

사물인터넷 디바이스 오픈소스 플랫폼(Mbed OS) 프로그래밍

2. Setup develop environment

이동명
2020.07



Agenda

1. Mbed Ecosystem
2. Setup develop environment
3. Peripheral IPs control practice
4. Cloud / Web application with Mbed



Official Site

ARM mbed: <https://os.mbed.com/>

ARM mbed GitHub: <https://github.com/ARMmbed>

ARM mbed forums: <http://forums.mbed.com>

ARM mbed blogs: <http://blog.mbed.com>

ARM mbed YouTube channel: <https://www.youtube.com/c/ARMmbed>

Korea Mbed Forum

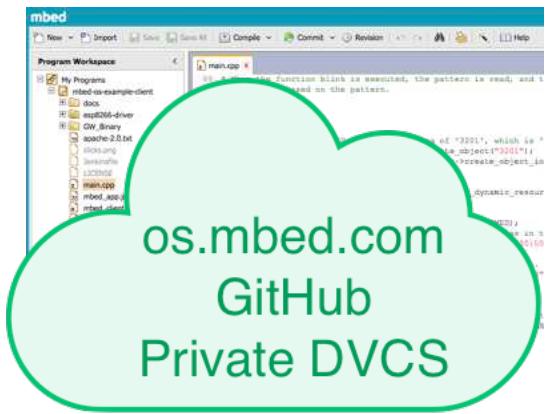
Naver Café: <https://cafe.naver.com/mbedkoreanforum>

Facebook: <https://www.facebook.com/groups/mbedkorea>

Mbed 개발 환경 소개



Development Environments



Online Compiler



Offline Compiler



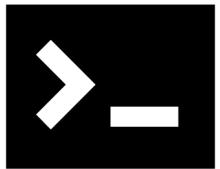
Offline IDE

arm MBED

Tools

- 컴파일과 디버깅을 위한 웹 기반 무료 툴
- 많이 사용되는 툴에 대한 폭넓은 타사 도구 지원

Mbed OS core tools



Mbed CLI

Command Line Interface



Mbed Greentea/Icetea

Porting Testsuite and CI



Mbed Compiler

Free Online IDE



Mbed Studio

An IDE for Mbed OS



Mbed DAPLink

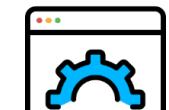
CMSIS-DAP Debug Firmware

Mbed Labs



Micro Tensor

machine learning on uP



Mbed Simulator

Simulation Mbed OS

Mbed OS IDEs and toolchains

arm KEIL

IAR
SYSTEMS

Arm Compiler 6



Mbed OS DVCS support



git



mercurial



GitHub



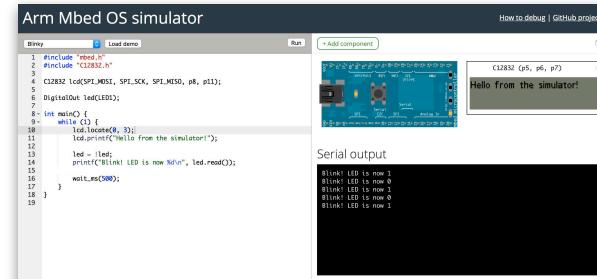
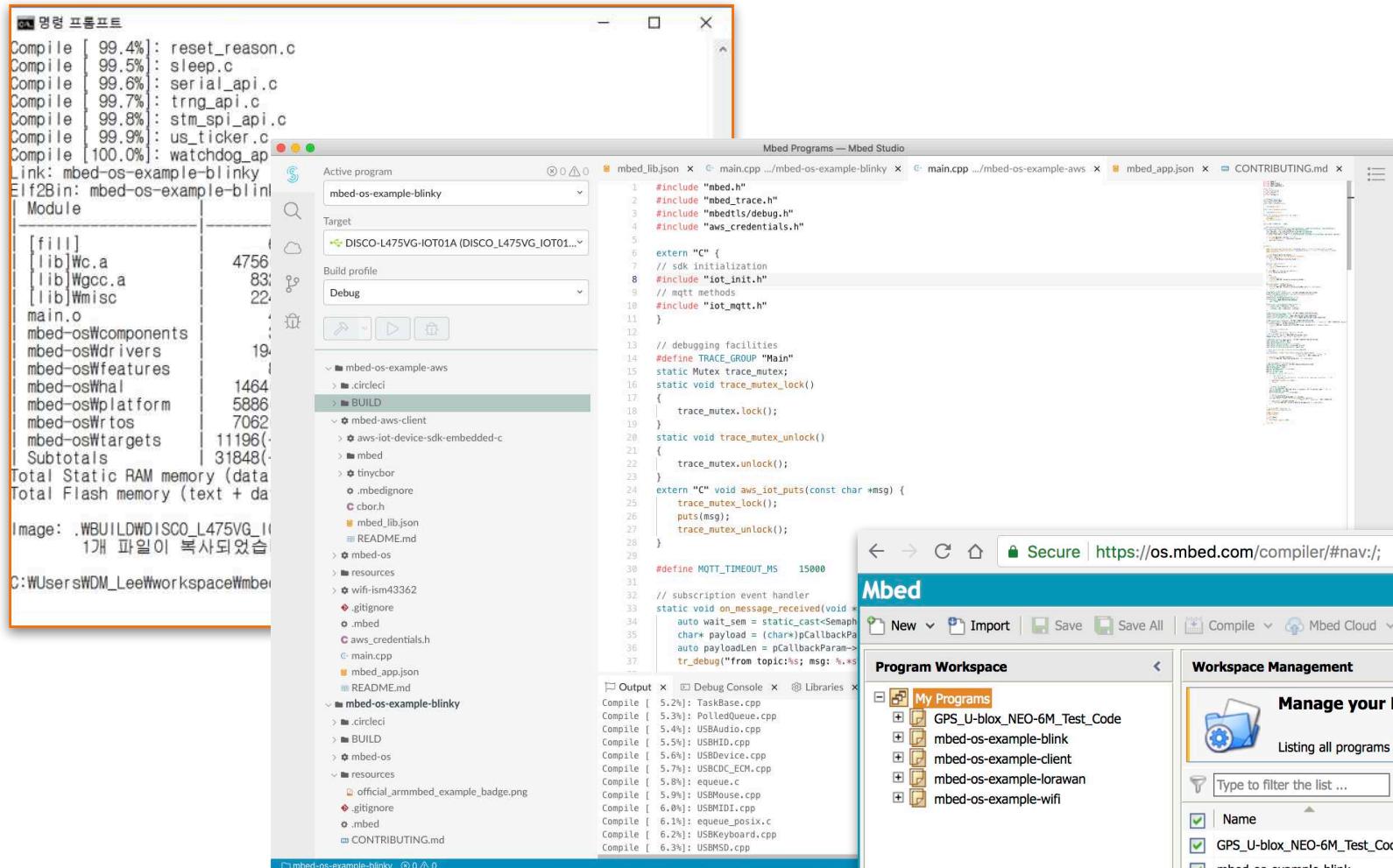
Atlassian
Bitbucket



GitLab

mbed.org/code

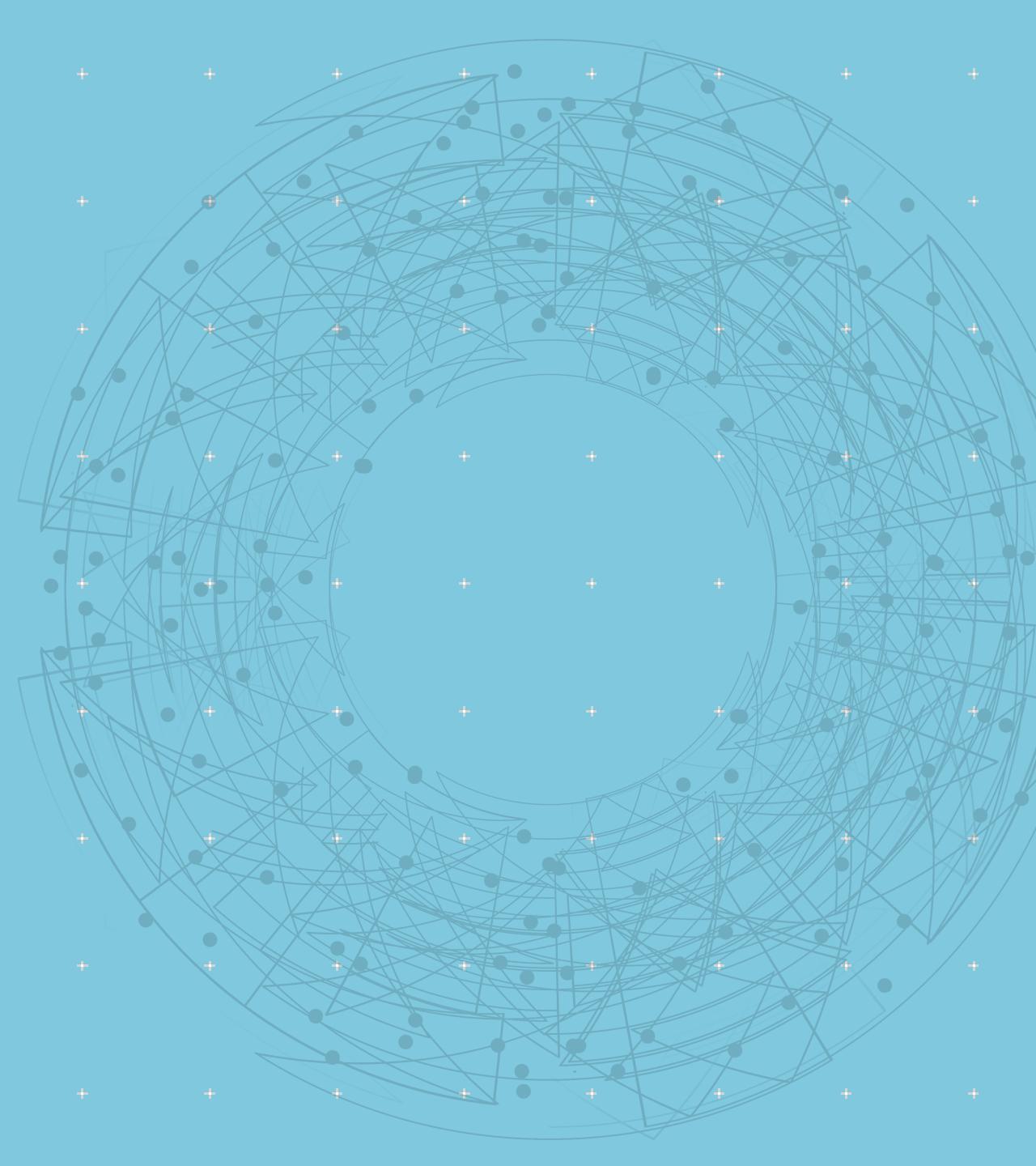
Three Main Tools



Mbed online compiler interface showing workspace management:

- Workspace Management:** Shows a list of programs in the "Program Workspace" and "My Programs" sections.
- Program Workspace:** Lists various projects and their compile statistics.
- My Programs:** Lists the following programs:

Name	Tags	Modified	Description
GPS_U-blox_NE0-6M_Test_Code	GPS LPC4330 Neo-6M u-blox	23 Jul 2018	Test code for GPS U-blox NEO-6M
mbed-os-example-blink		3 weeks, 3 days ago	
mbed-os-example-client		1 week, 1 day ago	
mbed-os-example-lorawan		3 days, 3 hours ago	
mbed-os-example-wifi		09 Jul 2018	



Mbed OS Webpage Overview

Mbed webpage

- Let's access to <https://os.mbed.com/>

The screenshot shows the official Mbed website. At the top, there is a navigation bar with links for Overview, Hardware, Code, Documentation, Case studies, Support, Blog, and Events. To the right of the navigation bar are search, compiler, and user profile icons. Below the navigation bar, the word "Mbed" is prominently displayed in large white letters, followed by the subtitle "Rapid IoT device development". A descriptive paragraph explains that Mbed is a free open source IoT operating system with networking and security built-in, supported by over 450,000 developers and 150 MCU development boards. A yellow button labeled "Sign up for free" is located at the bottom left. The background features a dark blue theme with abstract white and light blue icons related to IoT, such as a lock, a cloud, a magnifying glass over a circuit board, and a gear.

Mbed webpage – Overview

The screenshot shows the Mbed website's homepage. At the top is a dark blue navigation bar with white text and icons. Below it is a white sidebar containing several sections with icons and descriptions.

- Operating systems**
 -  **Mbed OS**
The open source OS for Cortex-M devices
- Development tools**
 -  **Mbed Studio**
Download the desktop IDE for Mbed OS
 -  **Mbed Online Compiler**
Start coding immediately in the browser IDE
 -  **Mbed CLI**
Command line access to Mbed tools and services
- Security and Connectivity**
 -  **Mbed TLS and Mbed Crypto**
Industry standard TLS stack and crypto library
 -  **Connectivity**
BLE, WiFi, Cellular, LoRaWAN and more
- Ecosystem**
 -  **Our partners**
Dozens of leading companies trust Mbed OS
 -  **Become a partner**
Bring your services to over 450,000 developers

Mbed webpage – Hardware

The screenshot shows the Mbed website's hardware section. At the top, there is a navigation bar with links: Overview, Hardware, Code, Documentation, Case studies, Support, Blog, and Events. Below the navigation bar, there is a large image of a computer monitor displaying a cloud and a lock icon, with some text partially visible: "tworking and", "product with", and "ent boards.". To the left of the main content area, there is a sidebar with the Mbed logo and the text "Rapid IoT development". It also mentions "Mbed gives you security built-in free development tools". A yellow button says "Sign up for free". At the bottom left of the sidebar, it says "News". The main content area has a white background and contains five sections with icons and descriptions:

- Boards**: Build your Mbed projects with development boards for Arm Cortex processors and MCUs.
- Modules**: Modules include a MCU, connectivity and onboard memory, making them ideal for designing IoT products for mass production.
- Components**: The component database hosts libraries for different sensors, actuators, radios, inputs, middleware and IoT services.
- Hardware overview & Mbed Enabled**: Learn about hardware support for Mbed, as well as the Mbed Enabled program, which identifies Mbed compatible products.
- Mbed HDK**: Reference designs, schematics and board layouts to develop production hardware and Mbed-compatible development boards.

Mbed webpage – Code

The screenshot shows the Mbed Code page with the following sections:

- Header:** Overview ▾, Hardware ▾, **Code**, Documentation ▾, Case studies ▾, Support ▾, Blog, Events.
- Search Bar:** Search Mbed repositories... with a Search button.
- Mbed OS 5 Section:**
 - Using our Online Compiler you can import Mbed OS 5 source code as a library, building your application against the C++ API.
 - Alternatively, you can find the Mbed OS source code on Github.
 - [Start a new program](#) button.
 - [Get the Mbed OS source on Github](#)
 - [Release notes for Mbed OS](#)
- Official Examples Section:** We maintain code examples that help you to utilize key functionality of Mbed OS.
 - [Blinky](#) > All great journeys begin by blinking an LED.
 - [WiFi](#) > Wifi and network socket API demo.
 - [Sockets](#) > HTTP transactions over a TCPSocket.
 - [Cellular](#) > TCP or UDP echo transaction example.
 - [File System](#) > Utilize the storage options of Mbed OS
 - [BLE](#) > Collection of Bluetooth Low Energy examples.
 - [Bootloader](#) > Learn how to create a bootloader.
 - [LoRaWAN](#) > Communicate with a network server.
 - [Crypto](#) > Cipher encrypt and decrypt using an AES key.
 - [TLS](#) > Collection of TLS examples.
- Most popular code:** Sorted by number of imports. Last updated: 08 Apr 2019. Mbed / OS 2 mbed_blinky. 25 imports, 997841 commits.
- Most active code:** Sorted by number of recent commits. Last updated: 02 May 2020. Nicolas Nackel / OS 2 PPP-Blinky COM1. 270 imports, 387 commits.
- Featured code:** Featured code. Last updated: 30 Apr 2020. David Smart / RA8875. 203 imports, 333 commits. ✓ Featured.

Mbed webpage – Documentation

주의

v6.0

Introduction to Mbed OS 6

- Introduction
- Architecture
- Hardware
- Tools
- Versions and releases
- Glossary
- Mbed OS bare metal profile

Docs › Introduction to Mbed OS 6 › Introduction

An introduction to Arm Mbed OS 6

Mbed OS is an open-source operating system for Internet of Things (IoT) Cortex-M boards: low-powered, constrained and connected. Mbed OS provides an abstracted API for hardware, making it easy to develop and deploy software across different hardware platforms.

[Arm Mbed Studio](#) [Docs › Arm Mbed Studio](#)

Profile

- Recently updated documentation
- Supported hardware and Mbed OS versions
- Known issues
- Installing
- Getting started
- Creating or importing a program

[Arm Mbed Studio](#) [Docs › Arm Mbed Studio](#)

Arm Mbed Studio is a local development environment for Mbed OS. It includes a code editor, a terminal, and a file browser. You can build, run and debug your programs directly from the studio.

[Arm Mbed Cordio](#) [Docs › Arm Mbed Cordio](#)

Profile

- Getting started
- Licensing
- About the documentation
- Glossary
- Stack
- Profiles
- Controller
- Wireless Software Foundation
- Sample applications
- Porting with PAL

[Arm Mbed Cordio](#) [Docs › Arm Mbed Cordio](#)

Arm Mbed Cordio

Arm Mbed Cordio is an open source Bluetooth Low Energy (BLE) solution offering both host and controller subsystems, with abstraction interfaces for both RTOS and hardware.

The Cordio BLE host subsystem implements a single-mode BLE device supporting both single- and dual-chip systems. It is composed of the following components:

- Cordio stack.
- Cordio profiles.

The Cordio stack implements a standard HCI for compatibility with off-chip BLE controllers when using the dual-chip system configuration. You can use wired transports, such as UART or SPI, to connect to off-chip BLE controllers. The single chip (in other words, SoC) configuration uses a "thin HCI" layer to connect the Cordio BLE host to the Cordio BLE controller.



