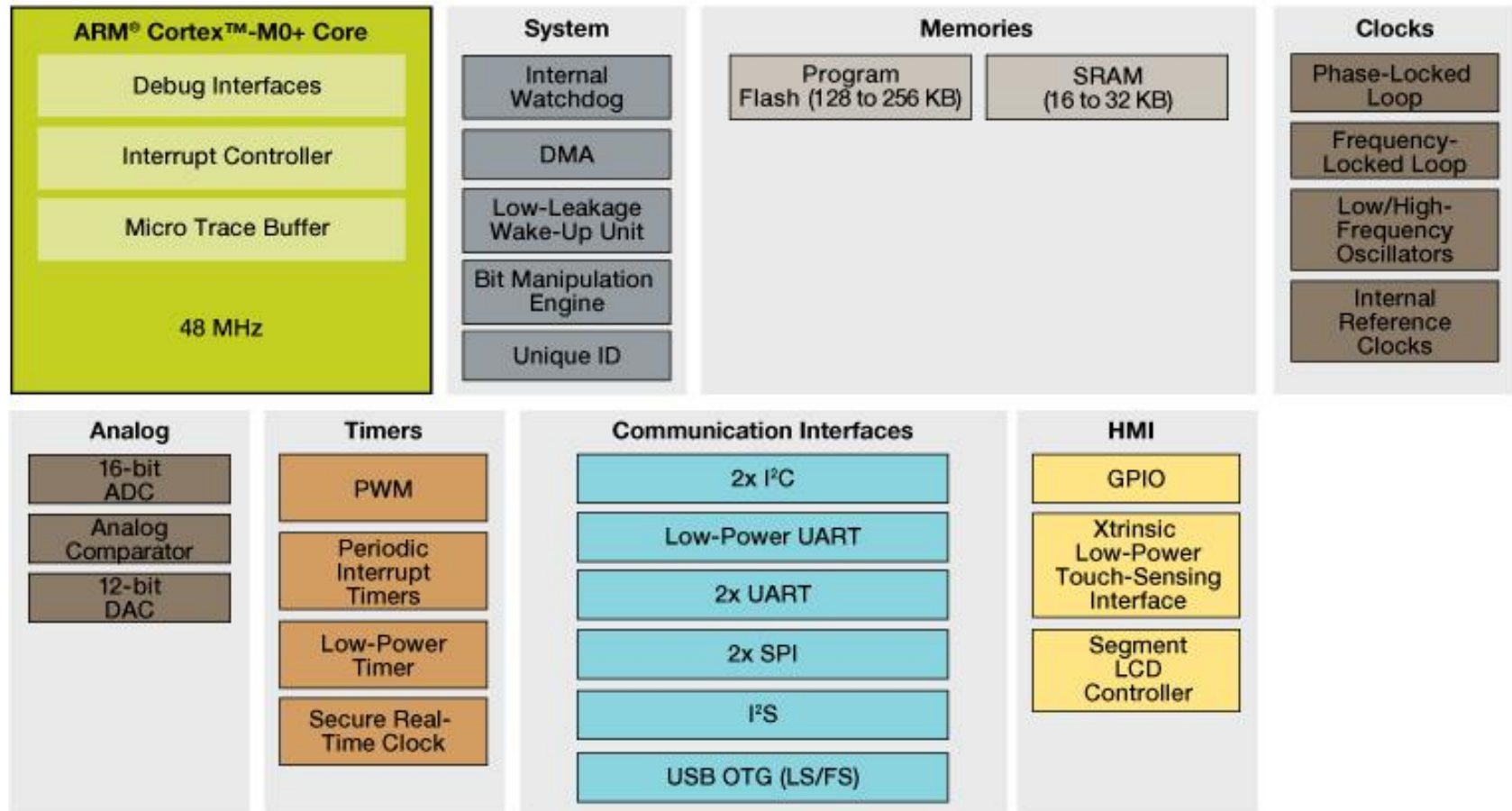


**OpenSDA High-Level Block Diagram**

# FRDM-KL46Z Hardware Description

## MKL46Z4 Microcontroller:

KL4x Family Block Diagram



☐ Standard    ☐ Optional

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# Development Tool chain Overview (KEIL)

