

arm



# CMSIS & ML Partner Event

embedded world 2025

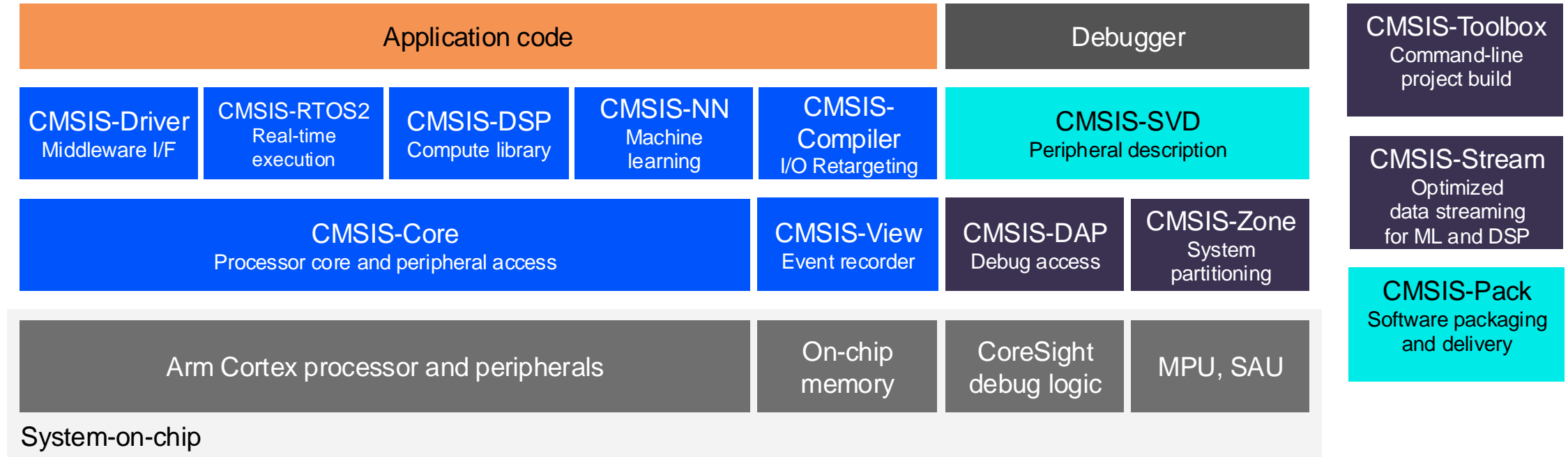
Reinhard Keil, Christopher Seidl, Joachim Krech  
March 11<sup>th</sup>, 2025

# Agenda

- State of CMSIS v6
- 2024 achievements
- CMSIS-Packs for device, board, and software support for scalable examples
- Arm commercial tooling
- Arm open-source tooling
- Roadmap
- Arm CMSIS Debug extension overview
- Collaboration with GitHub
- AI/ML tools and software with Edge Impulse
- Demo

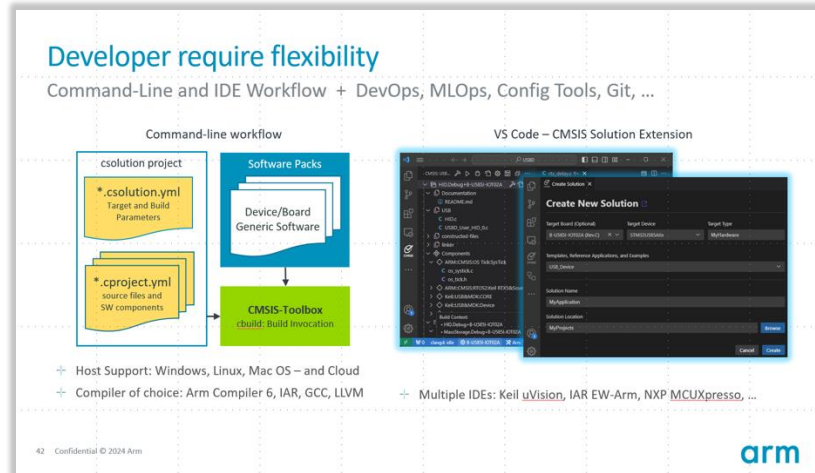
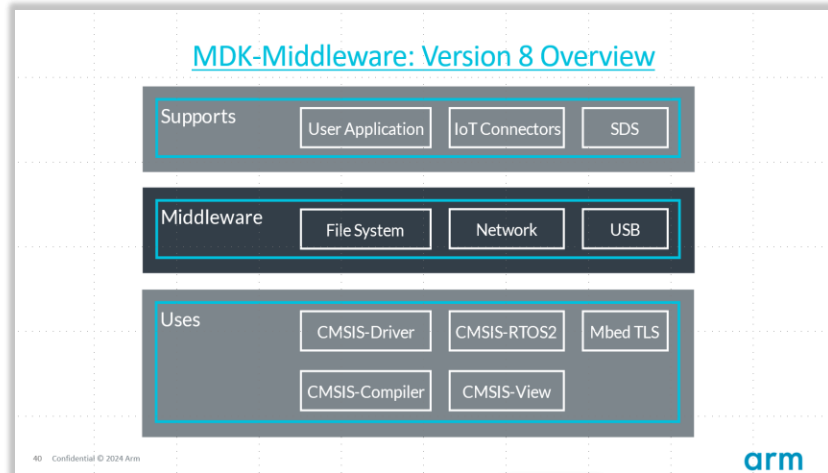
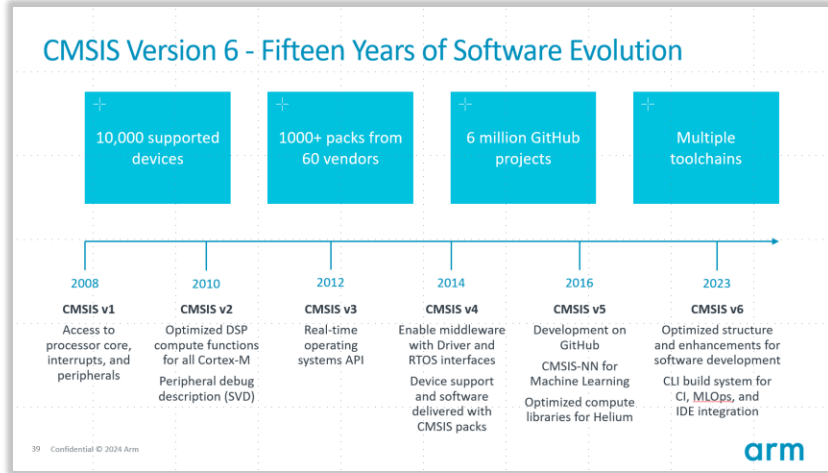
# CMSIS Version 6

[github.com/ARM-software/CMSIS\\_6](https://github.com/ARM-software/CMSIS_6)



- Software components
- Tools for optimizing development flows
- Specifications

# CMSIS – 2024 Achievements



## 2025 Focus

- Ease-of-Use
- Consistency
- Ecosystem
- VS Code Debug
- Zephyr
- Edge AI
- Arm Custom Instructions
- Cortex-A Transition



# Create Consistent DFP and BSP – Training Material

Enables toolchain agnostic support for many third-party software components

## Part 1

- Single core devices with C startup components
- Base-line contents of a BSP (documentation, tool-chain agnostic blinky example)
- [Recording](#)
- [Slides](#)