13

Mbed webpage – Case studies

The screenshot shows the Mbed website's navigation bar at the top, with the 'Case studies' dropdown expanded to show 'Products built with Mbed' and 'Submit a product'. A blue line connects the 'Products built with Mbed' link to the 'Built with Mbed' section on the left. An orange line connects the 'Submit a product' link to the 'Tell us about your Mbed OS-based product' form on the right.

Mbed

Overview ▾ Hardware ▾ Code Documentation ▾ Case studies ▾ Support ▾ Blog Events

Products built with Mbed

Submit a product

Home

Built with Mbed

Use Cases and Case Studies of IoT products

Explore the list of case studies describing some of the diverse IoT products that are built with Mbed and get more information from the manufacturers where they could accelerate your IoT deployments.

List your product

MOXA

SOLARIS OFFGRID

Tell us about your Mbed OS-based product

If your company has created a product based on Mbed OS, we'd love to chat.

We can discuss any help or support you might need, talk about the development process or how we could make your product and company visible to all the customers we meet via our global sales team.

If you are interested, please reach out to us:

What product(s) have you built using Mbed OS? *

First Name: *

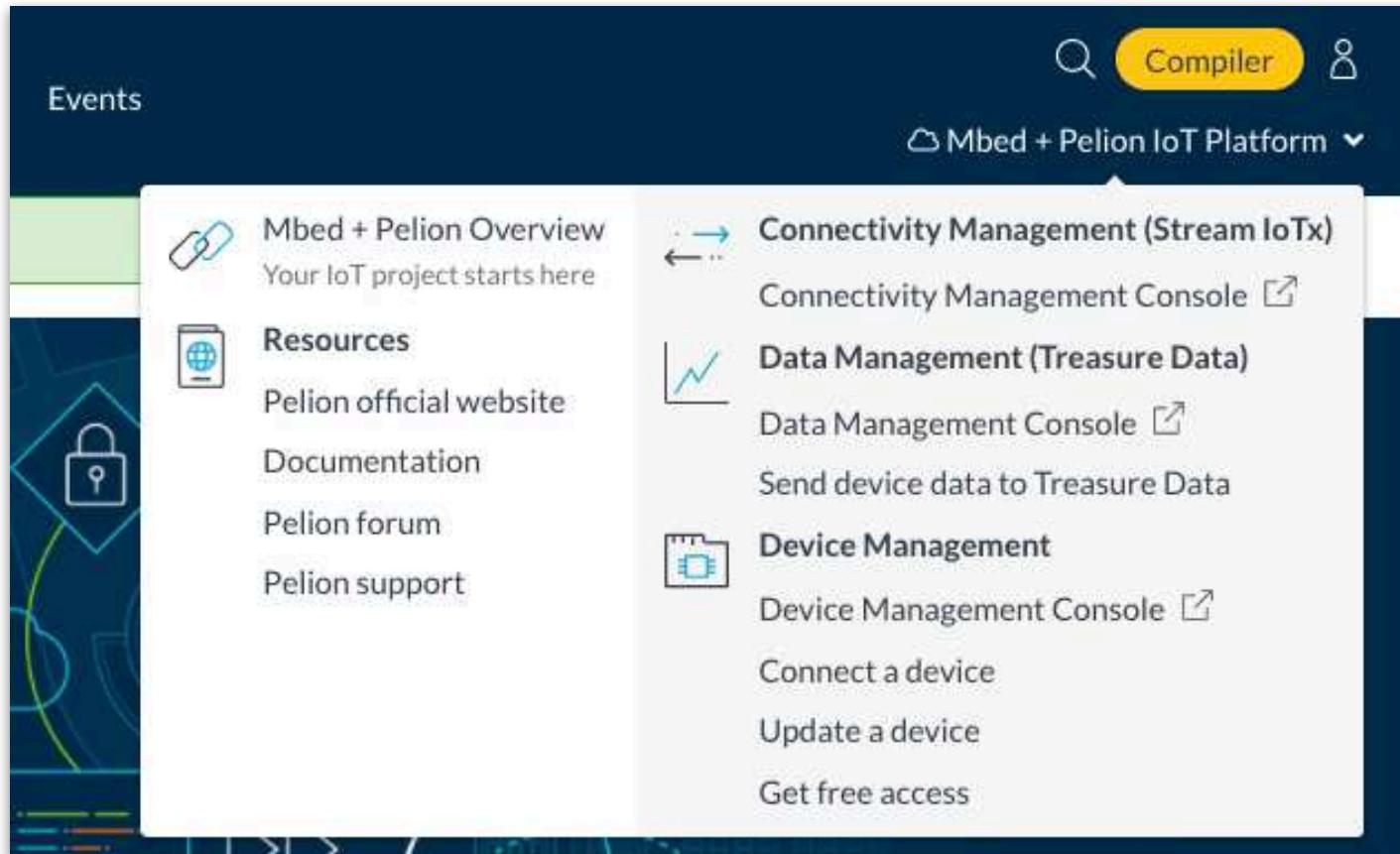
arm MBED

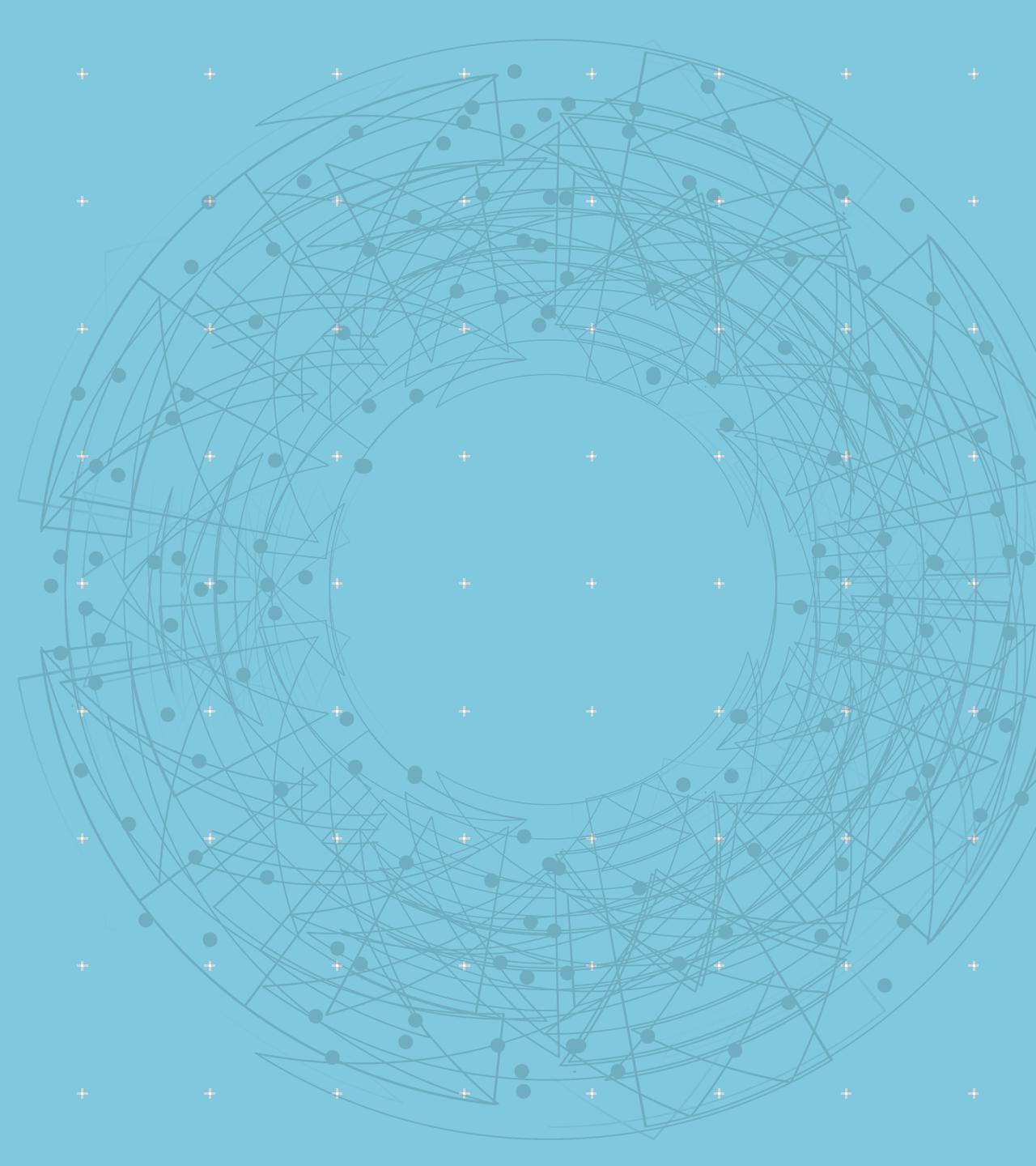
Mbed webpage – Support, Blog, and Event

The screenshot shows the Mbed website interface with various sections highlighted by colored boxes and lines:

- Support Section:** Located at the top right, a yellow box highlights the "Support" dropdown menu which includes "Forum", "Report a problem", "Commercial support and pricing", and "Contact sales".
- Blog Section:** A blue box highlights the "Blog" link in the top navigation bar.
- Events Section:** A yellow box highlights the "Events" link in the top navigation bar.
- Forum Section:** An orange box highlights the "Categories" button in the forum header, and a blue box highlights the "Mbed Commercial Support" section below it.
- Blog Post:** A yellow box highlights the "Mbed Blog" post titled "Mbed OS bare metal profile".
- Text Boxes:** Several text boxes are overlaid on the page:
 - "Arm Mbed and Pelion Device Management support forum"
 - "New Topic" and "Log In" buttons
 - "Mbed Commercial Support" (highlighted by a blue box)
 - "Mbed Blog" (highlighted by a blue box)
 - "Mbed OS bare metal profile" (highlighted by a yellow box)
 - "We introduced the bare metal profile in Mbed OS 5.12 to offer memory constrained devices a subset of Mbed OS's rich features. This configuration of Mbed OS excludes the RTOS and several other features and gives developers a higher degree of control over their application."

Mbed webpage – Mbed + Pelion IoT Platform

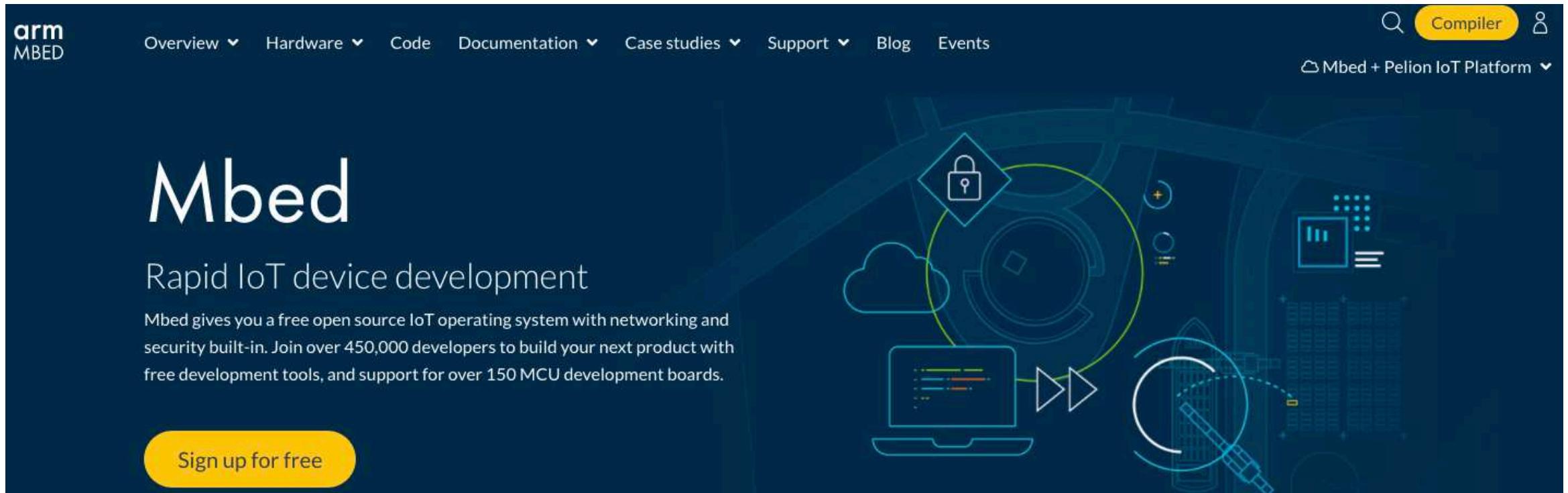




Mbed.com
Sign up

Mbed - Sign up #1

<https://os.mbed.com>



The screenshot shows the Mbed website homepage. At the top, there is a navigation bar with links for Overview, Hardware, Code, Documentation, Case studies, Support, Blog, and Events. To the right of the navigation bar are search, compiler, and user account icons. Below the navigation bar, the Mbed logo is displayed, followed by the text "Rapid IoT device development". A paragraph of text explains that Mbed is a free open source IoT operating system with networking and security built-in, supported by over 450,000 developers and 150 MCU development boards. A prominent yellow button at the bottom left says "Sign up for free". The background features a dark blue design with abstract white and light blue shapes representing technology and connectivity.

Mbed - Sign up #2

<https://os.mbed.com>

The screenshot shows the Mbed website homepage with a navigation bar at the top. The navigation bar includes links for Overview, Hardware, Code, Documentation, Case studies, Support, Blog, and Events. On the far right of the navigation bar is a user profile icon with a red notification bubble containing the number '1'. A blue arrow points from this icon down to the 'Log in or Sign up' button on the login form.

The main content area features the 'Mbed' logo and the tagline 'Rapid IoT device development'. Below this is a brief description of what Mbed offers: 'Mbed gives you a free open source IoT operating system with networking and security built-in. Join over 450,000 developers to build your next product with free development tools, and support for over 150 MCU development boards.' At the bottom left of this section is a yellow 'Sign up for free' button.

A large blue callout box highlights the 'Log in or Sign up' button on the login form. The login form itself has a red box around the 'Email or username' field and a red circle with the number '3' above the 'Sign up' link. A blue arrow points from the 'Email or username' field down to the 'Sign up' link.

The bottom right corner of the page features the 'arm MBED' logo.

Page footer: 19

Mbed - Sign up #3

**arm
MBED**

Sign up

Already have an Mbed account? [Log in](#)

Create a free Mbed account to access Mbed tools and services and contribute to the developer community.

Email address *

Username *

①

② Please enter a username.

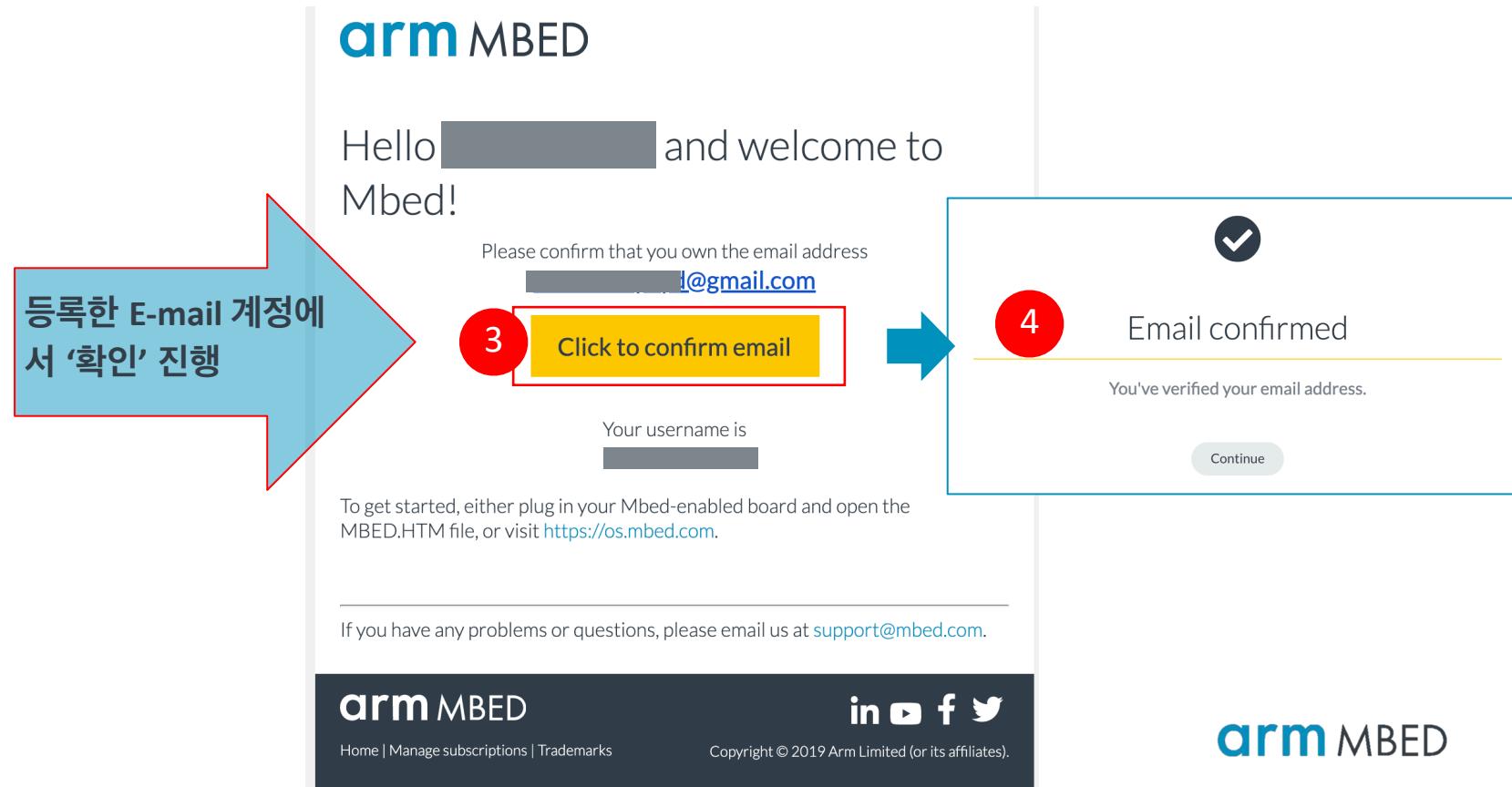
Password *

모두 작성

③ Please enter a password.