## Overview

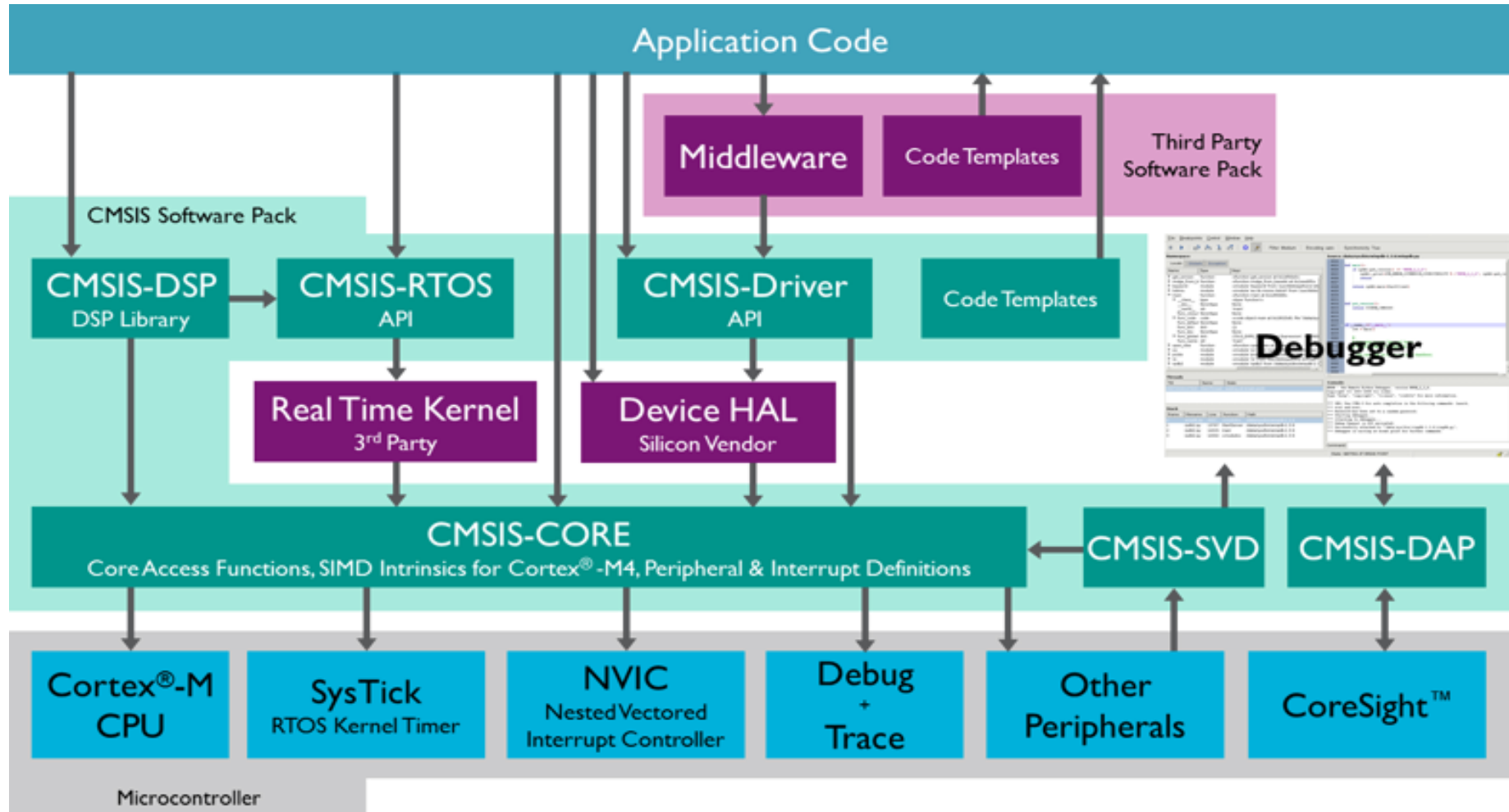
### MDK-ARM Microcontroller Development Kit



- MDK-ARM Software <https://www.keil.com/demo/eval/arm.htm>
- Patch for KL46 freedom board  
<http://www.keil.com/dd2/freescale/mkl46z256xxx4/>