## Part 2

- Devices that use a Configuration Generator
- Multi-core devices with tool-chain agnostic templates for different pre-configurations
- Create software layers based on driver standards to enable reference applications
- [Recording](#)
- [Slides](#)

Pack creation documentation: [open-cmsis-pack.github.io/cmsis-toolbox/pack-tools/](https://open-cmsis-pack.github.io/cmsis-toolbox/pack-tools/)

# CMSIS Example Applications

Exemplified on MDK-Middleware

## MDK Middleware Pack

### Reference Application Example

USB Device

RTOS

HID Class

CMSIS-View

connections:

- connect: USB Device HID

consumes:

- CMSIS\_USB\_Device
- CMSIS\_VIO

### Driver APIs

Layer Type: Board  
(<board-name>.clayer.yml)

connections:

- connect: Board with USB

provides:

- CMSIS\_USB\_Device
- CMSIS\_VIO

## BSP Pack

# CMSIS Ecosystem Software Stacks

[keil.arm.com/packs](http://keil.arm.com/packs)

## Graphics



## Middleware



## Machine Learning/DSP



## RTOS



## Other



## CMSIS

CMSIS



CMSIS-RTX

CMSIS-DSP

CMSIS-View

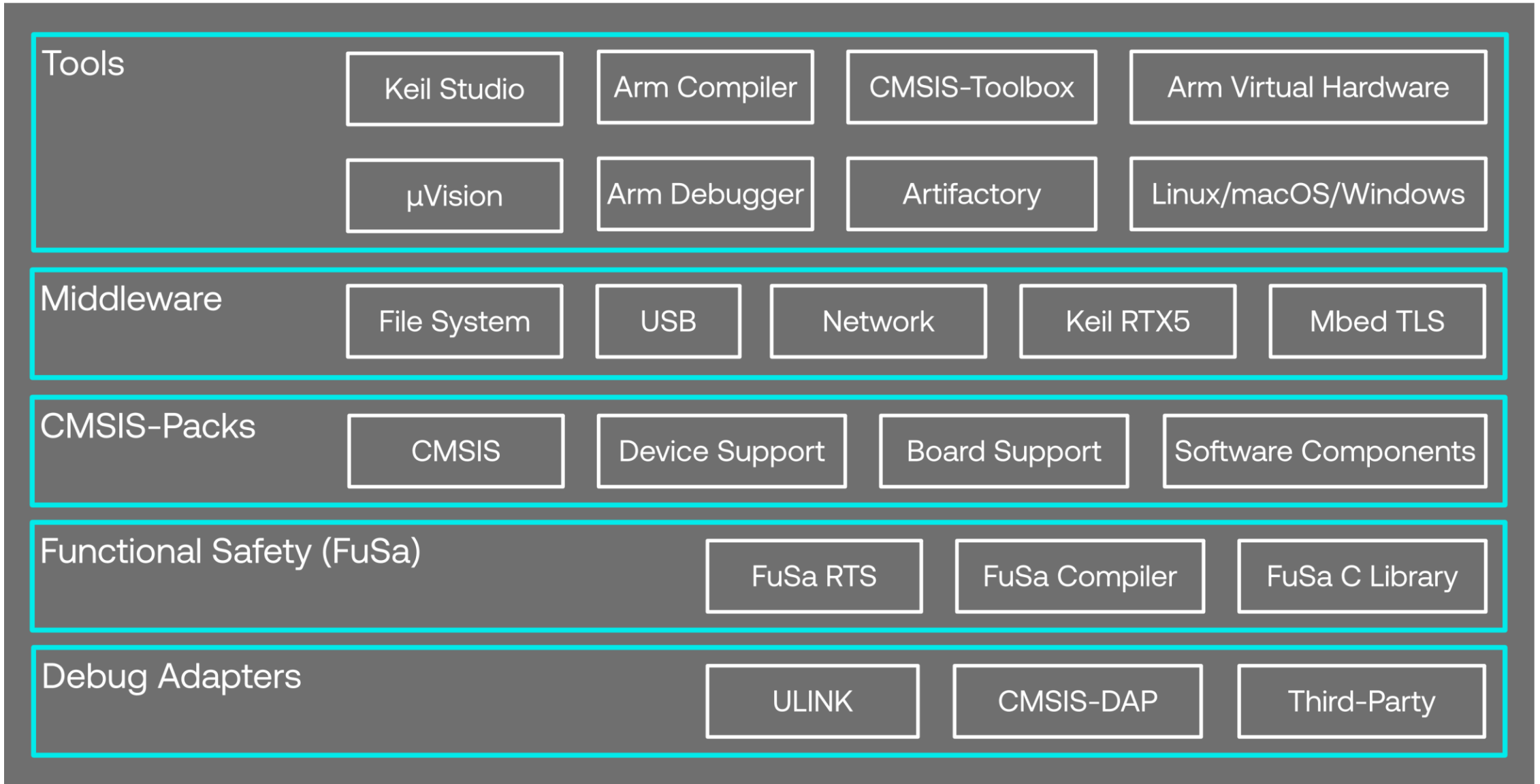
CMSIS-NN

CMSIS-Stream

CMSIS-FreeRTOS

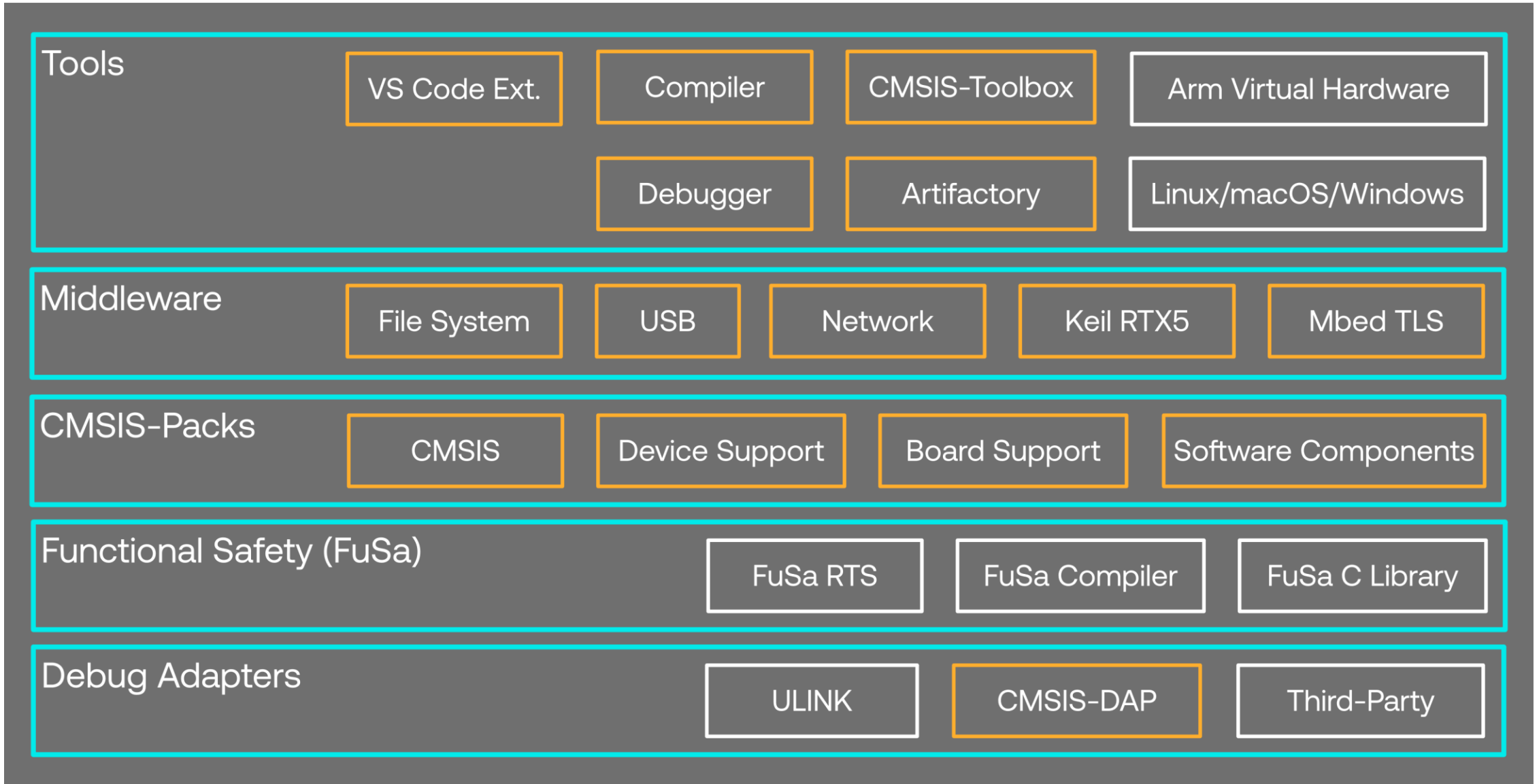