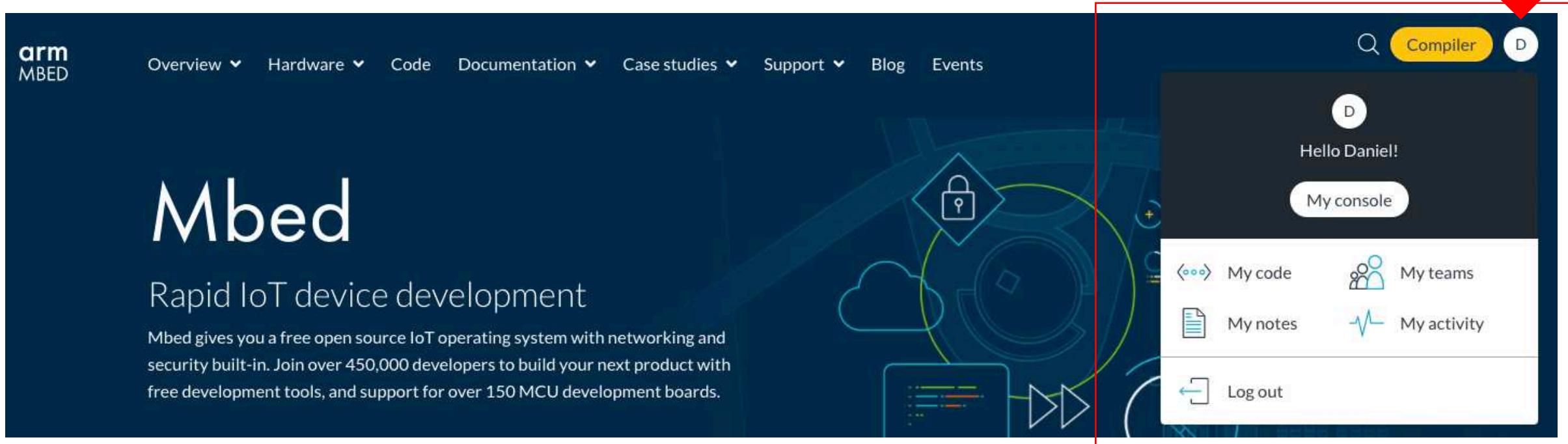
First name *

Last name *



Mbed - Sign up #4

메일에서 계정확인이 되고, os.mbed.com에 Login 하면 다음과 같은 화면을 볼 수 있습니다.



[Option] Pelion- Sign up #1

The screenshot shows the Mbed + Pelion IoT Platform homepage. At the top right, there is a search bar with 'Compiler' and a dropdown menu labeled 'D'. Below the search bar, the text 'Mbed + Pelion IoT Platform' is visible. A red arrow labeled '1' points to the 'Compiler' button. In the center, there is a large 'Mbed' logo and the text 'Rapid IoT device development'. Below this, a paragraph describes Mbed as a free open source IoT operating system. To the right, there are two columns of links. The left column under 'Resources' includes 'Mbed + Pelion Overview', 'Pelion official website', 'Documentation', 'Pelion forum', and 'Pelion support'. The right column under 'Connectivity Management' includes 'Connectivity Management (Stream IoTx)', 'Data Management (Treasure Data)', 'Send device data to Treasure Data', 'Device Management', 'Connect a device', and 'Update a device'. A red arrow labeled '2' points to a red-bordered button at the bottom right labeled 'Get free access'.

arm
MBED

Overview ▾ Hardware ▾ Code Documentation ▾ Case studies ▾ Support ▾ Blog Events

Mbed + Pelion IoT Platform ▾

Mbed
Rapid IoT device development

Mbed gives you a free open source IoT operating system with networking and security built-in. Join over 450,000 developers to build your next product with free development tools, and support for over 150 MCU development boards.

Mbed + Pelion Overview
Your IoT project starts here

Resources

- Pelion official website
- Documentation
- Pelion forum
- Pelion support

Connectivity Management (Stream IoTx)

Data Management (Treasure Data)

Device Management

Get free access

[Option] Pelion- Sign up #2

The screenshot shows the Arm Mbed website with a dark blue header. The header includes the 'arm Mbed' logo, a search bar, and navigation links: Overview, Hardware, Code, Documentation, Case studies, Support, Blog, and Events.

The main content area features a large heading 'Your Next IoT Project Starts' and a sub-section about Pelion IoT Device Management services. Below this, there's a list of three benefits:

- ✓ Connect and manage up to 100 IoT devices, choosing from a range of connectivity options.
- ✓ Carry out 200 firmware updates per month, with robust and easy-to-define FOTA and MDM.
- ✓ Communicate with your devices using up to 300,000 CoAP transaction messages per month.

A red arrow labeled '1' points to a yellow button labeled 'Activate Pelion Device Management account'. A red L-shaped arrow points from this section to a green button with a checkmark labeled 'Success! You now have access to Pelion Device Management free tier.'

To the right, a sidebar shows a dropdown menu for 'Mbed + Pelion IoT Platform'. The 'Device Management' section is highlighted with a red border and a red arrow labeled '2'. The sidebar also lists 'Mbed + Pelion Overview', 'Resources', and 'Pelion support'.

Activate Pelion Device Management account

Free access to Pelion Device Management **requires an Mbed account**, so that you can use our online development tools: OS.

Success! You now have access to Pelion Device Management free tier.

arm Mbed

[Option] Pelion- Sign up #3

1 [Log in with account.mbed.com](#)

2 I accept this licence on behalf of my team

3 [Accept](#)

4 [Accept and dismiss](#)

<https://www.arm.com/company/policies/cookies>

[Option] Pelion- Sign up #4

arm PELION
DEVICE MANAGEMENT

Search features

- Dashboard
- Usage dashboard
- Custom dashboard

- Device directory
- Device identity
- Firmware update
- Access management

Team configuration

- Profile
- Help
- Language
- Privacy

Usage dashboard

View: [this month](#) | [1 month](#) | [1 week](#) | [12 hours](#)

Usage summary

Devices:	0
Transactions:	0 (1 month)
Images:	0
Manifests:	0
Certificates:	0
API keys:	1
User groups:	2
Users:	1
Firmware updates monthly limit:	200

Deleted registrations Expired registrations
Registration updates

11/19/2019 11/26/2019 12/03/2019 12/12/2019

Transactions

Used: 0 (0.00%)

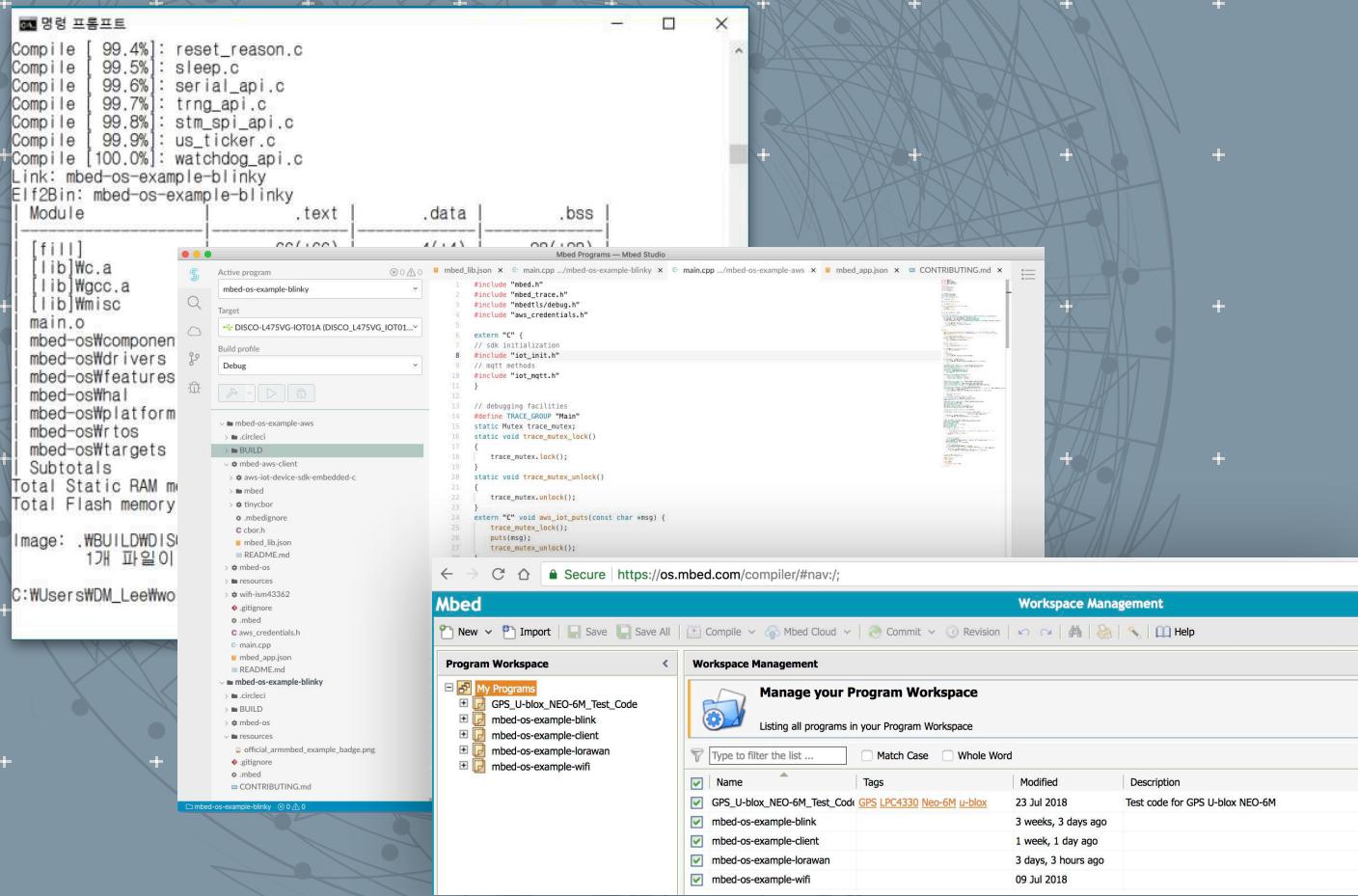
Transaction (0)

11/19/2019 11/26/2019 12/03/2019 12/12/2019

25

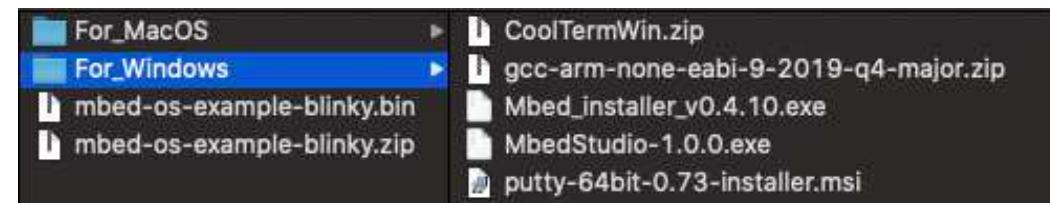
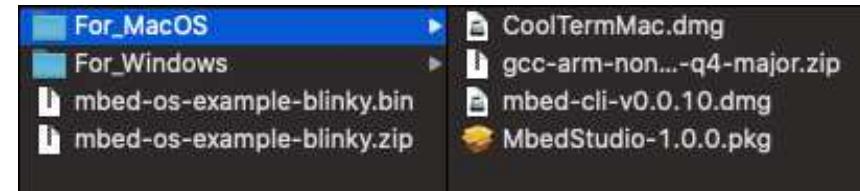
ABED

Main Tools



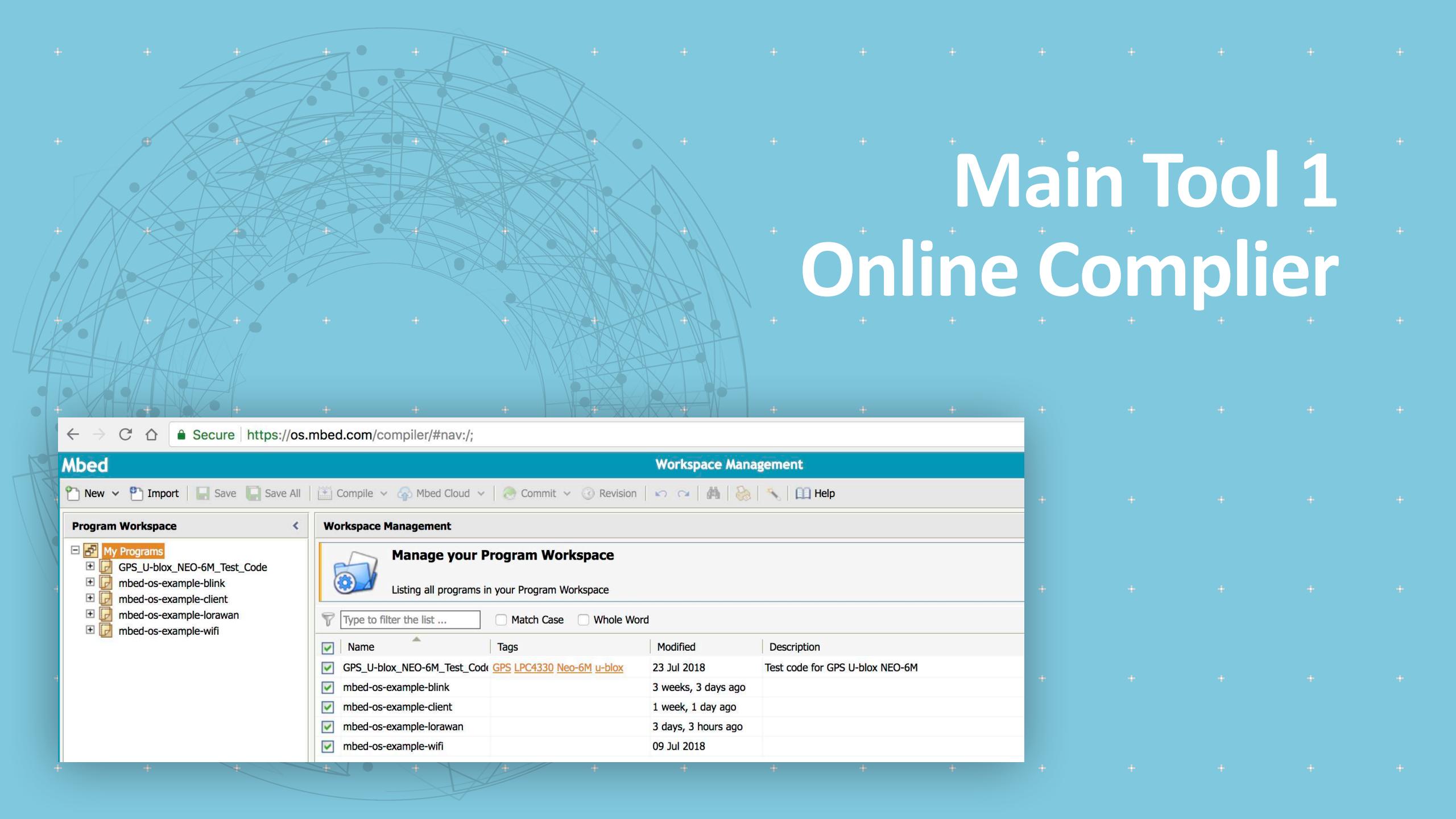
시작하기 전에...