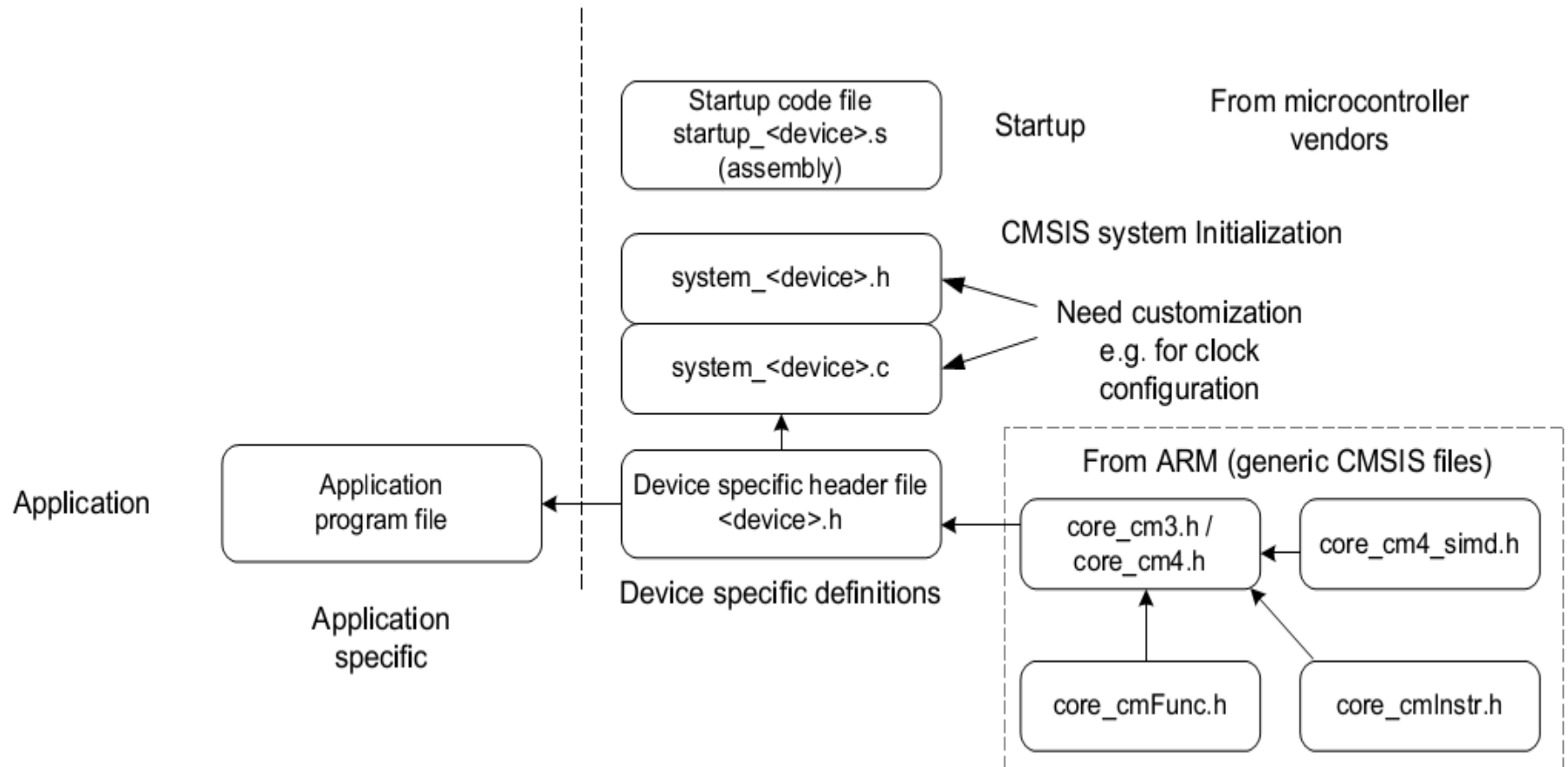
# Development Tool chain Overview (KEIL)