CMSIS-Compiler

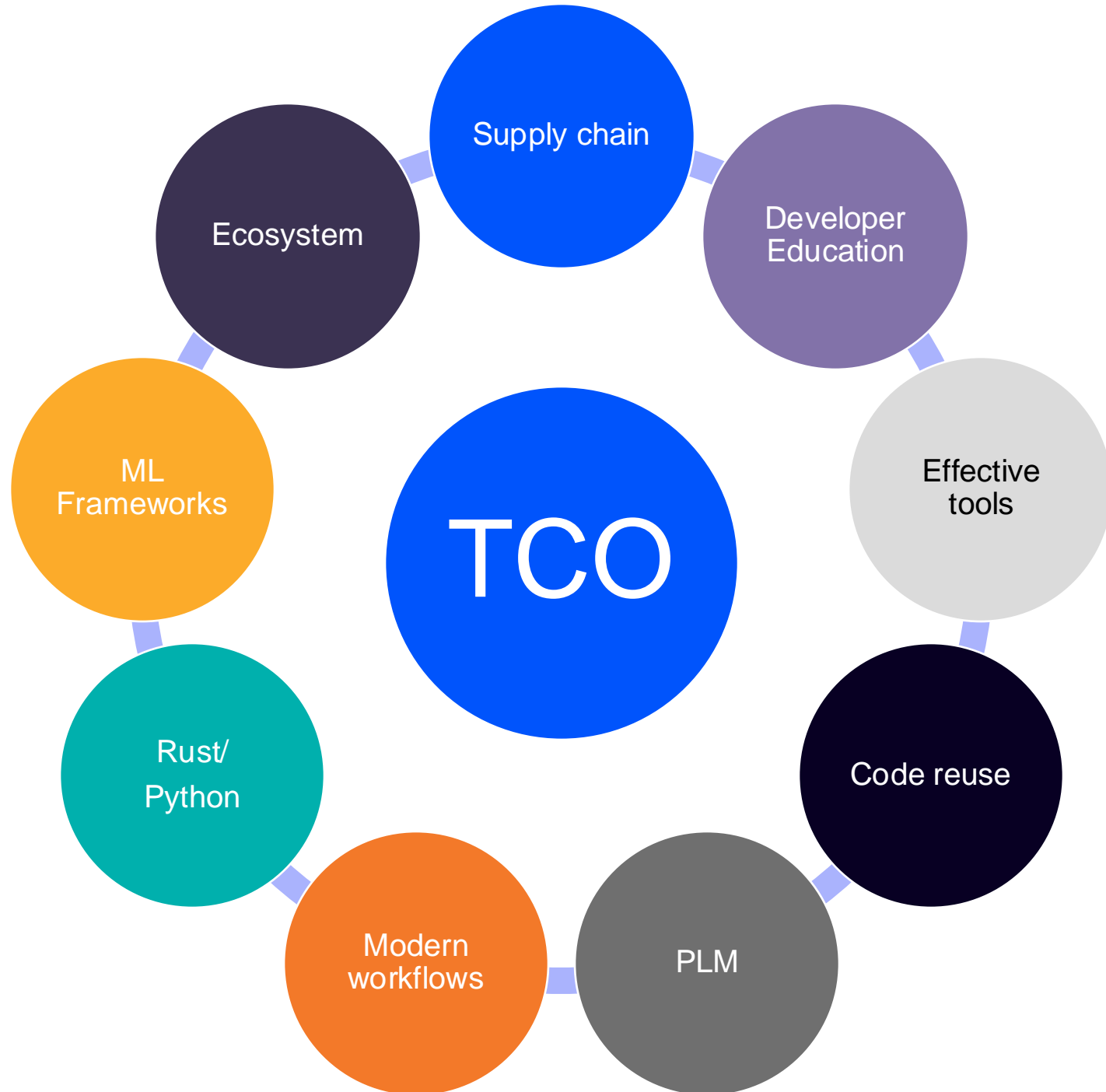
# Keil MDK Version 6



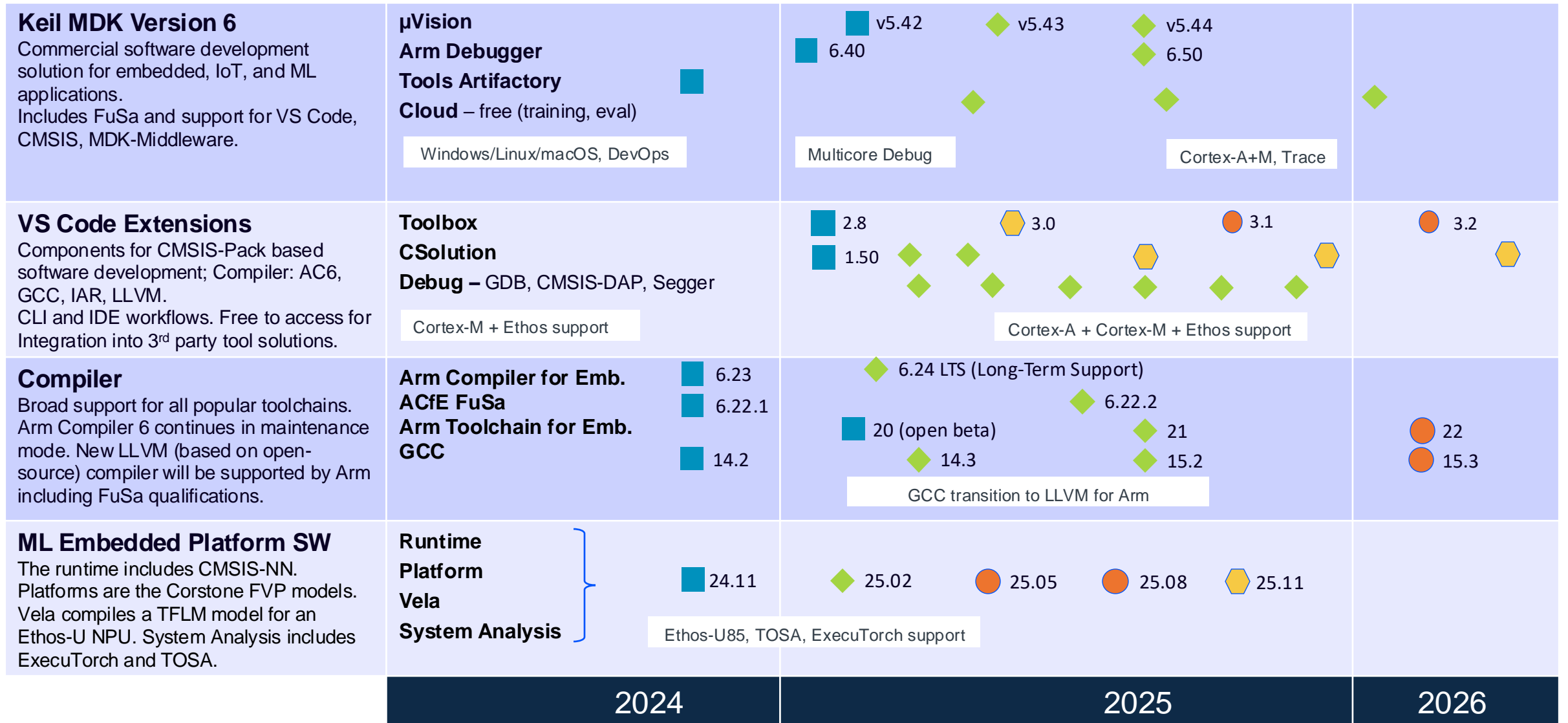


# Keil MDK Version 6





# Tools Roadmap



# Free to use Extensions – Available on VS Code Marketplace

Visual Studio | Marketplace

Visual Studio Code > Programming Languages > Arm CMSIS Solution

**arm** **Arm CMSIS Solution**

Arm [arm.com](https://arm.com) | 83,821 installs | ★★★★★ (0) | Free

Create embedded and IoT projects for Arm Cortex-M based devices using the Common Microcontroller Software Interface Standard (CMSIS) and csolution format

[Install](#) [Trouble Installing?](#)

Visual Studio | Marketplace

Visual Studio Code > Other > Arm Tools Environment Manager

**arm** **Arm Tools Environment Manager**

Arm [arm.com](https://arm.com) | 100,371 installs | ★★★★★ (0) | Free

Download, activate and license tools through declarative configuration

[Overview](#) [Version History](#) [Q & A](#) [Rating](#)

### Arm CMSIS Solution

The Arm® CMSIS Solution extension is a graphical user interface for the Arm CMSIS Solution [Toolbox](#). The extension supports microcontroller devices that use the Arm Cortex-M architecture, Arm Ethos®-U Neural Processing Units (NPU), and works with various development environments.