- 보안프로그램에 의해서 Online complier 외에 동작이 안될 수 있습니다.
 - 회사의 보안프로그램이 설치되어 있는지?
 - 회사의 보안프로그램이 특정 Port를 막은 것은 아닌지?
 - 회사의 보안프로그램에 의해 외부 프로그램이 설치가 불가 할 수 있습니다.
- Serial Terminal Program
 - Windows
 - [Putty](#), [Tera Term](#) 등
 - MacOS & Linux
 - [Coolterm](#), minicom 등



Main Tool 1

Online Complier

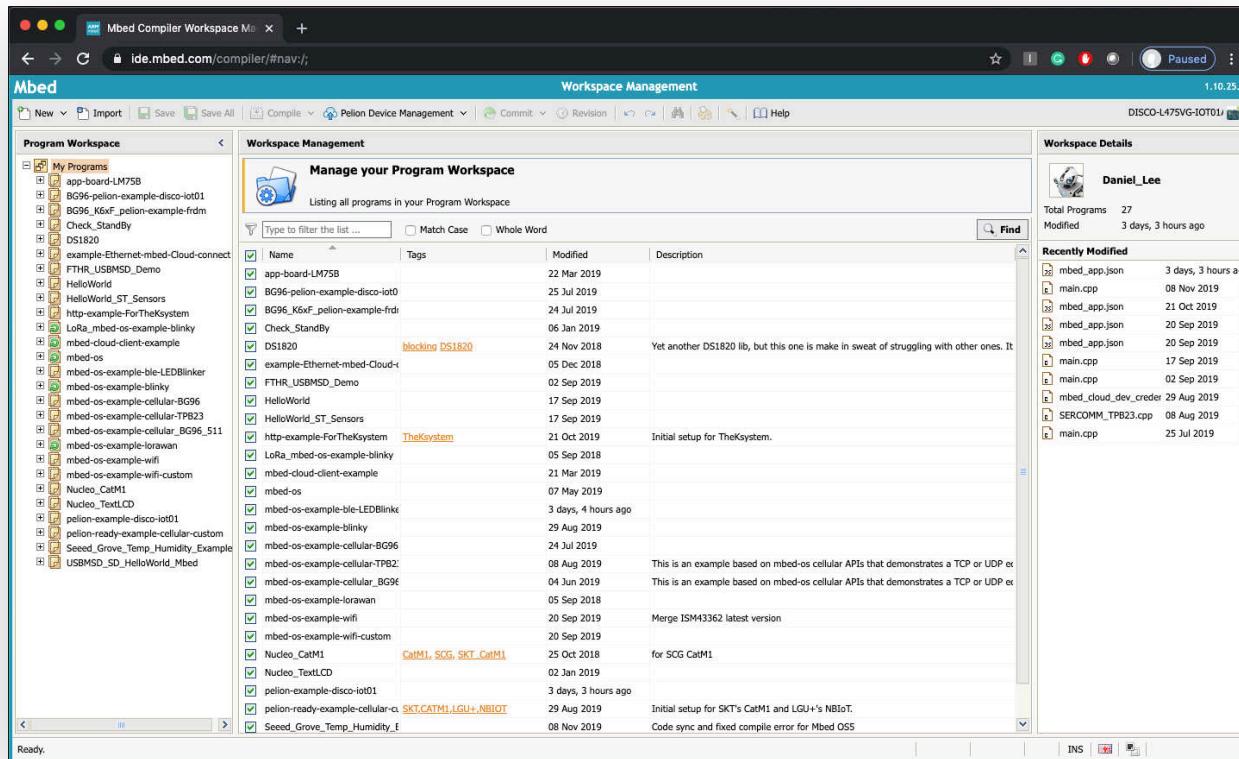


A screenshot of the Mbed Online Compiler interface. The top navigation bar shows a secure connection to <https://os.mbed.com/compiler/#nav:/>. The main title is "Mbed". The top menu includes "New", "Import", "Save", "Save All", "Compile", "Mbed Cloud", "Commit", "Revision", and "Help". The left sidebar is titled "Program Workspace" and contains a tree view under "My Programs" with items: GPS_U-blox_NEO-6M_Test_Code, mbed-os-example-blink, mbed-os-example-client, mbed-os-example-lorawan, and mbed-os-example-wifi. The central workspace is titled "Workspace Management" and "Manage your Program Workspace". It displays a table of programs in the workspace:

Name	Tags	Modified	Description
GPS_U-blox_NEO-6M_Test_Code	GPS LPC4330 Neo-6M u-blox	23 Jul 2018	Test code for GPS U-blox NEO-6M
mbed-os-example-blink		3 weeks, 3 days ago	
mbed-os-example-client		1 week, 1 day ago	
mbed-os-example-lorawan		3 days, 3 hours ago	
mbed-os-example-wifi		09 Jul 2018	

Online Complier

<https://os.mbed.com/compiler/>



장점

- 매우 간단하게 사용할 수 있음
- Web 기반 Compiler (Local PC 환경 Setup 필요없음)
- 24시간 사용가능
- ARM compiler v6 사용
- 컴파일 후 Host PC로 Download 됨
- Pelion connect & update 지원
- 개발보드 없이도 프로그램 개발 가능

단점

- 큰 용량의 코드를 사용하기 어려움
- 디버깅의 어려움
- 네트워크 상황에 영향이 큼
- 정해진 보드(Mbed enabled board)만 사용가능 함

Online Complier - 관련 자료

<https://os.mbed.com/docs/mbed-os/v5.14/tools/developing-mbed-online-compiler.html>

The screenshot shows the Mbed Online Compiler documentation interface. At the top, there's a navigation bar with the 'arm MBED' logo, a version dropdown set to 'v5.14', and a menu with 'Reference', 'Tools', 'Overview', and 'Developing: Mbed Online Compiler'. The 'Developing: Mbed Online Compiler' link is underlined, indicating it's the current page. On the left, a sidebar titled 'Getting started' lists several items: 'Importing code', 'Creating a new program', 'Getting your program on your board', 'Forking a repository', 'Publishing code', 'Updating devices', 'Source control', 'Collaborative work', and 'The Online Compiler reference'. The 'Getting your program on your board' item is currently selected and highlighted in blue.

- [Mbed tutorial #2] Online compiler 사용하기
 - <https://cafe.naver.com/mbedkoreanforum/926>

The screenshot shows a Naver Cafe post titled '[Mbed 시작하기 - Online Complier]'. The post was made by 'armDE(dolm****)' on June 28, 2019, at 16:10. It has a URL of <https://cafe.naver.com/mbedkoreanforum/926>. The main content of the post is a green box containing the text: '개요 : 가장 최근 버전인 5.12를 기준으로 어떻게 사용하는지, 어떻게 시작해야되는지 설명하고자합니다.' (Summary: Based on the latest version 5.12, I will explain how to use it and how to start using it.)

- <https://youtu.be/-ljTn7bEDrg>



Online Complier - Let's try LED Blinky Example



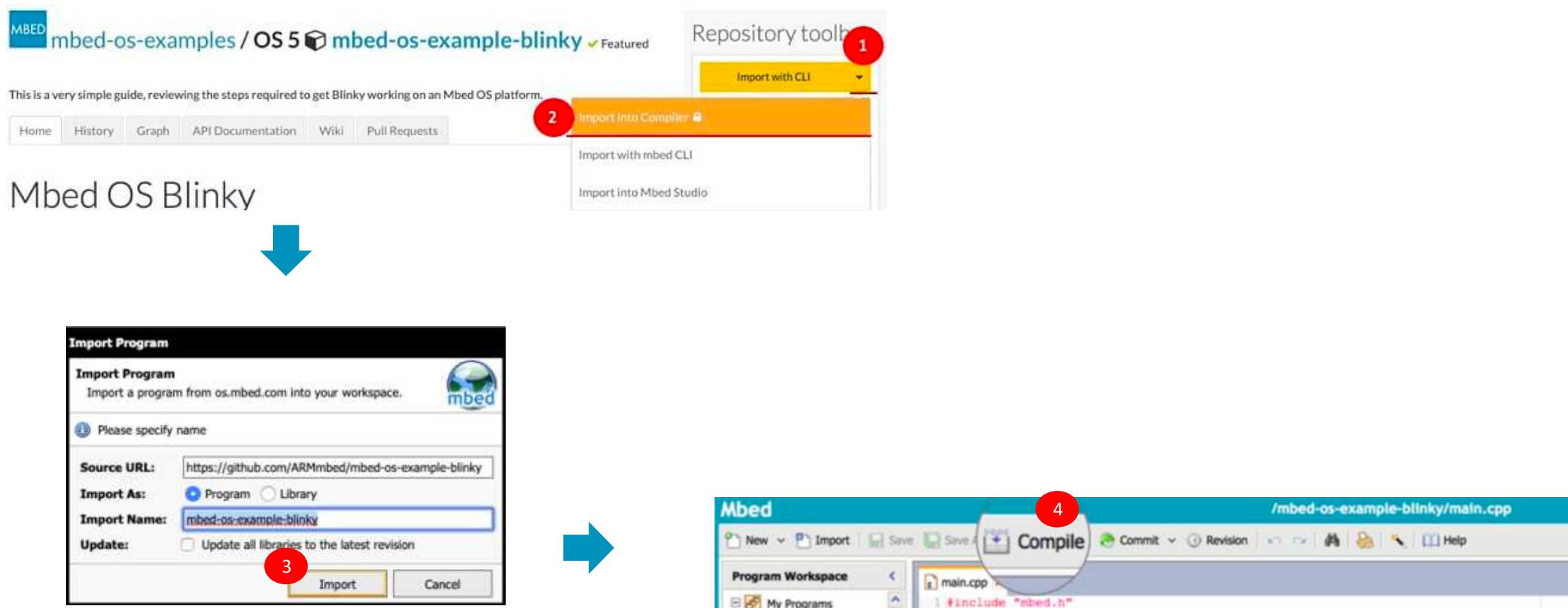
Online Complier - LED Blinky Example (Step 1)

1. Mbed 계정생성
2. Target board 를 본인의 계정에 추가
 - Target board 추가 방법 : PC 에 연결된 Board의 mbed.htm 을 클릭하여 연결
 - 구글 검색 또는 Mbed board(<https://os.mbed.com/platforms/>) 에서 검색

The screenshot shows the Mbed website interface for the DISCO-L475VG-IOT01A board. At the top, there's a navigation bar with links for Overview, Hardware, Docs, Code, Support, and Built with Mbed. Below the navigation is a search bar and buttons for Portal and Compiler. The main content area features the board's name 'DISCO-L475VG-IOT01A' and a brief description: 'STM32L4 Discovery kit IoT node, low-power wireless, BLE, NFC, SubGHz, Wi-Fi'. A thumbnail image of the blue printed circuit board (PCB) is displayed. To the right of the board image is a note: 'To compile a program for this board using Mbed CLI, use DISCO_L475VG_IOT01A as the target name.' Below this note is a 'Board Partner' section featuring the ST logo and the tagline 'life.augmented'. On the left side of the main content area, there's an 'Overview' section with a detailed description of the board's features and a 'Table of Contents' sidebar. The 'Table of Contents' includes links for Overview, Microcontroller features, Board features, Board pinout, Supported shields, Technical references, Known limitations, and Tips and Tricks. At the bottom of the main content area, there's a red box highlighting a 'Add to your Mbed Compiler' button. The footer of the page includes a 'Buy Now' button and a 'Follow' button. The bottom right corner of the page has the 'arm MBED' logo.

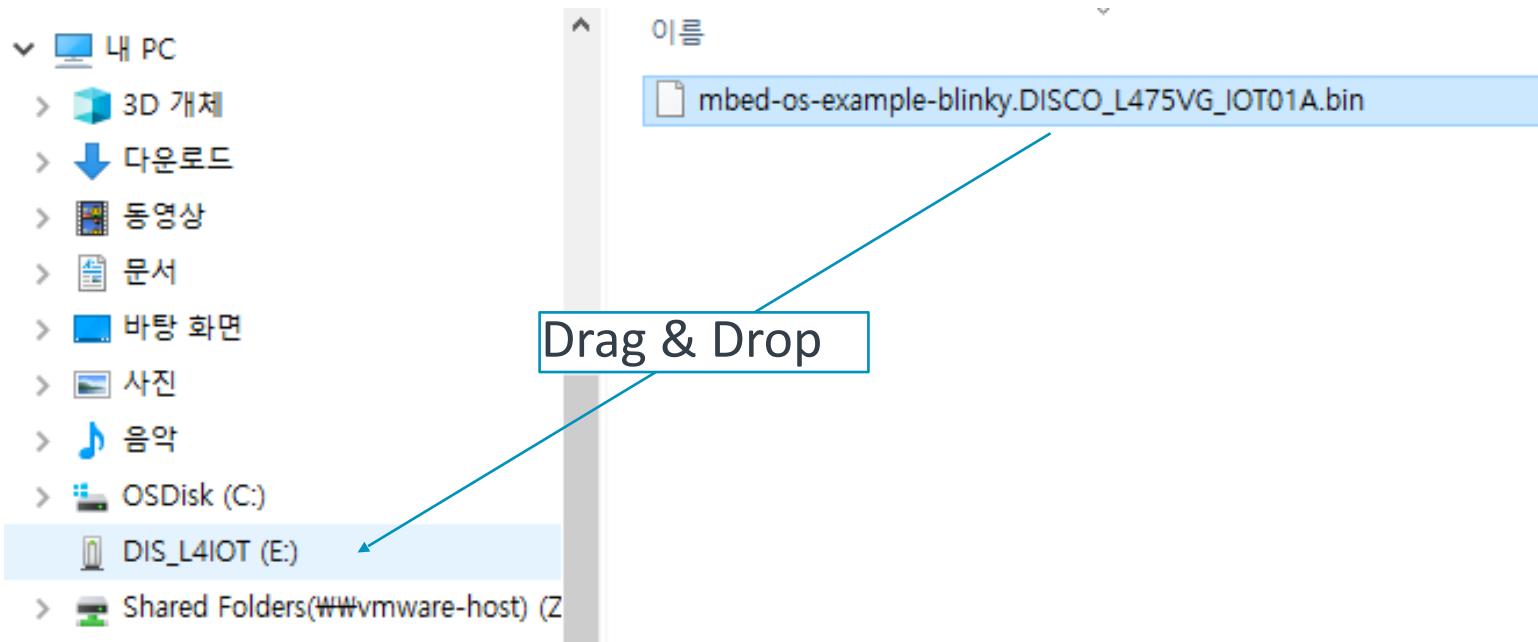
Online Complier - LED Blinky Example (Step 2)

- Mbed Blinky Example : <https://os.mbed.com/teams/mbed-os-examples/code/mbed-os-example-blinky/>



Online Complier - LED Blinky Example (Step 3)

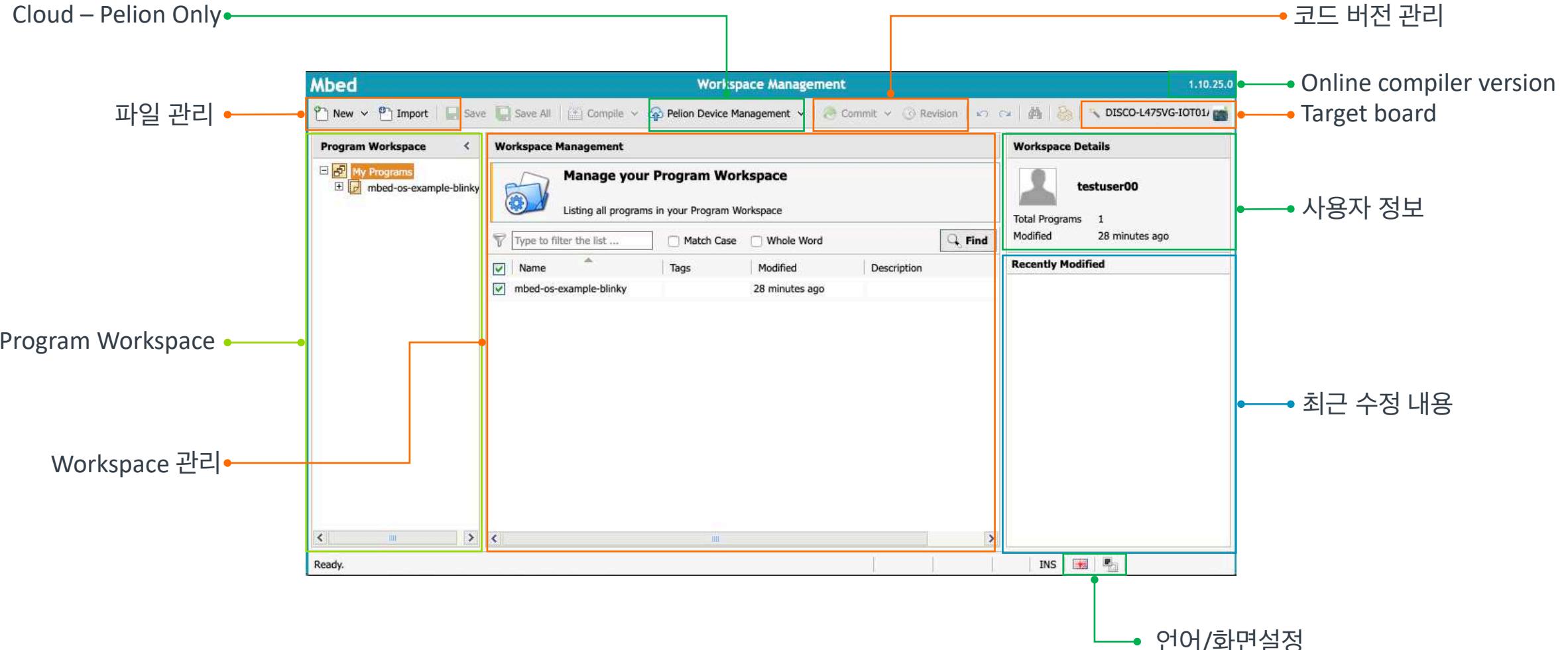
- 컴파일이 완료되면 생성된 바이너리가 PC로 자동 다운로드 또는 사용자 지정 경로로 저장
 - 회사 정책상 PC에 보안프로그램이 설치되어 있는 분들은 복사가 안될 수도 있음.
- 다운로드 된 바이너리를 이동식 디스크로 인식된 Target board 에 복사(Drag & Drop)



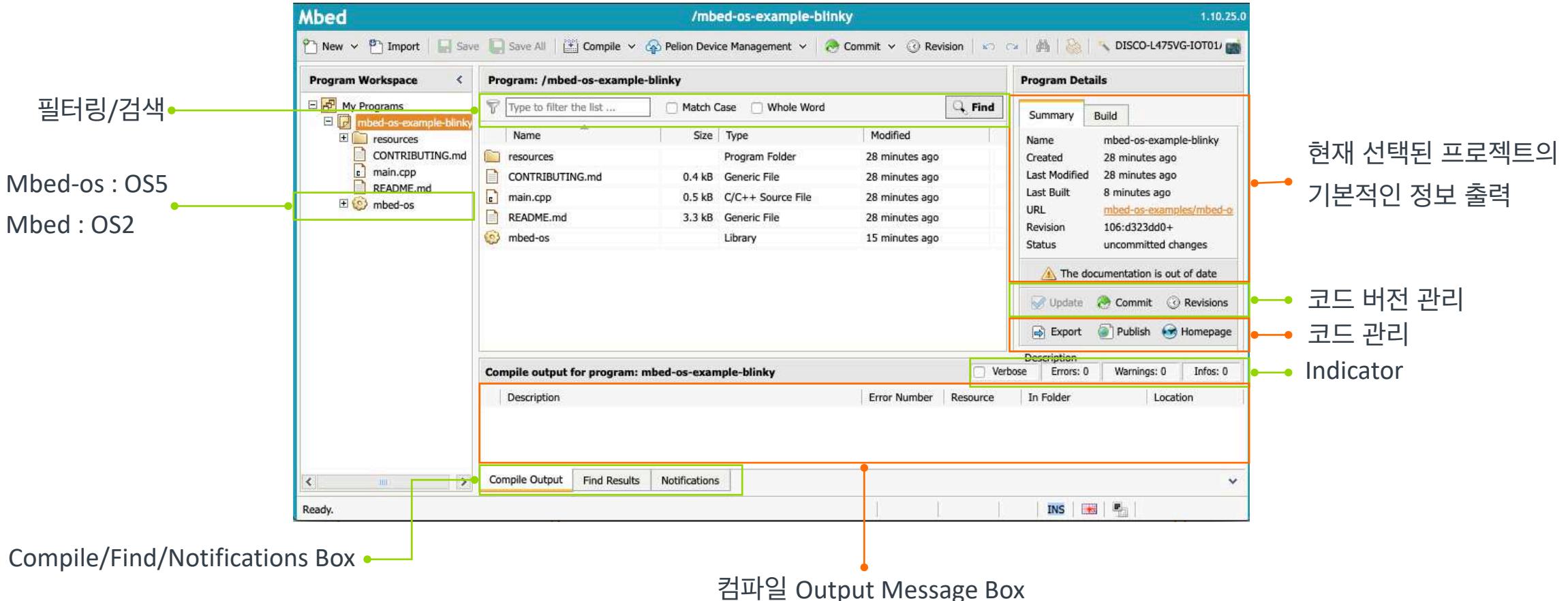
Online Complier - LED Blinky Example (Step 4)