## CMSIS Overview



# Development Tool chain Overview (KEIL)

## CMSIS Overview

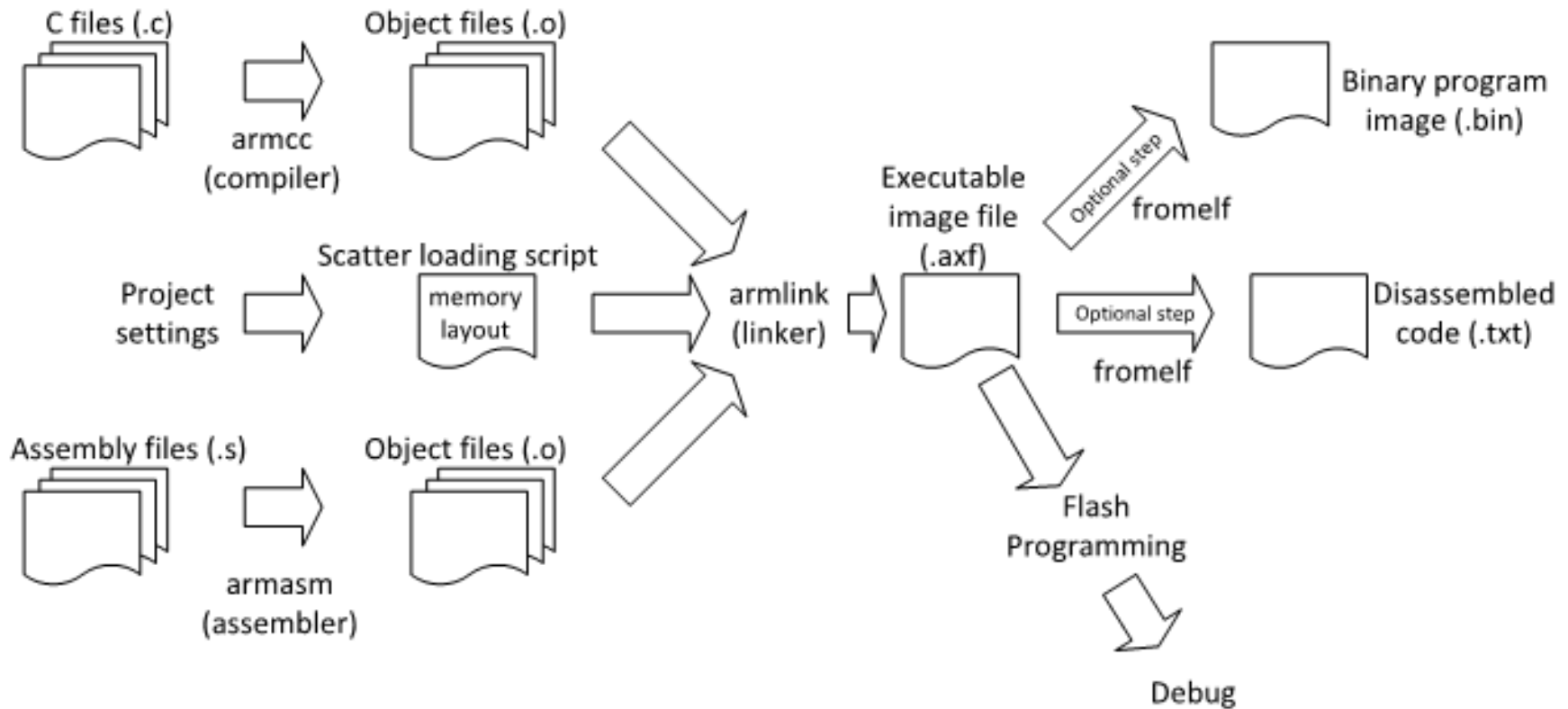


Example project view when including CMSIS-Core files from ARM



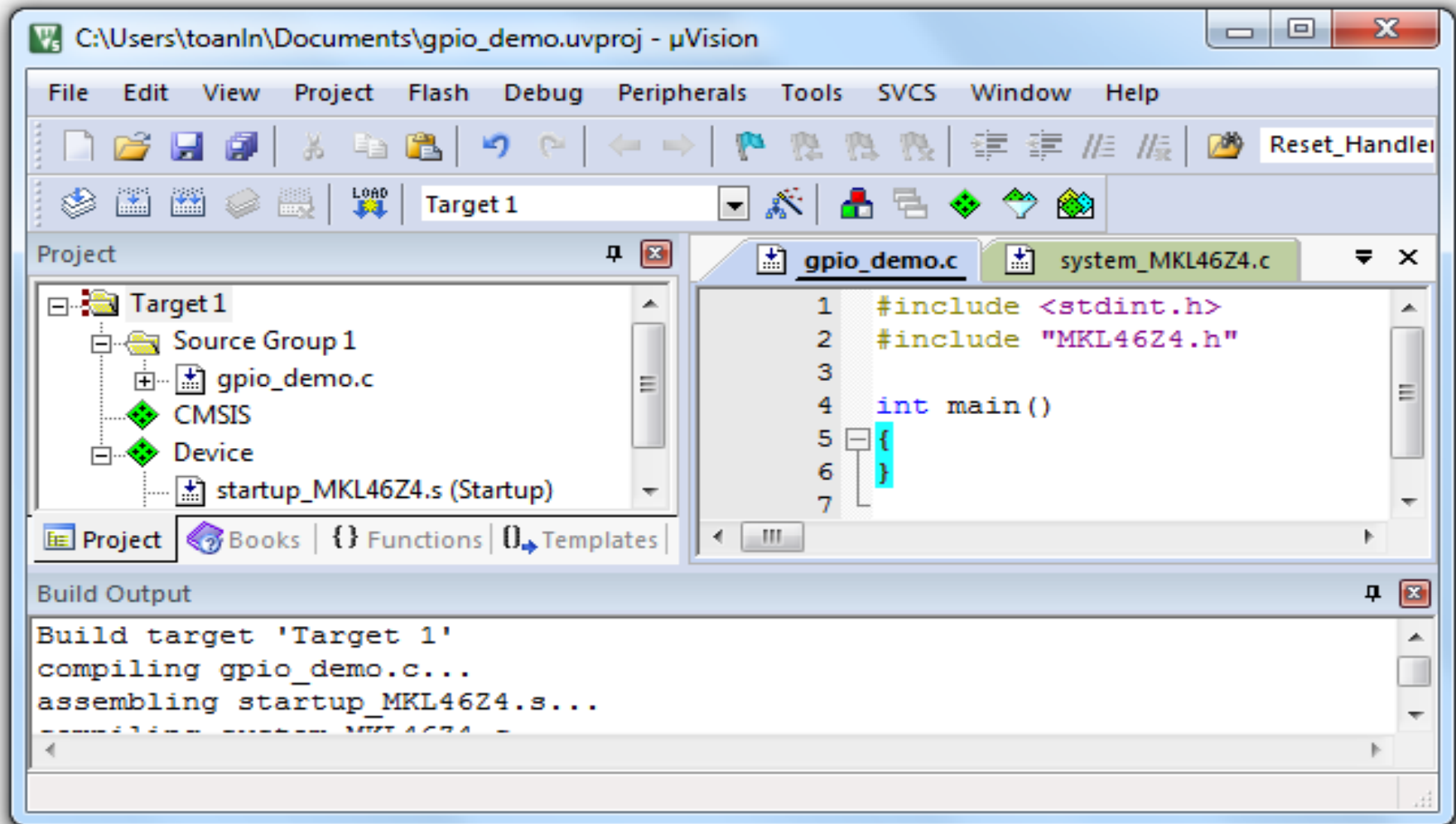
# Development Tool chain Overview (KEIL)

## Typical program compilation flow



# Development Tool chain Overview (KEIL)

## Getting Started with $\mu$ Vision