This extension is [free to use](#) and you can install it individually or as part of the [Arm Keil® Studio Pack](#).

The complete [documentation](#) for Arm CMSIS Solution and the [Developer website](#).

Arm CMSIS Solution provides the following views:

Visual Studio | Marketplace

Visual Studio Code > Debuggers > Arm CMSIS Debugger

**arm** **Arm CMSIS Debugger** Preview

Arm [arm.com](https://arm.com) | 16 installs | ★★★★★ (0) | Free

Run and debug embedded and IoT projects on Arm Cortex-M single or multi core devices. Connects via pyOCD to CMSIS-DAP or other GDB servers.

[Install](#) [Trouble Installing?](#)

[Overview](#) [Version History](#) [Q & A](#) [Rating & Review](#)

### Arm CMSIS Debugger

The Arm® CMSIS Debugger extension is an extension pack for Visual Studio Code® that demonstrates how to combine technologies from various open source projects to create a comprehensive debug platform for Arm-based IoT solutions.

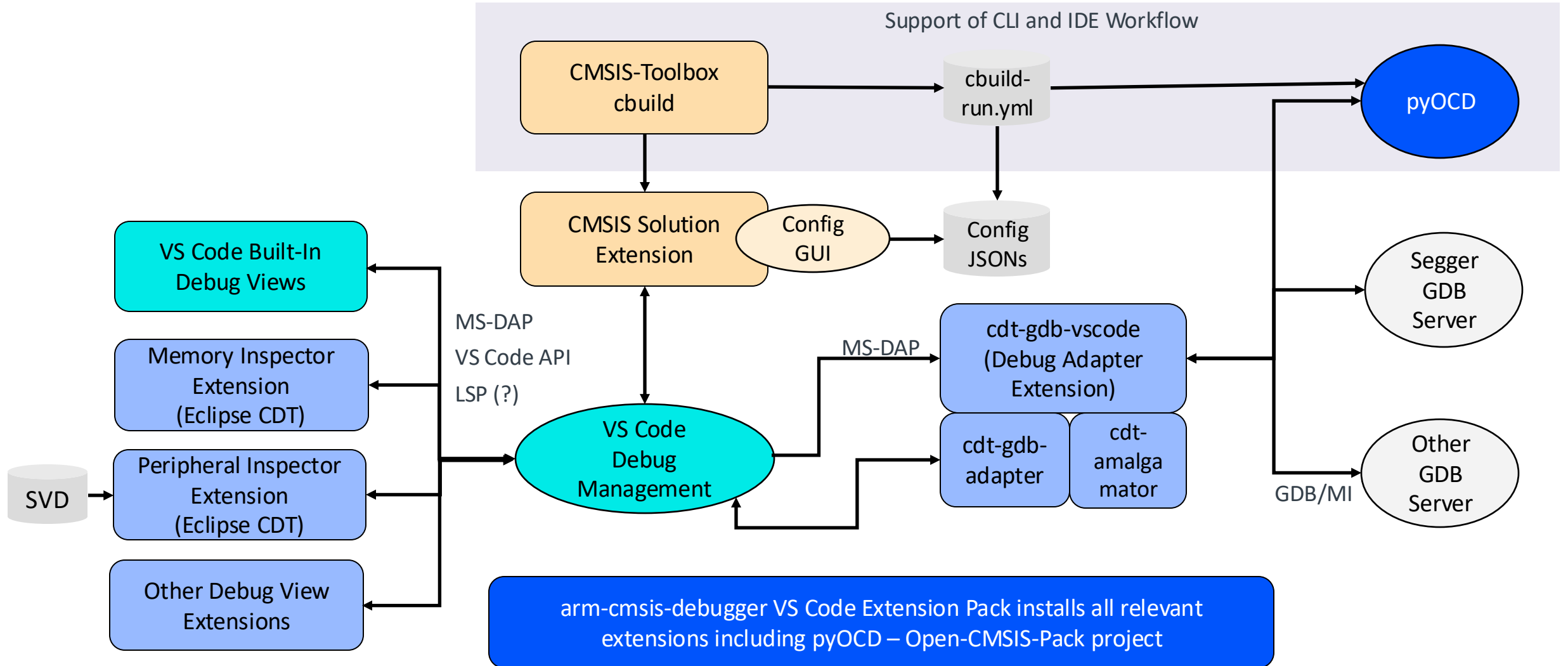
Related open source projects are

[Rating & Review](#)