Online Complier - User Interface

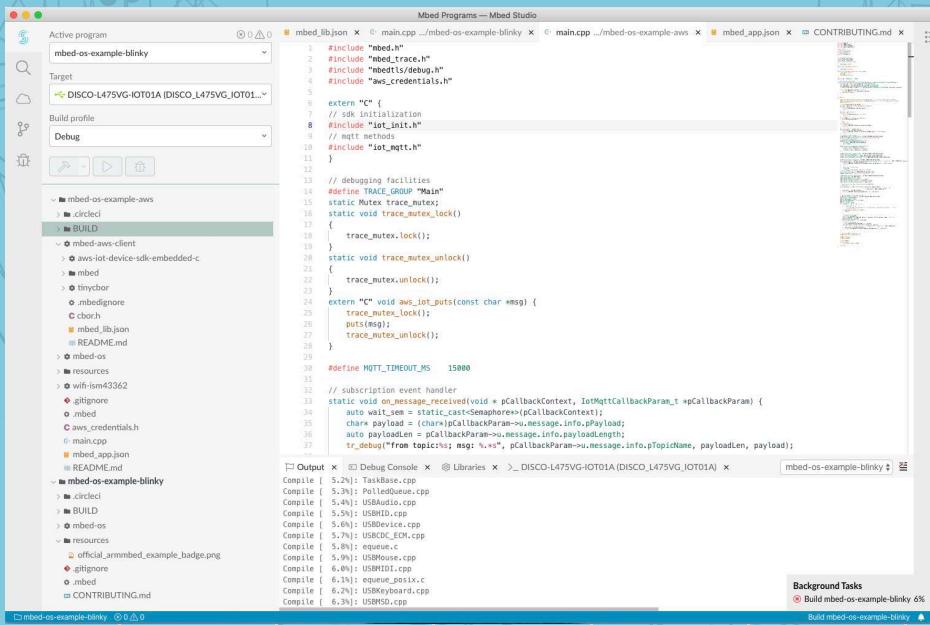


Online Complier - I/F : mbed-os-example-blinky

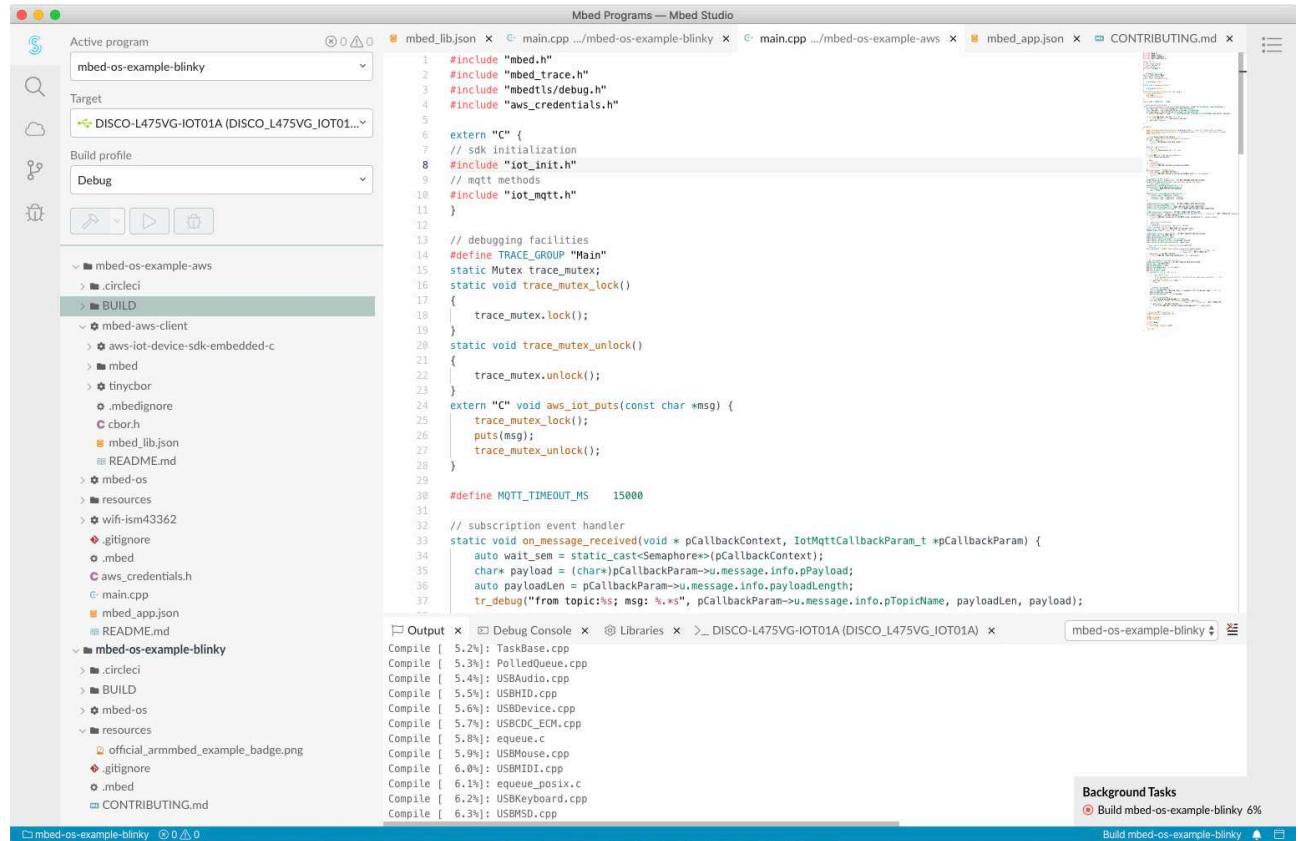


Main Tool 2

Mbed Studio



Mbed Studio



장점

- GUI 기반 & Monaco I/F
- 1.0 version (2020.Jun)
- ARM compiler v6 사용(GCC 가능)
- pyOCD 기반 실시간 디버깅 가능
- Git - Built in
- 타겟 보드 인식 및 컴파일 후 자동 다운로드
- Serial Monitor 지원
- Win/Mac/Linux 모두 지원함
- Custom Board 개발 가능

단점

- Mbed OS 5.12 이상에서만 사용 가능
- 예기치 못한 에러들...

Mbed Studio

- [Mbed tutorial #3] Mbed Studio 시작하기
 - <https://cafe.naver.com/mbedkoreanforum/964>

[Mbed tutorial #3] Mbed Studio 시작하기 | 이것저것 강좌

2019.08.21. 22:32 | 보관 | 수정 | 삭제

armDE(dolm****) 부매니저 5

<https://cafe.naver.com/mbedkoreanforum/964> | 주소복사 | 글 게시글 분석

[Mbed 시작하기] - Mbed Studio

개요 : 최근 버전 Mbed OS 5.13을 기준으로 어떻게 사용하는지, 어떻게 시작해야되는지 설명하고자합니다.

Mbed Studio - Let's try LED Blinky Example



Mbed Studio - Blinky Example (step 1)

Mbed Studio

The desktop IDE for Mbed

Mbed Studio is a free IDE for Mbed OS 5 application and library development, including all the dependencies and tools you need in a single package so that you can create, compile and debug your Mbed programs on the desktop.

[Download for Windows](#)

[Download for Mac](#)

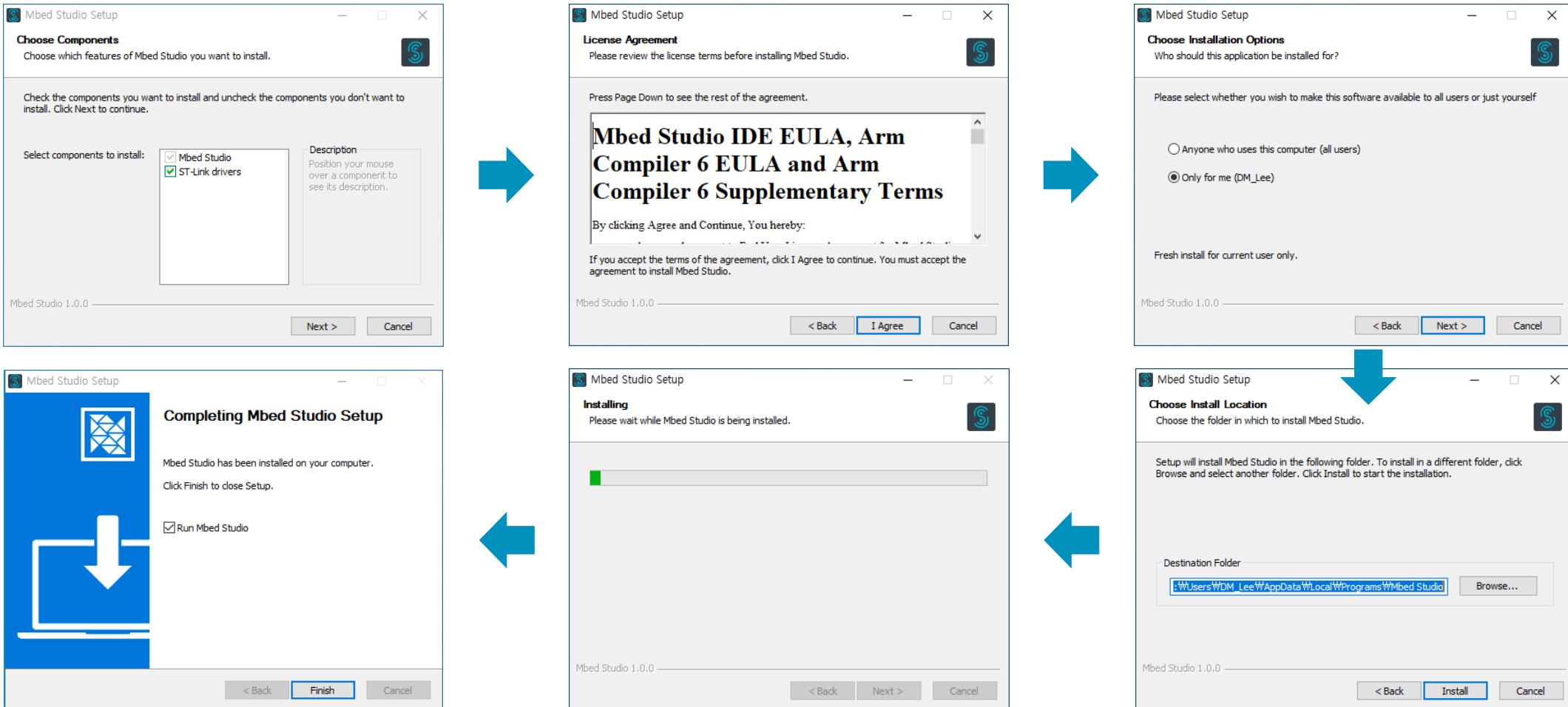
[Download for Linux](#)

<https://os.mbed.com/studio/>

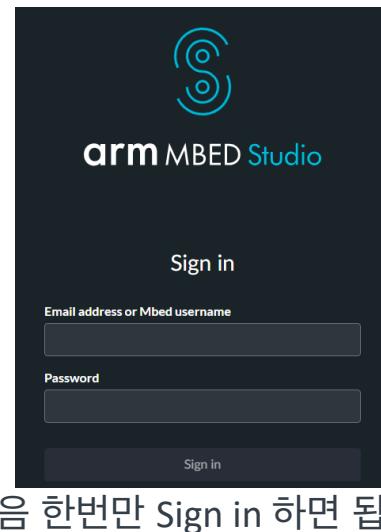
<https://os.mbed.com/docs/mbed-studio/current/introduction/index.html>

Mbed Studio - Blinky Example (step 2)

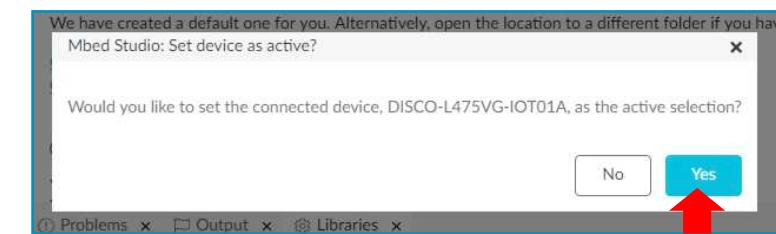
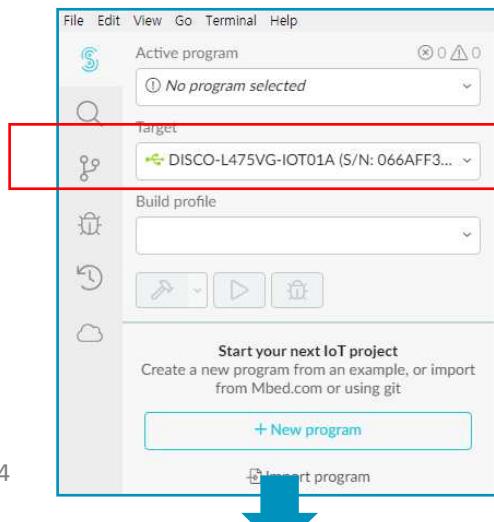
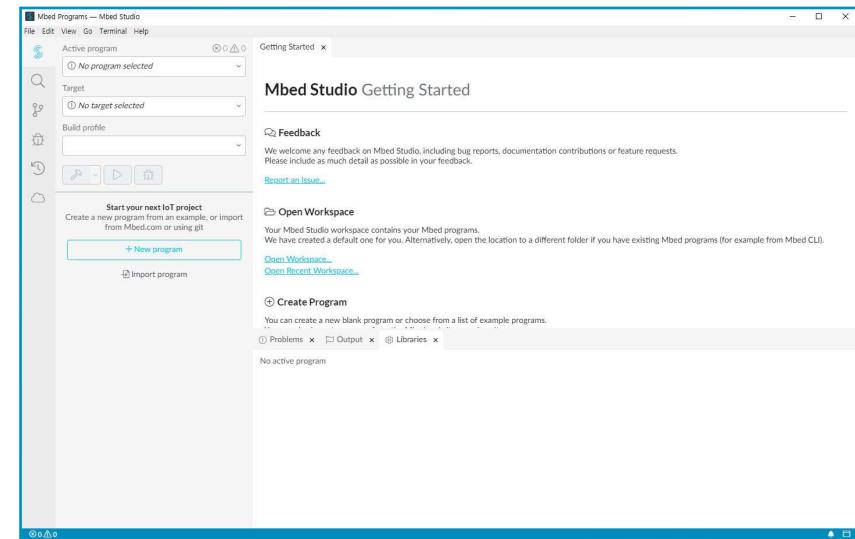
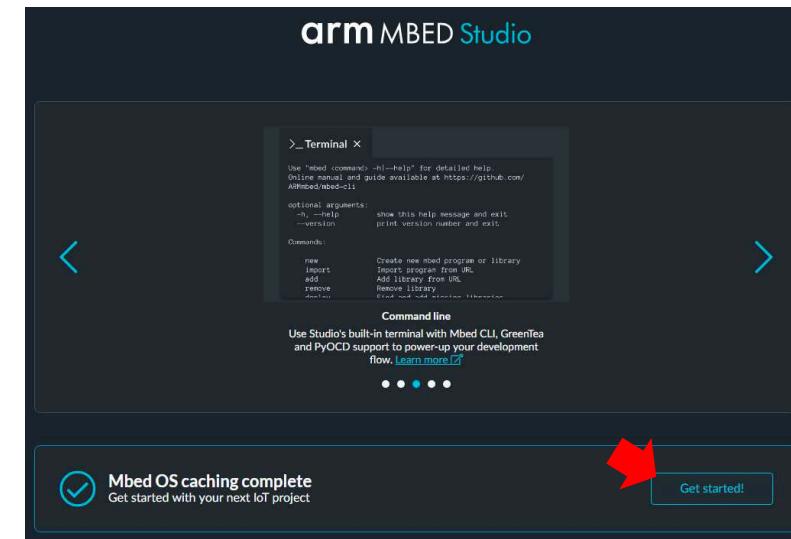
- Install Mbed Studio



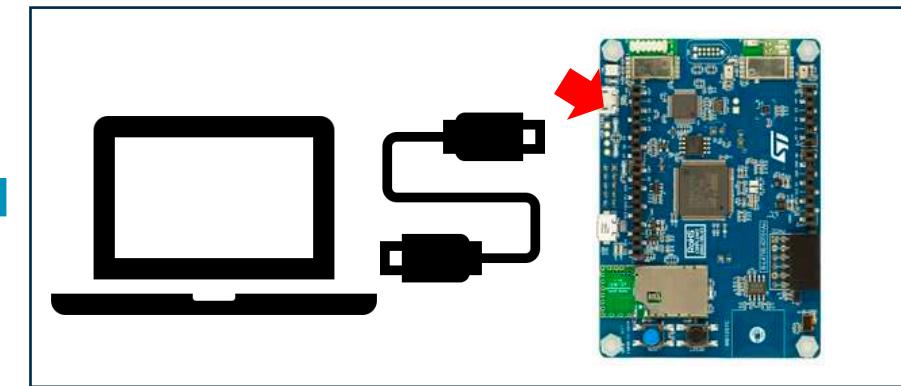
Mbed Studio - Blinky Example (step 2)



처음 한번만 Sign in 하면 됩니다.