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# FRDM-KL46Z Started Project

## Requirement:



- Using SW1 to control Red LED
  - Press SW1 to toggle Red LED

# FRDM-KL46Z Started Project

## **PORT Module:**

The port control and interrupt (PORT) module provides support for port control, and external interrupt functions.

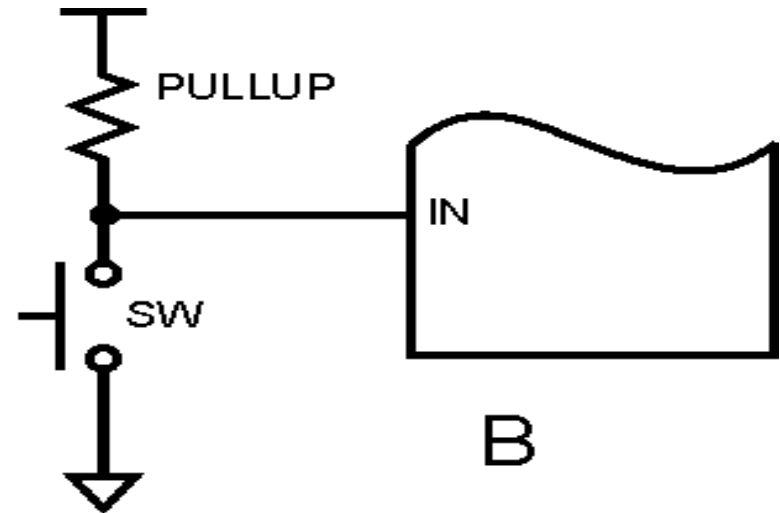
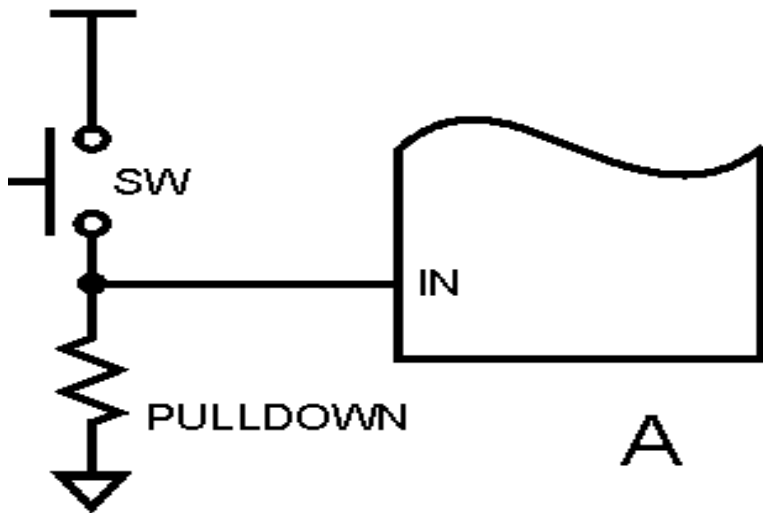
## **Features:**