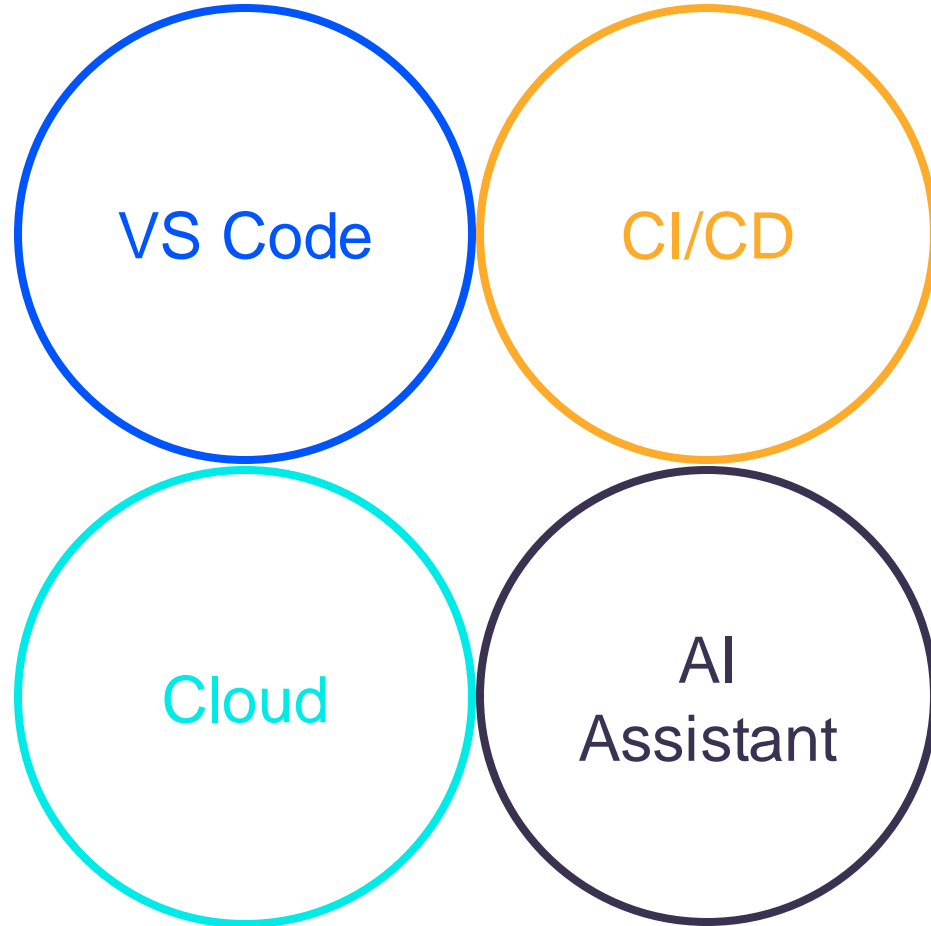
downloads, installs, and manages software development tools. The Arm Tools Environment Manager uses the `vcpkg-configuration.json` manifest file to define the tools needed to set up your development environment. This includes the Arm CMSIS Solution debugger, simulation models, and utilities) and the different [licensing \(UBL\)](#) license that you must activate with the Arm Tools Environment Manager.

individually or as part of the [Arm Keil® Studio Pack](#).

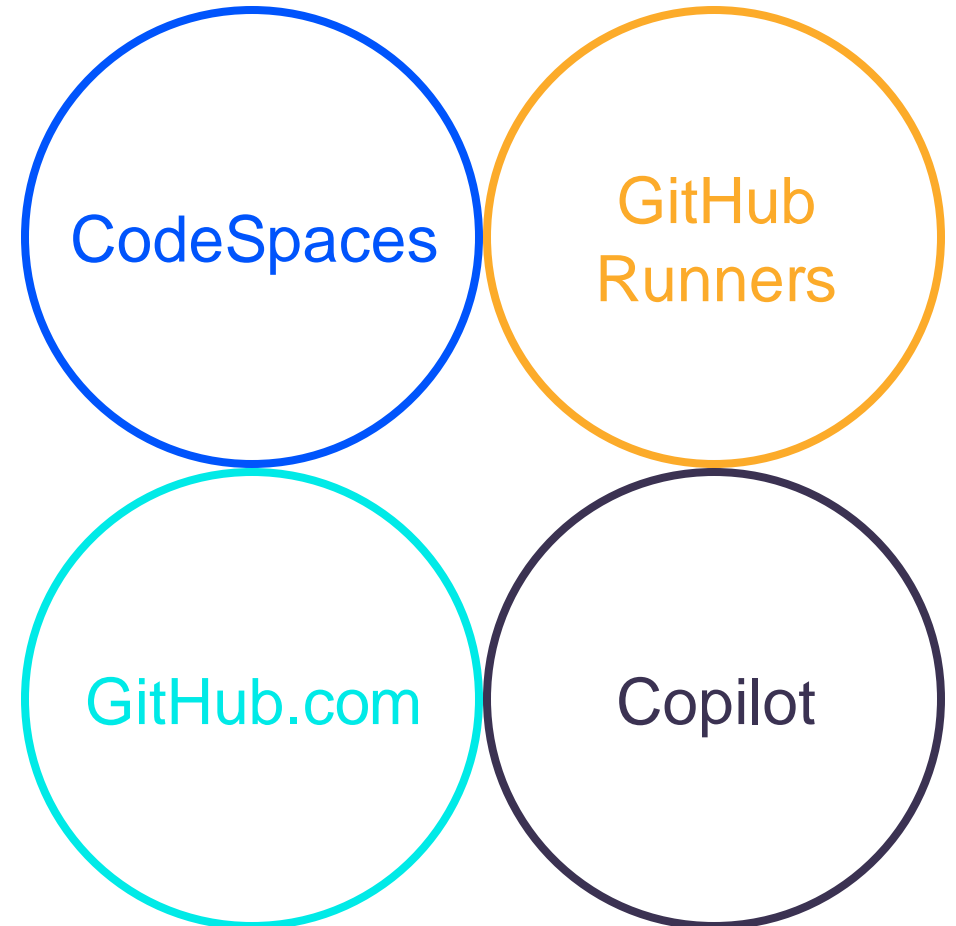
# VS Code Extensions and Tools for CMSIS Software Development