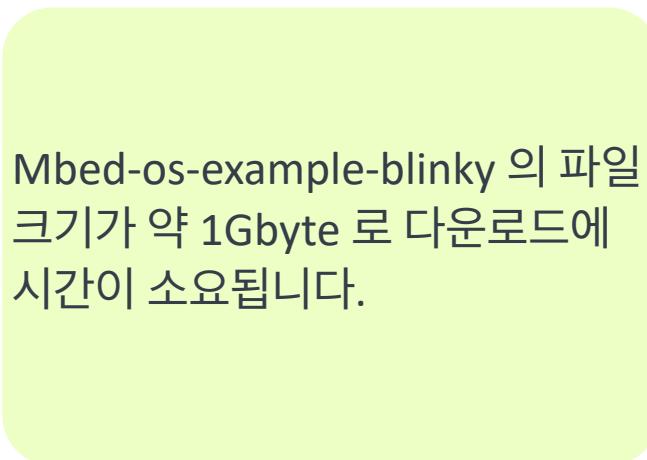
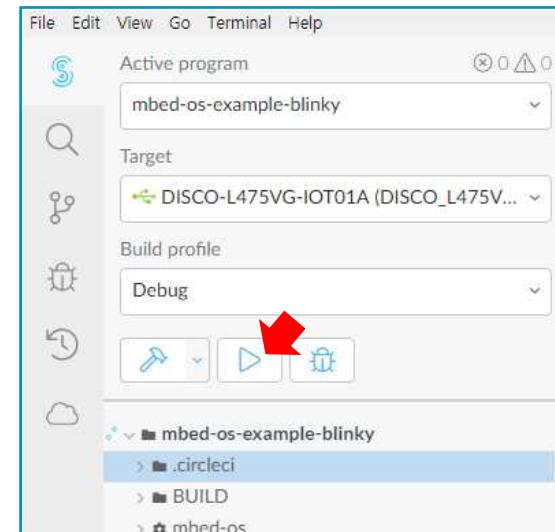
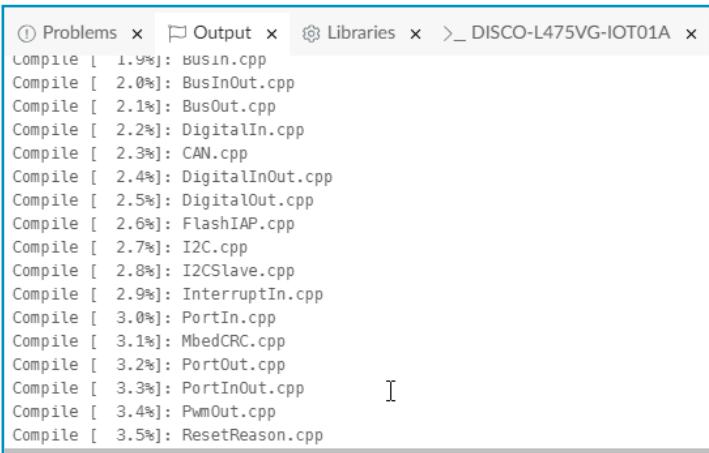
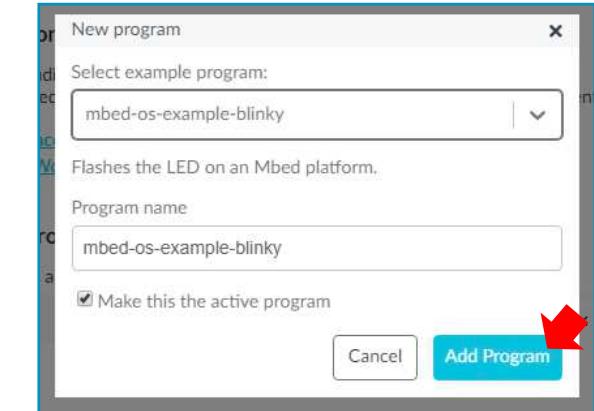
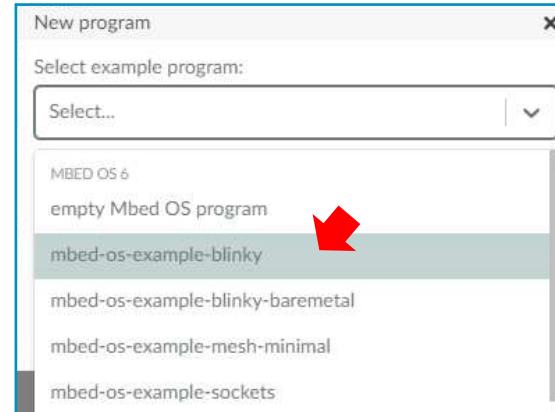
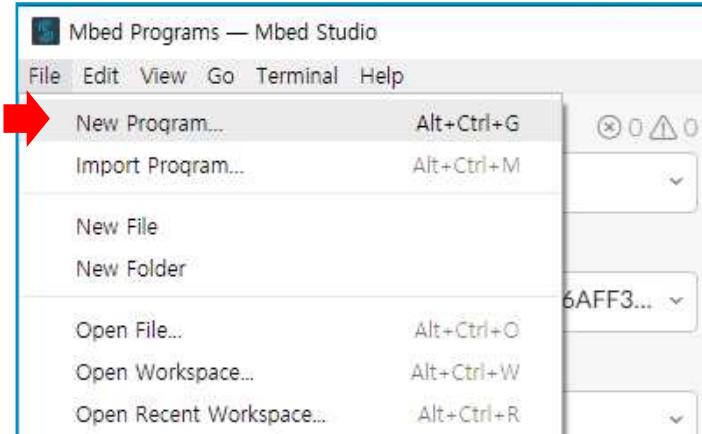
Target board가 인식됨을 확인합니다



Target board를 PC에 연결합니다.

Mbed Studio - Blinky Example (step 3)

Blinky example 을 loading 합니다.

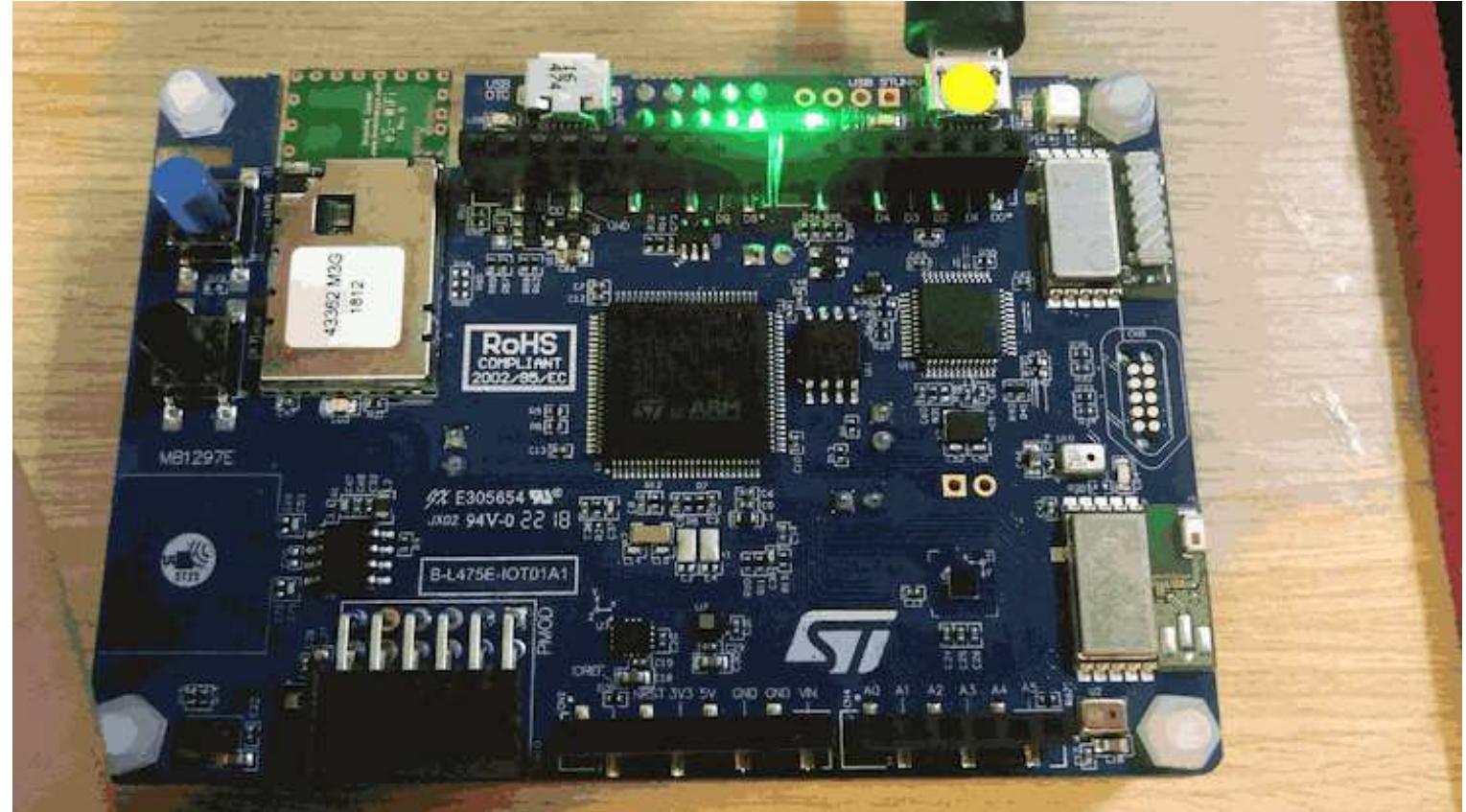


Compile 을 진행합니다.

Mbed Studio - Blinky Example (step 4)

Compile 된 Binary 는 자동으로 Target board 로 다운로드 되고, ST-Link 에 의해 MCU 는 자동 Reset이 되어 프로그램이 동작됩니다.

```
① Problems x ② Libraries x ③ Output x >_ DISCO-L475VG-IOT01A (DISC...  
[Warning] @0,0: L6439W: Multiply defined Global Symbol ble::interface::Sect...  
[Warning] @0,0: L6439W: Multiply defined Global Symbol ble::interface::Sect...  
Elf2Bin: mbed-os-example-blinky  
Module .text .data .bss  
[lib]\c_w.l 4202(+4202) 16(+16) 348(+348)  
[lib]\fz_wm.l 26(+26) 0(+0) 0(+0)  
[lib]\libcppabi_w.l 44(+44) 0(+0) 0(+0)  
anon$$.obj.o 64(+64) 0(+0) 1280(+1280)  
main.o 124(+124) 0(+0) 0(+0)  
mbed-os\components 62(+62) 0(+0) 4(+4)  
mbed-os\drivers 831(+831) 0(+0) 0(+0)  
mbed-os\hal 1978(+1978) 8(+8) 130(+130)  
mbed-os\platform 9366(+9366) 64(+64) 349(+349)  
mbed-os\rtos 10694(+10694) 168(+168) 7009(+7009)  
mbed-os\targets 11864(+11864) 8(+8) 961(+961)  
Subtotals 39255(+39255) 264(+264) 10081(+10081)  
Total Static RAM memory (data + bss): 10345(+10345) bytes  
Total Flash memory (text + data): 39519(+39519) bytes  
Image: BUILD/DISCO_L475VG_IOT01A/ARMC6\mbed-os-example-blinky.bin
```



Mbed Studio - User Interface

- Target board 가 인식 되어야만 프로그램이 동작함

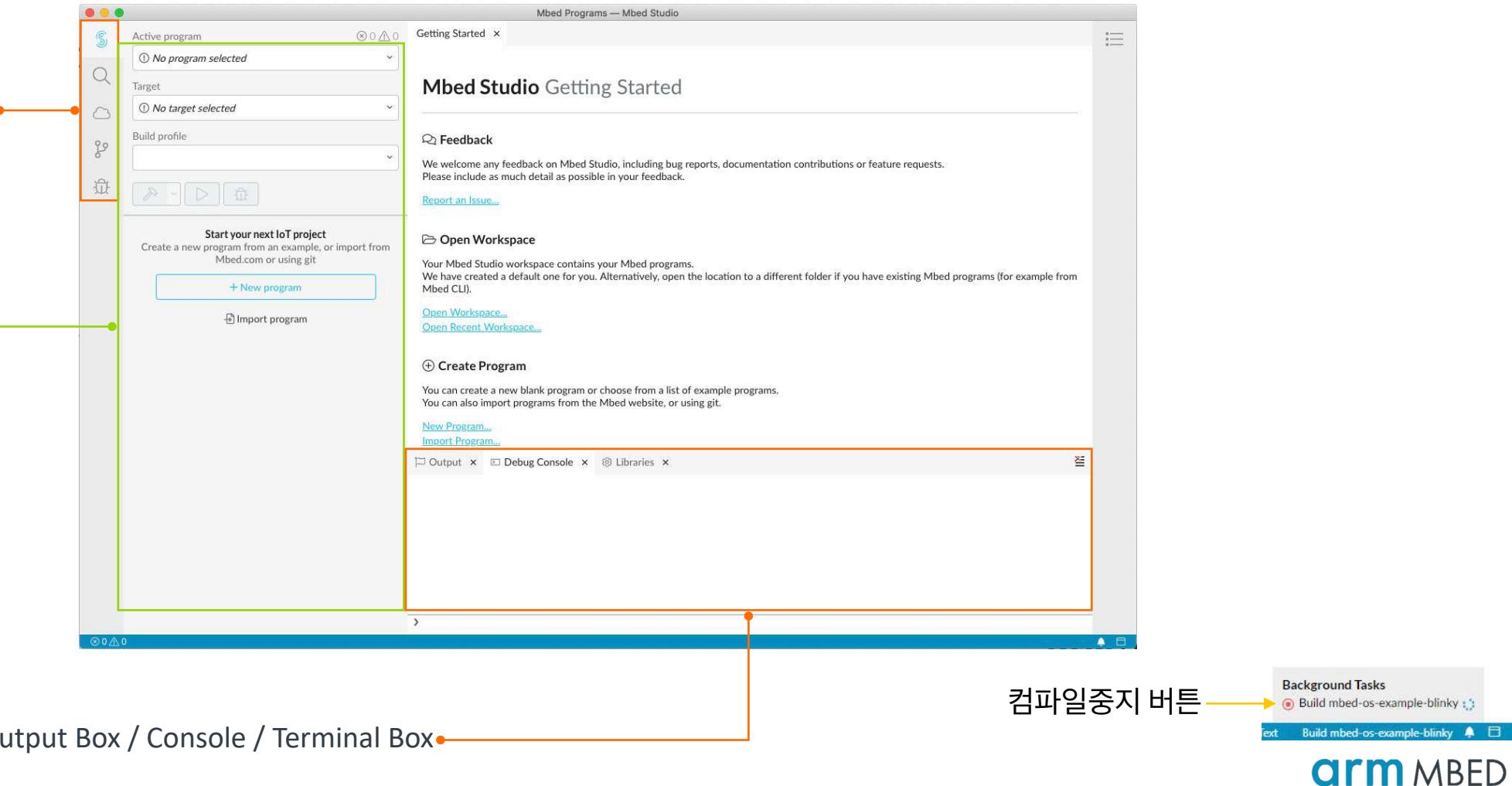
프로그램 검색

클라우드

소스 관리(Git)

