arm Education

Embedded Systems Essentials with Arm: Getting Started

Module 2

KV1 (2): Introduction to the Mbed Platform and Mbed OS

Mbed is a platform that makes it easy to prototype and develop applications and systems based on Arm Cortex-M-based microcontrollers, typically for use in the world of the Internet of Things.

The Mbed platform offers a range of features to power developers; these include:

The Mbed Operating System, which is an open-source embedded operating system and includes APIs and drivers for security, connectivity and input/output

A suite of development tools such as Mbed Studio, which is an integrated development environment for developing Mbed OS applications and libraries. There is also the Mbed Command-line interface or CLI, and Mbed Online Compiler, which offer alternate methods for developing with Mbed.

A hardware development kit, which is a collection of resources for hardware design.

We'll look at the relevant APIs, the hardware development kit, debugging and testing software, and other assets in future Knowledge Videos.

The Mbed Operating System, or Mbed OS, is specifically designed for Internet of Things or IoT devices, and offers a variety of features to enable the development of IoT-connected systems.

It provides a layer of abstraction that interprets the application code in a way the hardware can understand. This enables the developer to focus on programming applications that can run on any Mbed-compatible platform.

Mbed OS runs a real-time core, or RTOS.

The RTOS utilises abstract data types called semaphores, which manage access to shared resources, and synchronization mechanisms such as locks or mutexes that resolve concurrency problems. This enables the development of applications with deterministic real-time behaviour that can execute multiple tasks in parallel, known as multi-threading.

The Arm Mbed OS ecosystem includes many tools designed to work with Mbed OS through the development process. Projects can be created, imported and built using Arm Mbed Studio, Arm Mbed Online Compiler and the Arm Mbed CLI.

Developers can fetch Mbed OS source code from GitHub and mbed.com, along with dependencies, and compile code for a target board.

Mbed Studio is an integrated development environment or IDE, for Mbed OS applications and library development. The environment includes everything needed for a quick development, debug, and deployment cycle.

Mbed Studio automatically detects any Mbed Enabled board or module that is plugged into the host system. It then sources any files required for programming the specific platform, so that the user can focus on their program. The IDE can also flash code directly to the platform.

Additionally, the IDE provides a pre-defined debug profile, and can launch a debug session to debug an application.

The Mbed Online Compiler is similar to Mbed Studio. It is a lightweight online C and C++ IDE that enables the fast development and compilation of applications, allowing users to either write code from scratch or import existing projects. The Online Compiler can also deploy applications to a microcontroller. Because it's online, it circumvents the need for a dedicated desktop setup.

The Mbed Online Compiler requires no pre-installation or set-up to work with Mbed and includes a full code editor, version control, and library management.

Arm Mbed CLI is a command-line tool packaged as 'mbed-cli' and based on Python. It enables Git and Mercurial-based version control, along with dependency management, code publishing, support for remotely hosted repositories, and use of the Arm Mbed OS build system. It supports Arm, GNU Arm Embedded, and IAR Embedded workbench compilers.

Mbed provides two security-focused embedded building blocks: Mbed Transport Layer Security or TLS, and the Secure Partition Manager.

Mbed TLS is a protocol for securing communication channels between devices and servers or gateways. Its intuitive API makes it easy for developers to include cryptographic and SSL or TLS capabilities in their embedded products, with minimal coding footprint.

The secure partition manager, or SPM, is responsible for isolating software within partitions, managing the execution of software within partitions, and providing Inter-Process Communication (IPC) between partitions.

Connectivity is the basic requirement of all IoT devices. Mbed OS supports a range of communication options, including Bluetooth Low Energy, NarrowBand-IoT, and 6LoWPAN.

The Mbed platform contains several code testing tools.

Greentea is an automated testing tool for Arm Mbed OS development. It can automate the process of flashing firmware to boards, running the tests, and generating reports. Greentea pairs with 'UNITY' and 'utest' frameworks in order for the developer to write a suite of tests to test or debug a target application.

The Arm Mbed Enabled program outlines a set of functionality and requirements that must be met in order for a product to be labeled "Mbed Enabled". These products can include development boards, modules, components, and interfaces.

This assures developers that the platforms they choose to work with can perform certain functions or provide certain performance.

It also benefits vendors, as certification allows their products more exposure, and encourages developers in the Mbed eco-system to become familiar with their product.

Some example boards include the Nucleo-F401RE and the Nordic nRf51-DK.