# Modernized Workflows



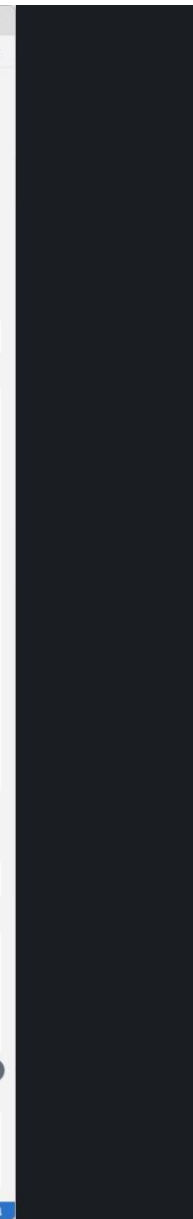
# GitHub Collaboration



```

1  /*
2  * MDK Middleware - Component ::USB:Device
3  * Copyright (c) 2004-2023 Arm Limited (or its affiliates). All rights reserved.
4  *
5  * Name: HID.c
6  * Purpose: USB Device - Human Interface Device example
7  */
8
9  #include <stdio.h>
10
11 #include "main.h"
12
13 #include "cmsis_os2.h"
14 #include "cmsis_vio.h"
15
16 #include "rl_usb.h"
17 #include "usb_hid.h"
18
19 // Main stack size must be multiple of 8 Bytes
20 #define APP_MAIN_STK_SZ (4096U)
21 static uint64_t app_main_stk[APP_MAIN_STK_SZ / 8];
22 static const osThreadAttr_t app_main_attr = {
23     .stack_mem = &app_main_stk[0],
24     .stack_size = sizeof(app_main_stk)
25 };
26
27 /*-----*/
28 * Application main thread
29
30 _NO_RETURN void app_main_thread (void *argument) {
31     uint8_t but;
32     uint8_t but_prev = 0U;
33
34     (void)argument;
35     printf("USB Device HID example\n");
36
37     USBD_Initialize(device: 0U); // USB Device @ Initia
38     USBD_Connect (device: 0U); // USB Device @ Conne
39
40     for (;;) { // Loop forever
41         but = (uint8_t)(vioGetSignal(mask: 0xFFU));
42         if (but != but_prev) {
43             but_prev = but;
44             if (USBID_Configured (device: 0)) { USBID_HID_GetReportTrigger(in
45                 osDelay(ticks: 100U); // 100 ms delay for sa
46         }
47     }
48
49
50 /*-----*/
51 * Application main function
52 /*-----*/
53 int app_main (void) {
54     osKernelInitialize();
55     osThreadNew(func: app_main_thread, argument: NULL, attr: &app_main_a
56     osKernelStart();
57     return 0;
58 }
59

```



**Reinhard Keil** · 1st  
Senior Director of Embedded Technology a...  
2W ·



Does [GitHub #Copilot](#) help [#embedded](#) programmers?

Recently, I experimented with Copilot in [#VSCode](#). As Copilot is trained using [#CMSIS](#) and [#MDK-Middleware](#), I expected that this is useful. But the result exceeded my expectations.

I started from an USB HID Device example provided with MDK Middleware and entered the prompt: "How can I add a MSC to this application?" As Copilot understands the CMSIS \*csolution project\*, the answer was right to the point. It gave me instructions for adding a USB Mass Storage Class with required files, components, and configuration settings. An amazing result. My conclusion: Copilot does not repla ...more

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# arm

# GitHub

Clay Nelson, GitHub  
March 11<sup>th</sup>, 2025



# Development Flow for Edge AI Devices



Watch the webinar



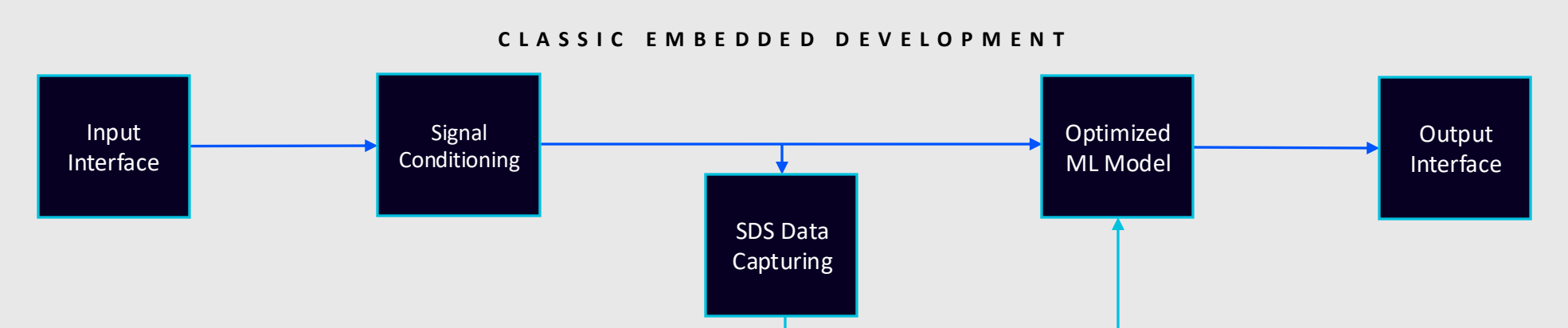
Sensor



Audio



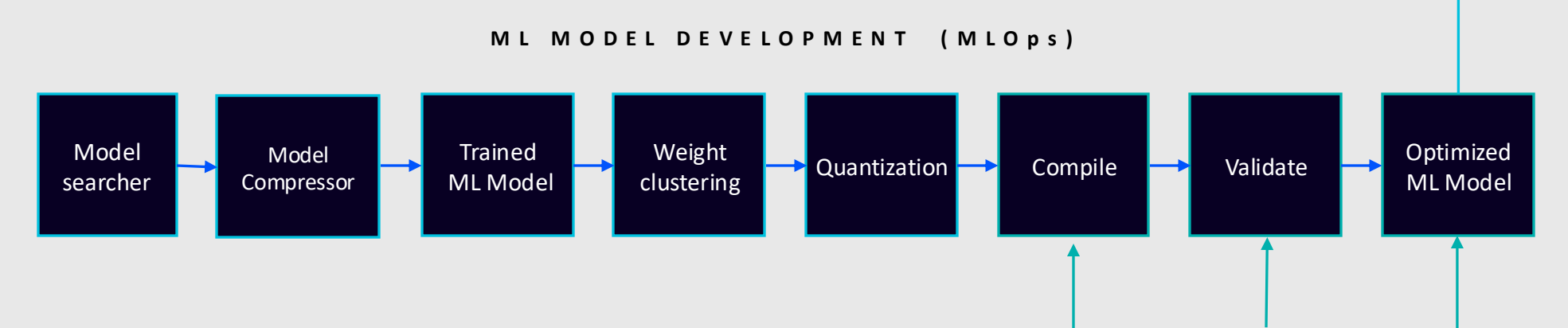
Video



Data



Use-Case



Arm tools integrate here

[docs.edgeimpulse.com/docs/run-inference/arm-keil-cmsis](https://docs.edgeimpulse.com/docs/run-inference/arm-keil-cmsis)

# CMSIS Packs in Edge Impulse

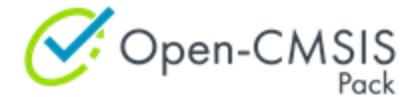
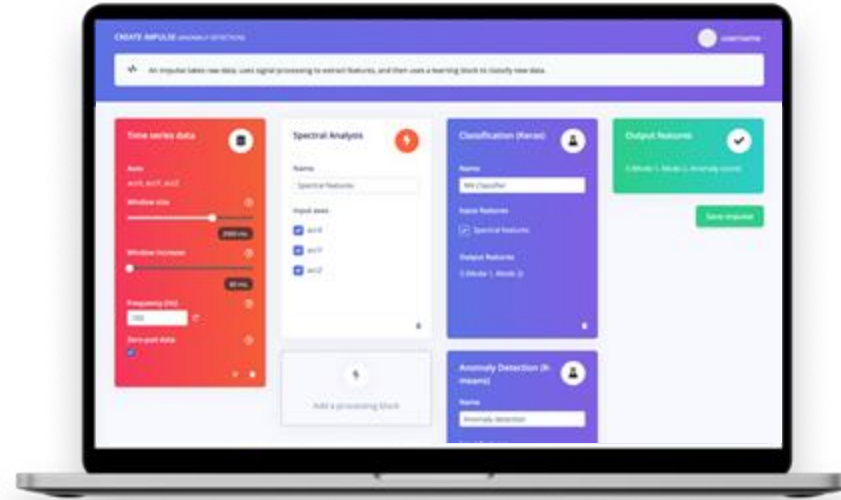
Arjan Kamphuis

Embedded Lead, Edge Impulse

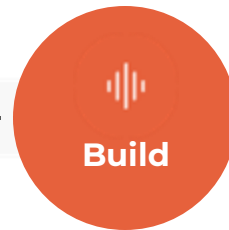


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# Edge AI with Edge Impulse



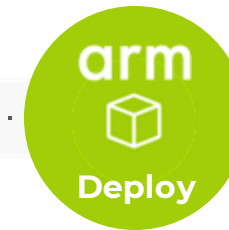
Build a high-quality datasets



Find optimal DSP and model within constraints



Tune model for on-device performance



Configure and package for chosen edge device

# CMSIS pack deployment

Library deployment options



## Open CMSIS pack

Generates a CMSIS Software Component pack.