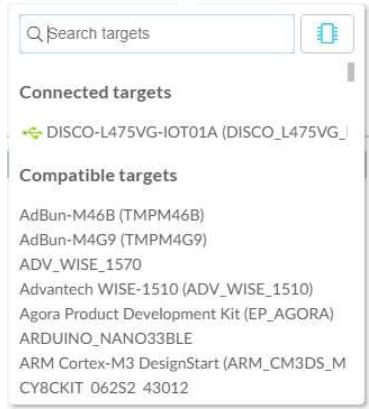
디버깅

I/F Box

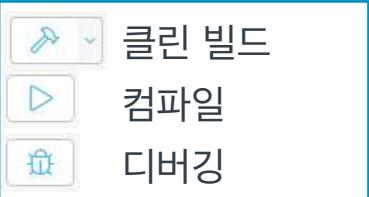


Mbed Studio - User I/F, Connected Target Board

Target

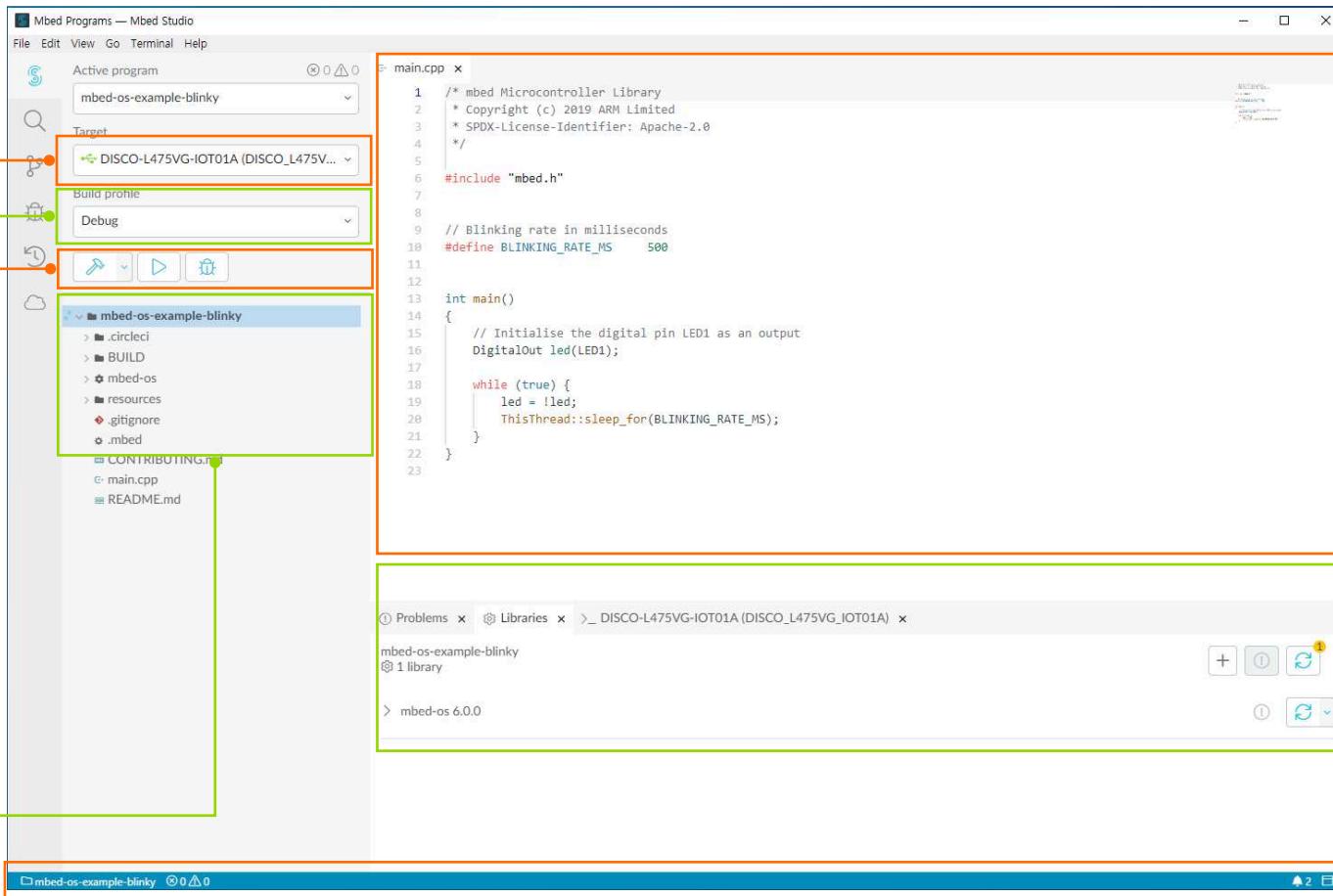


Build profile

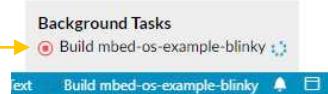


Source code

48



컴파일중지 버튼



arm MBED

Code/ Thumbnail Box

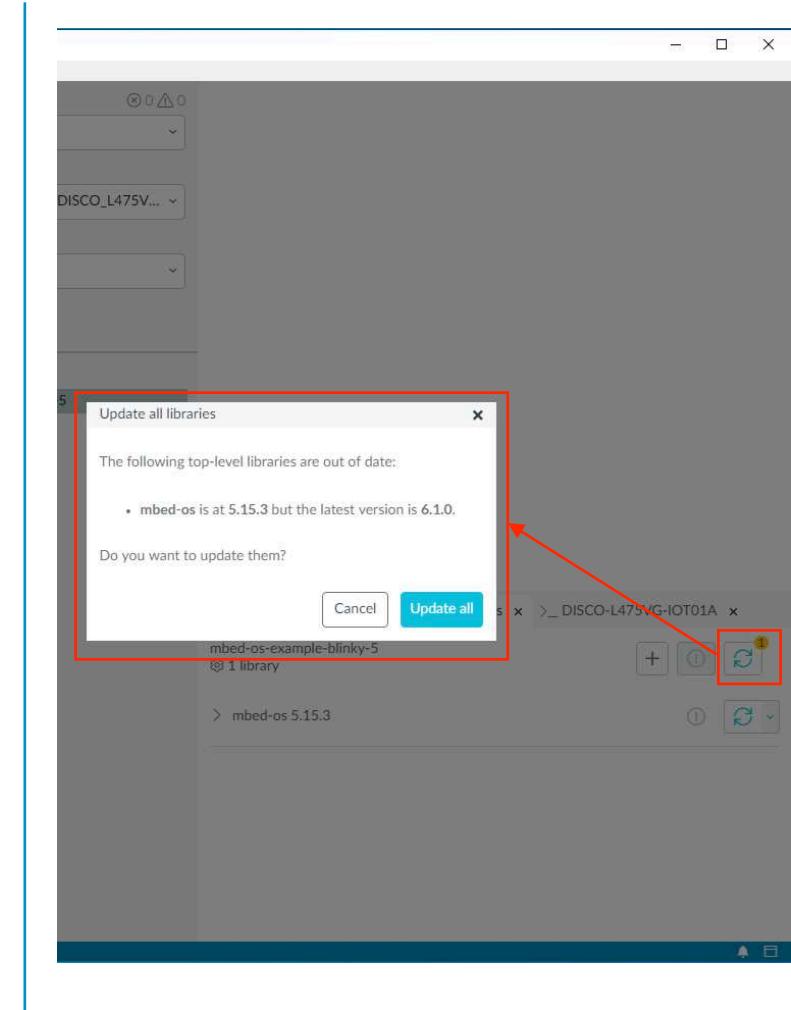
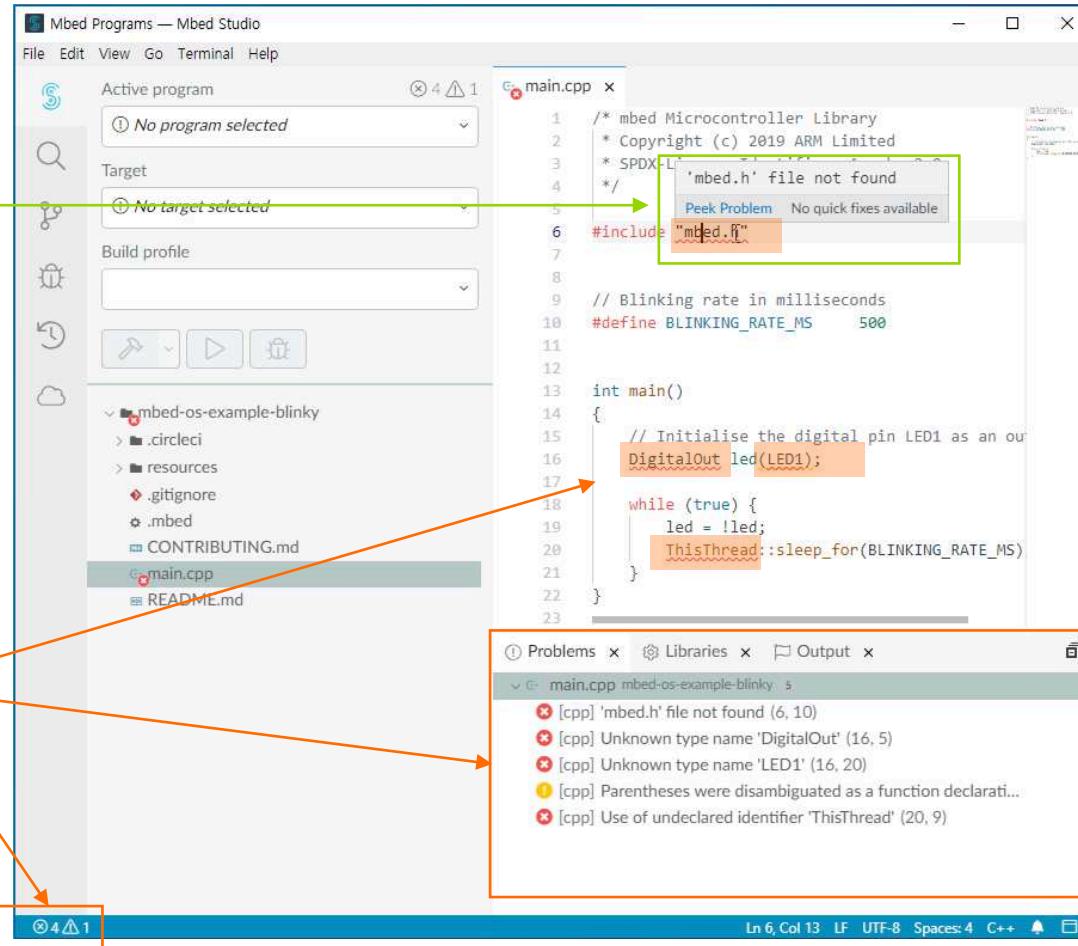
프로젝트 관련 상태 표시 Box
Serial terminal,
Compile output,
OS version update check 등

프로그램 상태 표시창
프로젝트/상태/알람등

Mbed Studio - User I/F, Error Status

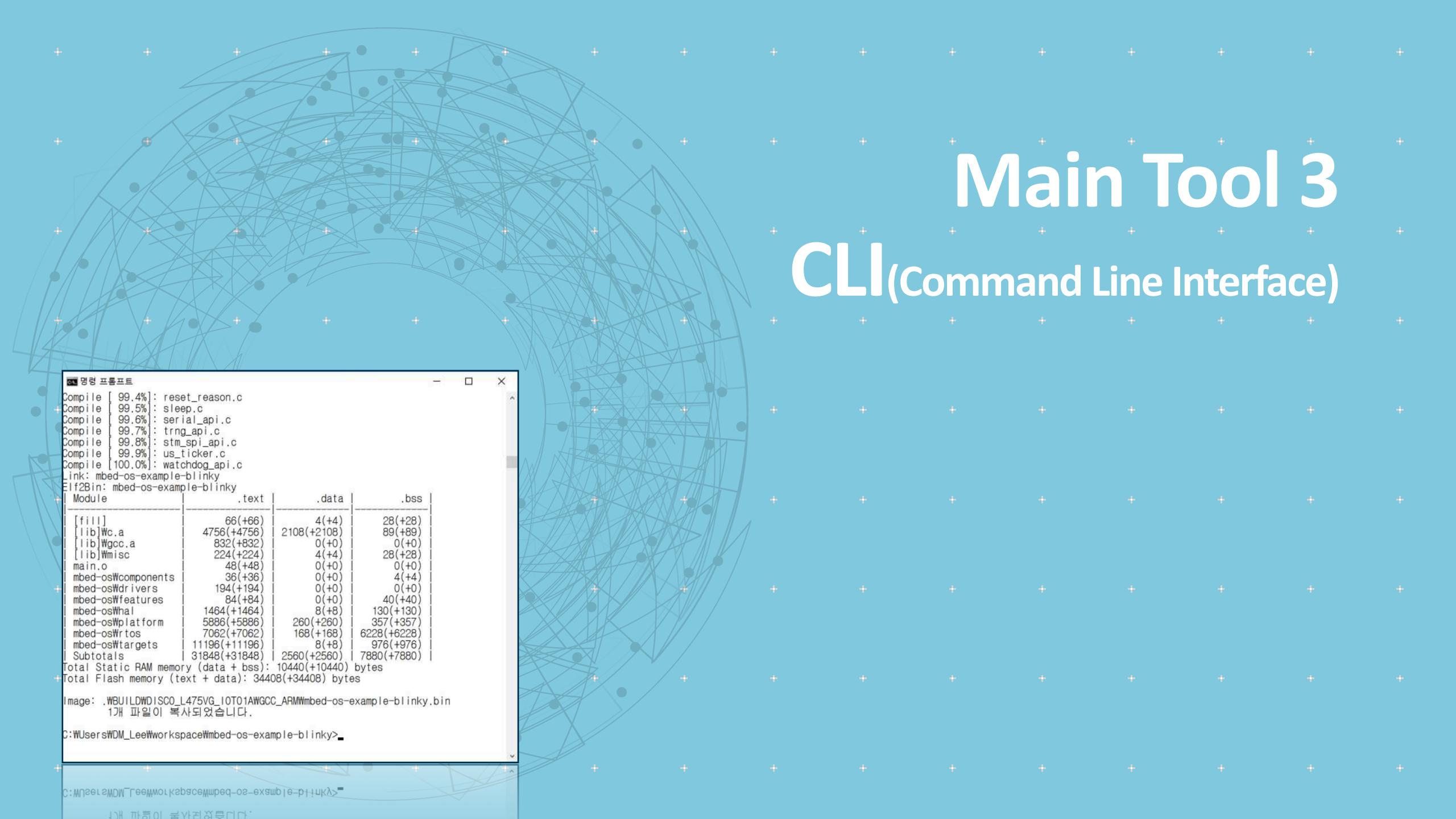
밑줄에서 더블클릭하면 해당 정보를 Tooltip 으로 표시합니다.

Warning & Error



Main Tool 3

CLI(Command Line Interface)



```
명령 프롬프트
Compile [ 99.4%]: reset_reason.c
Compile [ 99.5%]: sleep.c
Compile [ 99.6%]: serial_api.c
Compile [ 99.7%]: trng_api.c
Compile [ 99.8%]: stm_spi_api.c
Compile [ 99.9%]: us_ticker.c
Compile [100.0%]: watchdog_api.c
Link: mbed-os-example-blinky
Elf2bin: mbed-os-example-blinky

Module .text .data .bss
[fill] 66(+66) 4(+4) 28(+28)
[lib]Wc.a 4756(+4756) 2108(+2108) 89(+89)
[lib]Wgcc.a 832(+832) 0(+0) 0(+0)
[lib]Wmisc 224(+224) 4(+4) 28(+28)
main.o 48(+48) 0(+0) 0(+0)
mbed-osWcomponents 36(+36) 0(+0) 4(+4)
mbed-osWdrivers 194(+194) 0(+0) 0(+0)
mbed-osWfeatures 84(+84) 0(+0) 40(+40)
mbed-osWhal 1464(+1464) 8(+8) 130(+130)
mbed-osWplatform 5886(+5886) 260(+260) 357(+357)
mbed-osWtos 7062(+7062) 168(+168) 6228(+6228)
mbed-osWtargets 11196(+11196) 8(+8) 976(+976)
Subtotals 31848(+31848) 2560(+2560) 7880(+7880)
Total Static RAM memory (data + bss): 10440(+10440) bytes
Total Flash memory (text + data): 34408(+34408) bytes

Image: .\WBUILD\DISCO_L475VG_10T01AWGCC_ARM\mbed-os-example-blinky.bin
1개 파일이 복사되었습니다.

C:\Users\WDM_Lee\workspace\mbed-os-example-blinky>
```

CLI(Command Line Interface)

The image shows two separate command-line windows side-by-side. Both windows are titled '명령 프롬프트' (Command Prompt) and are running the Mbed CLI.

The top window displays memory usage statistics:

	11196(+11196)	8(+8)	976(+976)
Subtotals	31848(+31848)	2560(+2560)	7880(+7880)
Total Static RAM memory (data + bss):	10440(+10440)	bytes	
Total Flash memory (text + data):	34408(+34408)	bytes	

Image: .\WBUILD\DISCO_L475VG_IOT01AWGCC_ARM\mbed-os-example-blinky.bin
1개 파일이 복사되었습니다.

C:\Users\DM_Leet\workspace\mbed-os-example-blinky>dir
C 드라이브의 블록에는 이름이 없습니다.
블록 일련 번호: 78FA-F433

The bottom window shows the compilation process and memory map:

Compilation progress (Module 1 of 1):

Module	.text	.data	.bss
[fille]	66(+66)	4(+4)	28(+28)
[lib]Wc.a	4756(+4756)	2108(+2108)	89(+89)
[lib]Wgcc.a	832(+832)	0(+0)	0(+0)
[lib]Wmisc	224(+224)	4(+4)	28(+28)
main.o	48(+48)	0(+0)	0(+0)
mbed-os\components	36(+36)	0(+0)	4(+4)
mbed-os\drivers	194(+194)	0(+0)	0(+0)
mbed-os\features	84(+84)	0(+0)	40(+40)
mbed-os\hal	1464(+1464)	8(+8)	130(+130)
mbed-os\platform	5886(+5886)	260(+260)	357(+357)
mbed-os\rtos	7062(+7062)	168(+168)	6228(+6228)
mbed-os\targets	11196(+11196)	8(+8)	976(+976)
Subtotals	31848(+31848)	2560(+2560)	7880(+7880)
Total Static RAM memory (data + bss):	10440(+10440)	bytes	
Total Flash memory (text + data):	34408(+34408)	bytes	

Image: .\WBUILD\DISCO_L475VG_IOT01AWGCC_ARM\mbed-os-example-blinky.bin
1개 파일이 복사되었습니다.

C:\Users\DM_Leet\workspace\mbed-os-example-blinky>

장점

- 제품 개발자에게 권장
- Mbed Tool 의 모든 기능을 사용할 수 있음
- 개발자 능력에 따라 다양하게 사용할 수 있음, 사용 속도가 빠름
- IDE tool(Vscode...) 과 함께 사용가능
- Text base / Git / Debug / Editor(ex, Vi)
- Mbed 포팅 및 자체 개발 제품에 사용
- 컴파일러를 선택적으로 사용할 수 있음

단점

- Text base / Debug
- Command 사용의 불편함
- pip/git 등의 tool에 대한 지식이 필요함

CLI - 시작하기전에!!

- Python 3 사용자분 들은!!
 - CLI tool 의 Default 설치는 python 2.7 입니다.
 - CLI tool 설치 시 설치 항목에서 Python 설치를 해제 하셔야 합니다!

CLI - 관련 자료

- [Mbed tutorial #1] mbed 처음 시작하기 !!
 - <https://cafe.naver.com/mbedkoreanforum/916>

제목 [Mbed tutorial #1] mbed 처음 시작하기 !! | 이것저것 강좌

작성일 2019.06.19. 13:51 | 보관 | 수정 | 삭제

작성자 armDE(dolm****) 부제-자리

URL https://cafe.naver.com/mbedkoreanforum/916 주소복사 | 글쓰기

[Mbed 시작하기]

개요 : 가장 최근 버전인 5.12를 기준으로 어떻게 사용하는지, 어떻게 시작해야되는지 설명하고자합니다.

한국시간으로 2019년 6월 28일에 Mbed OS 5.13이 릴리즈 되었습니다만, 아래의 내용은 OS 버전에 관계없이 사용할 수 있습니다.

강의에 사용된 재료 :

- <https://os.mbed.com/platforms/> 중 하나의 보드를 선택하시면됩니다.
- 본 강의에서 사용하는 Board는 Nucleo series 중 DISCO_L475VG_IOT01A를 사용했습니다.
 - Board information : <https://os.mbed.com/platforms/ST-Discovery-L475E-IOT01A/>
 - 구매처 : <https://www.icbanq.com/P007602212> , <http://eleparts.co.kr/goods/view?no=6506642>
- K64F 등 다른 보드를 사용하셔도 따라하실 수 있습니다!