- Pin interrupt on selected pins
- Port control
  - Individual pull control fields pullup, pulldown, pull-disable
  - Individual mux control field supporting analog or pin disabled, GPIO, and up to six chip-specific digital functions

# FRDM-KL46Z Started Project

## Pull-up/down Resistor

- Issue: When one pin is configured as an input and nothing is connected to the pin -> program cannot read the pin state (floating or unknown state)



# FRDM-KL46Z Started Project

## **GPIO Module:**

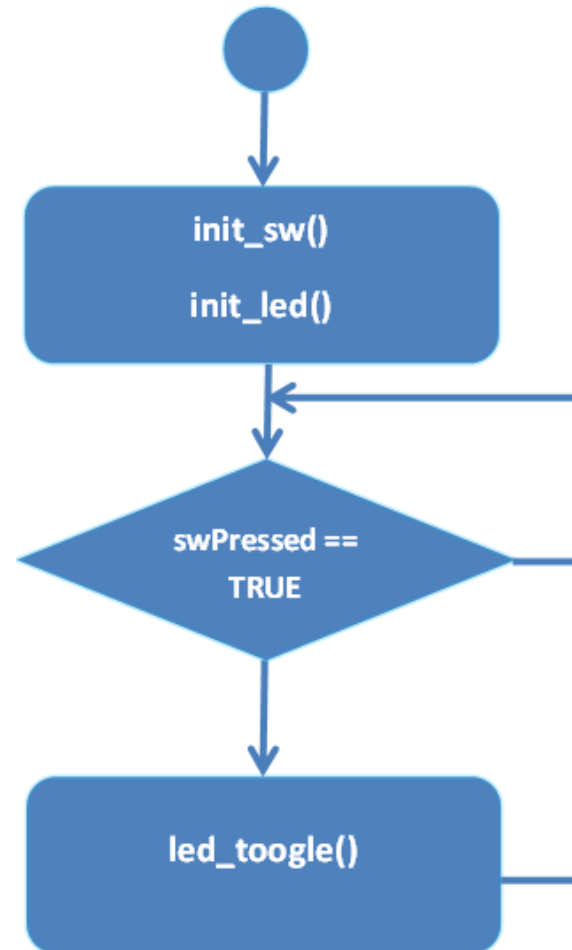
GPIO (*General Purpose Input Output*) is a generic pin on a chip whose behavior can be controlled (programmed) through software

## **Features:**

- Pin input data register visible in all digital pin-multiplexing modes
- Pin output data register with corresponding set/clear/toggle registers
- Pin data direction register
- Zero wait state access to GPIO registers through IOPORT

# FRDM-KL46Z Started Project

## Project Flowchart with pooling





# Summary

## **The FRDM-KL46Z features:**

- MKL46Z256VLL4, up to 48MHz Clock, 256KB of flash, 32KB RAM, and loads of analog and digital peripherals.
- OpenSDA circuit with several options (serial communication, run-control debug, flash programming).

**The MDK-ARM** is a complete software development environment for Cortex™-M, Cortex-R4, ARM7™ and ARM9™ processor-based devices

**Getting Started Project** with GPIO and PORT modules in KEIL

# Question & Answer



***Thank you for your attention !***

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