## Ethos-U55-128 Open CMSIS Pack

A C++ library in Open CMSIS pack format with for devices with an Ethos-U55-128 NPU, High End Embedded with shared SRAM. For example: Alif E7 RTSS-HE.



## Alif AI/ML Kit Gen2 HP core

Binaries containing both the Edge Impulse data acquisition client and your full impulse.

# Thanks!

HAL 4  
Booth #4-505

[arjan@edgeimpulse.com](mailto:arjan@edgeimpulse.com)

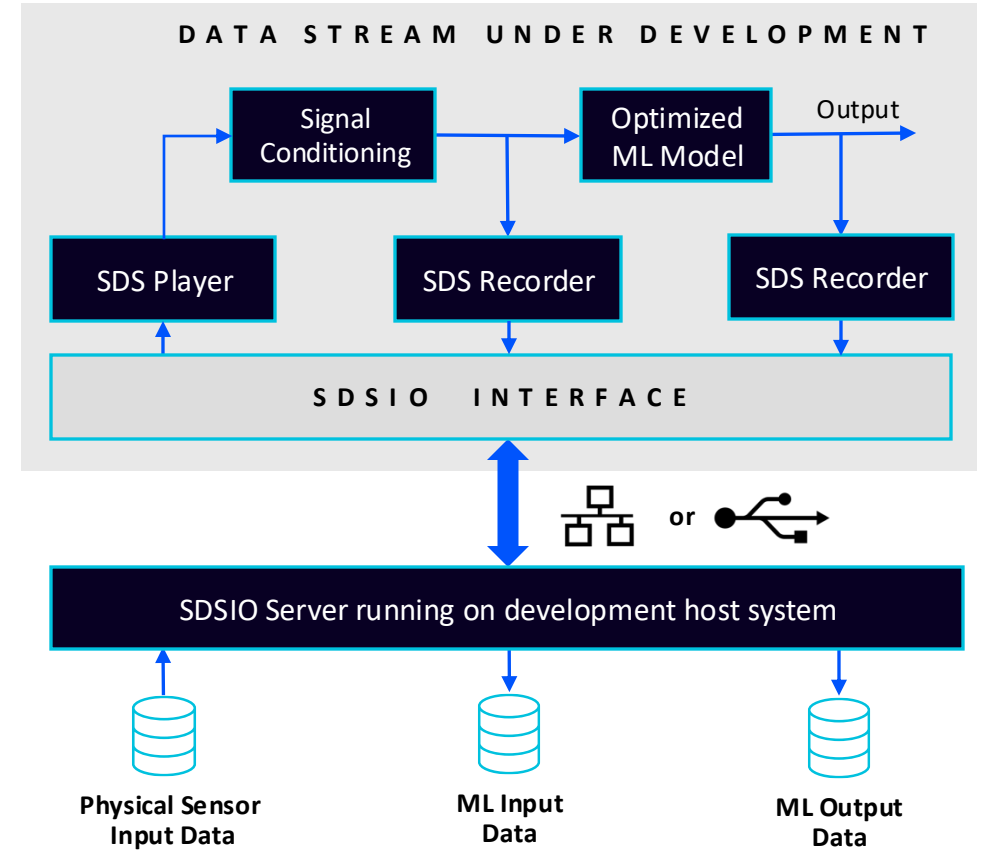
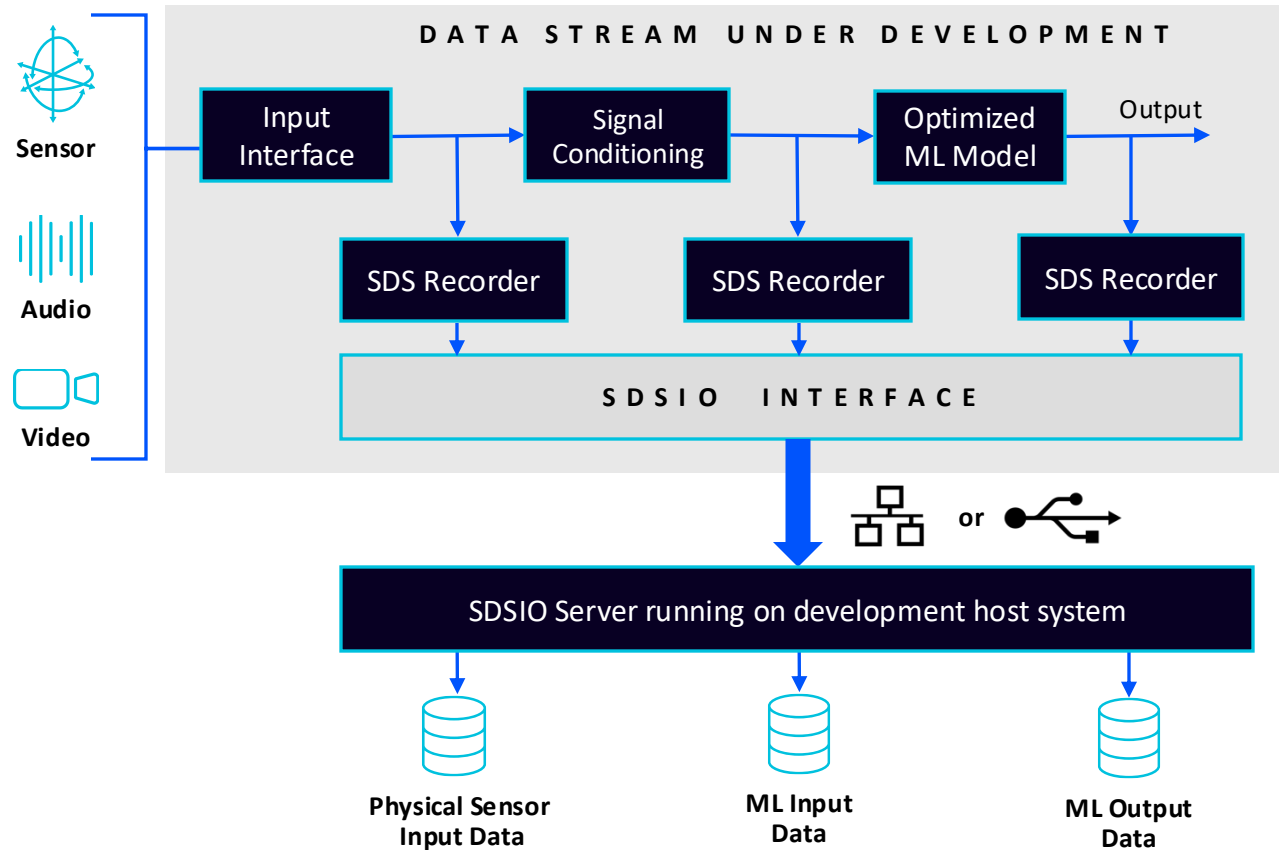


[hello@edgeimpulse.com](mailto:hello@edgeimpulse.com)

3031 Tisch Way  
110 Plaza West  
San Jose, CA 95128  
USA

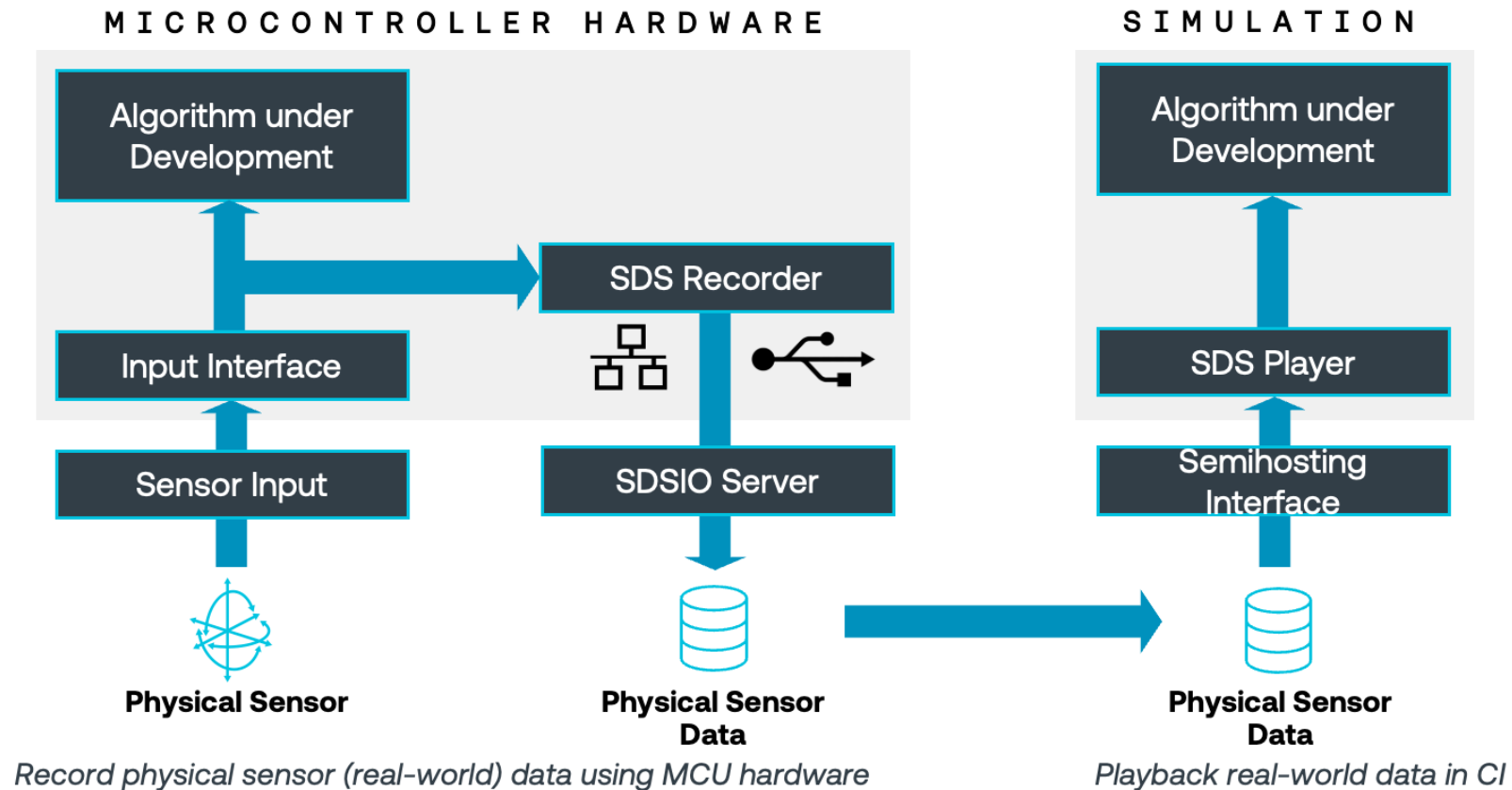
# The Challenge: Get Real World Data

[github.com/ARM-software/SDS-Framework](https://github.com/ARM-software/SDS-Framework)



# SDS-Framework Usage

- Validate physical input signals from sensors or output of algorithms.
- Input to DSP development tools (such as filter designers) or MLOps systems (for AI model training).
- CI test automation using Arm Virtual Hardware (AVH-FVP).



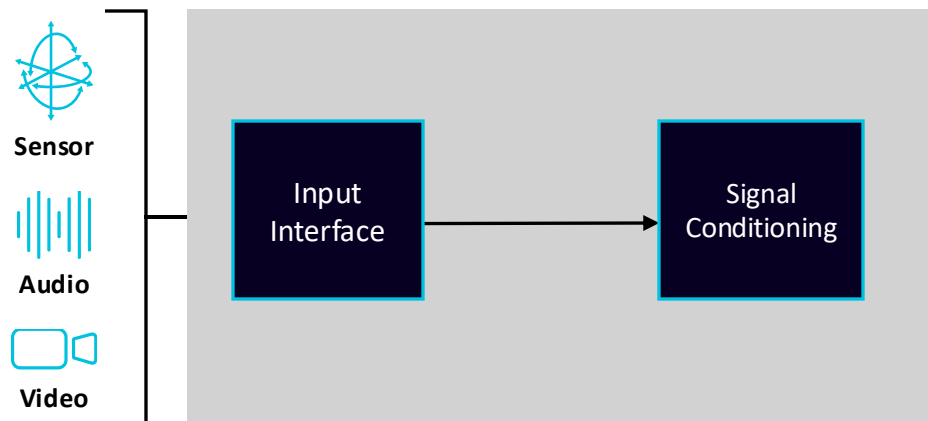
# Arm Custom Instructions – Made Easy

[github.com/Arm-Software/ACI-GetStarted](https://github.com/Arm-Software/ACI-GetStarted)

license Apache-2.0    arm Plugin Linux passing    arm Plugin Windows passing    arm GPR Test passing    arm GPR Example passing  
arm MVE Test passing    arm MVE Example passing

## Get Started with Arm Custom Instructions (ACI)

[Arm Custom Instructions \(ACI\)](#) extend Arm processors with application-specific instructions to optimize the performance of algorithms. ACI is currently implemented on Cortex-M33, Cortex-M52, Cortex-M55, and Cortex-M85 processors using the **Custom Datapath Extension (CDE)**. It extends the processor with a custom compute pipeline for accelerators that avoids the overhead of the co-processor interface.



- Example use cases:
- Sine and cosine trigonometric functions
- Image pixel manipulations
- CRC
- ...



Please fill in

# 2025 Edge AI Developer Survey



This survey is prepared by

# arm

With generous support from our partners



## Raspberry Pi



## EDGE IMPULSE



# arm

# Demo

Joachim Krech  
March 11<sup>th</sup>, 2025

arm

Merci

Danke

Gracias

Grazie

谢谢

ありがとう

Asante

**Thank You**

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