1. 개발환경설정하기

: 자신의 PC에 환경(CLI)을 구축하는 방법과, 운영체제에 관계없이 Online에서 컴파일 할 수 있는환경을 제공합니다. 두개중에 선택하면 됩니다. 단, Online compiler의 경우 컴파일할 코드의 크기와 네트워크 상황 그리고 arm의 정기정검등으로 인해 일시적으로 컴파일이 안될 가능성이 있습니다. CLI(Command Line interface; offline compiler) 환경을 추천드립니다

CLI - Download Tool

<https://os.mbed.com/docs/mbed-os/v5.15/tools/installation-and-setup.html>

Tools

Overview

Developing: Mbed Online Compiler

Developing: Mbed Studio

Developing: Mbed CLI

Installation and setup

Installers

Manual installation

Configuration options

Working with Mbed CLI

Exporting

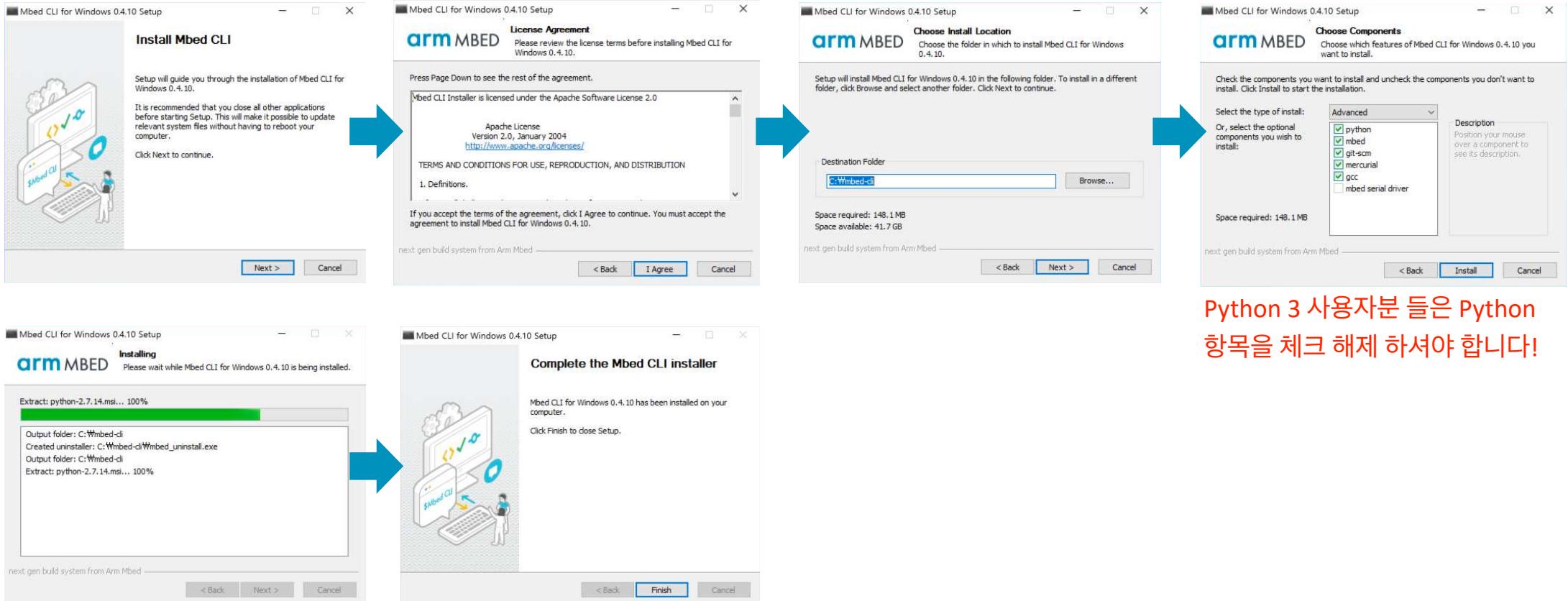
Debugging

Testing

- Windows
 - <https://github.com/ARMmbed/mbed-cli-windows-installer/releases/tag/v0.4.10>
- Mac OS
 - <https://github.com/ARMmbed/mbed-cli-osx-installer/releases/tag/v0.0.10>
- Linux
 - 자동설치 파일은 지원되지 않음으로 수동 설치가 필요함.
 - <https://os.mbed.com/docs/mbed-os/v5.14/tools/manual-installation.html>
 - 가상환경 User 를 위한 리눅스 OS이미지
 - Install Virtual box
 - <https://www.virtualbox.org/>
 - VB image download, mount image to VB
 - https://drive.google.com/open?id=1KXn5wO2McQZcn6KcJGYU4gaFwwrBBG_J
 - User & Password : mbed2017
 - This VB image are included all tools for Mbed compile.

CLI - Install Tool

- 기본 설치를 진행합니다.

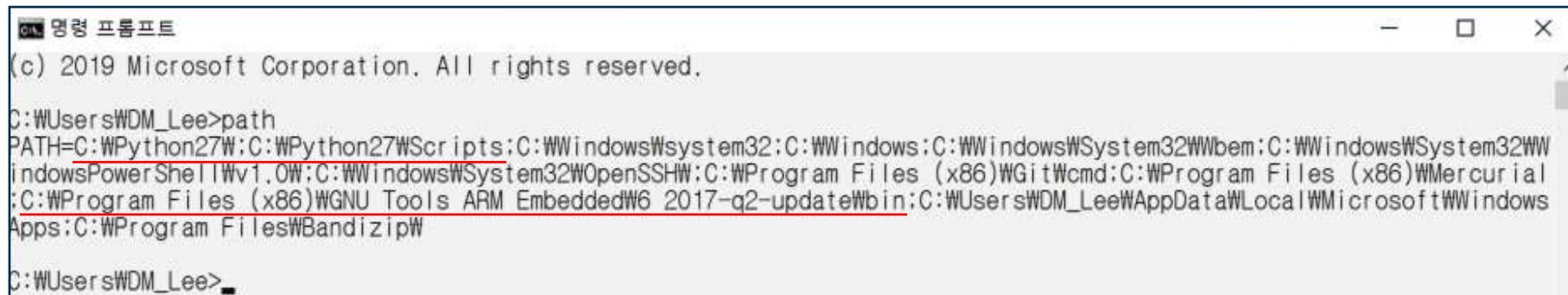


CLI - Configure (Step 1)

- 설치 확인

- C:\> path

<— 현재 설치된 compiler version/Path 확인



```
명령 프롬프트
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\DM_Lee>path
PATH=C:\Python27;C:\Python27\Scripts;C:\Windows\system32;C:\Windows;C:\Windows\System32\WBem;C:\Windows\System32\WindowsPowerShell\v1.0\;C:\Windows\System32\OpenSSH;C:\Program Files (x86)\Git\cmd;C:\Program Files (x86)\Mercurial;C:\Program Files (x86)\GNU Tools ARM Embedded\6 2017-q2-update\bin;C:\Users\DM_Lee\AppData\Local\Microsoft\Windows Apps;C:\Program Files\Bandizip\

C:\Users\DM_Lee>
```

- C:\> mbed

<— Mbed CLI version 확인

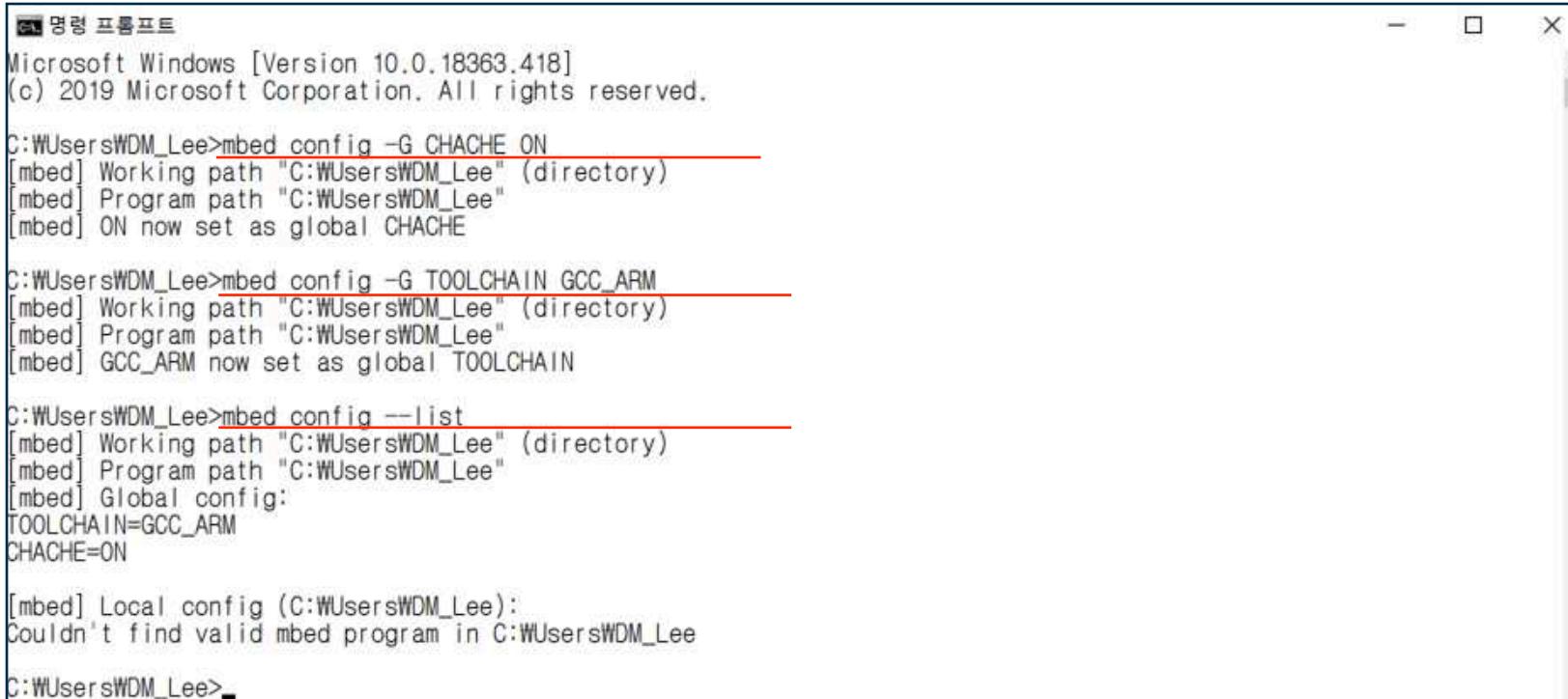


```
선택 명령 프롬프트
C:\Users\DM_Lee>mbed
usage: mbed [-h] [--version] ...
...
Command-line code management tool for ARM mbed OS - http://www.mbed.com
version 1.8.3
Use "mbed <command> -h|--help" for detailed help.
Online manual and guide available at https://github.com/ARMmbed/mbed-cl i
```

CLI - Configure (Step 2)

- 필수 설정

- C:\> mbed config -G CHACHE ON
- C:\> mbed config -G TOOLCHAIN GCC_ARM
- C:\> mbed config --list



```
명령 프롬프트
Microsoft Windows [Version 10.0.18363.418]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\WDM_Lee>mbed config -G CHACHE ON
[mbed] Working path "C:\Users\WDM_Lee" (directory)
[mbed] Program path "C:\Users\WDM_Lee"
[mbed] ON now set as global CHACHE

C:\Users\WDM_Lee>mbed config -G TOOLCHAIN GCC_ARM
[mbed] Working path "C:\Users\WDM_Lee" (directory)
[mbed] Program path "C:\Users\WDM_Lee"
[mbed] GCC_ARM now set as global TOOLCHAIN

C:\Users\WDM_Lee>mbed config --list
[mbed] Working path "C:\Users\WDM_Lee" (directory)
[mbed] Program path "C:\Users\WDM_Lee"
[mbed] Global config:
TOOLCHAIN=GCC_ARM
CHACHE=ON

[mbed] Local config (C:\Users\WDM_Lee):
Couldn't find valid mbed program in C:\Users\WDM_Lee

C:\Users\WDM_Lee>
```

CLI - Configure (Step 3)

- Update Mbed-CLI

- C:\> pip install -U mbed-cli //<https://pypi.org/project/mbed-cl/>
 - C:\> python -m pip install --upgrade pip

- [Option] Update Compiler

- 공식 GNU arm embedded toolchain site에서 최근버전을 다운받아 환경 변수(PATH)를 설정

<https://developer.arm.com/tools-and-software/open-source-software/developer-tools/gnu-toolchain/gnu-rm/downloads>



```
명령 프롬프트
(c) 2019 Microsoft Corporation. All rights reserved.

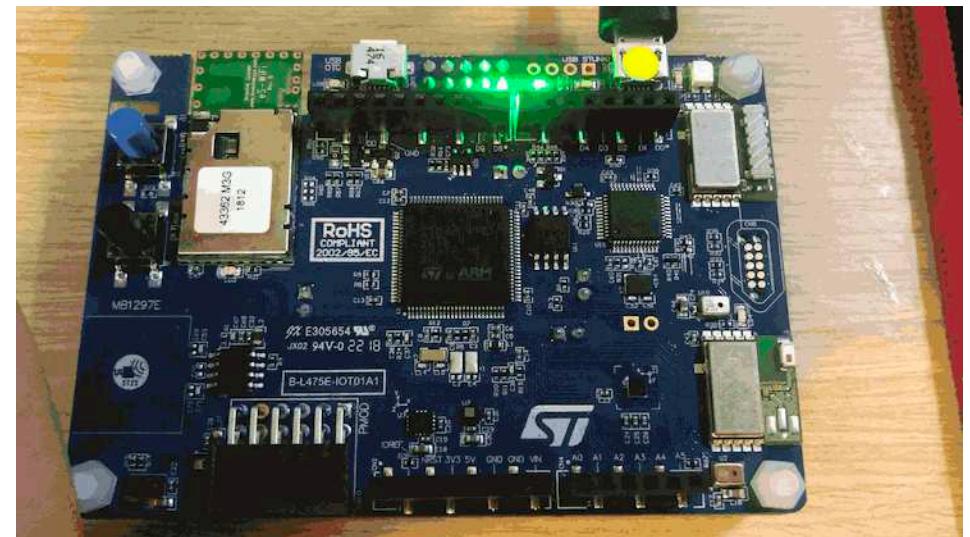
C:\Users\DM_Lee>path
PATH=C:\Python27;C:\Python27\Scripts;C:\Windows\system32;C:\Windows;C:\Windows\System32\WBem;C:\Windows\System32\WindowsPowerShell\v1.0\;C:\Windows\System32\OpenSSH;C:\Program Files (x86)\Git\cmd;C:\Program Files (x86)\Mercurial;C:\Program Files (x86)\GNU Tools ARM Embedded\6.2017-q2-update\bin;C:\Users\DM_Lee\AppData\Local\Microsoft\Windows Apps;C:\Program Files\Bandizip\

C:\Users\DM_Lee>
```

- [Option] Update Python 3.x(3.6 이상 권장)

- Python 3.x 을 이미 사용하고 계신 분들은 윈도우 환경 변수(PATH)에서 Python 2.7 삭제 및 Python 3.x 의 PATH를 추가

CLI - Let's try LED Blinky Example



CLI - Blinky Example (step 1)

- Ex) Windows
 - 프로젝트 생성을 위한 workspace 폴더 생성 및 mbed-os-example-blinky 예제 다운로드 & 컴파일 절차

```
C:\Users\WDM_Lee>mkdir workspace
C:\Users\WDM_Lee>cd workspace
C:\Users\WDM_Lee\workspace>mbed import mbed-os-example-blinky
[mbed] Working path "C:\Users\WDM_Lee\workspace" (directory)
[mbed] Program path "C:\Users\WDM_Lee\workspace"
[mbed] Importing program "mbed-os-example-blinky" from "https://github.com/ARMmbed/mbed-os-example-blinky" at latest revision
in the current branch
[mbed] Adding library "mbed-os" from "https://github.com/ARMmbed/mbed-os" at rev #165be79392ae
[mbed] Auto-installing missing Python modules (colorama, urllib3, prettytable, junit_xml, pyyaml, jsonschema, future, six, mbe
d_cloud_sdk, requests, idna, pyserial, jinja2, intelhex, mbed_ls, mbed_host_tests, mbed_greentea, beautifulsoup4, pyelftools,
manifest_tool, icetea, pycryptodome, pyusb, hidapi, cmsis_pack_manager, pywin32, wmi, psutil, cryptography, click, cbor)...
C:\Users\WDM_Lee\workspace>cd mbed-os-example-blinky
C:\Users\WDM_Lee\workspace\mbed-os-example-blinky>mbed detect
[mbed] Working path "C:\Users\WDM_Lee\workspace\mbed-os-example-blinky" (program)
[mbed] Detected DISCO_L475VG_IOT01A, port COM3, mounted F:, interface version 0221:
[mbed] Supported toolchains for DISCO_L475VG_IOT01A


| Target              | mbed OS 2 | mbed OS 5 | uARM | IAR       | ARM       | GCC_ARM   |
|---------------------|-----------|-----------|------|-----------|-----------|-----------|
| DISCO_L475VG_IOT01A | -         | Supported | -    | Supported | Supported | Supported |


Supported targets: 1
Supported toolchains: 3
C:\Users\WDM_Lee\workspace\mbed-os-example-blinky>mbed compile -m DISCO_L475VG_IOT01A -f
[mbed] Working path "C:\Users\WDM_Lee\workspace\mbed-os-example-blinky" (program)
[Warning] @.: Compiler version mismatch: Have 6.3.1: expected version >= 9.0.0 and < 10.0.0
Building project mbed-os-example-blinky (DISCO_L475VG_IOT01A, GCC_ARM)
Scan: mbed-os-example-blinky
Compile [ 0.1%]: mbed_tz_context.c
Compile [ 0.2%]: NanostackRfPhyAtmel.cpp
[Warning] NanostackRfPhyAtmel.cpp@352,63: 'void mbed::TickerBase::attach_us(mbed::Callback<void(), us_timestamp_t)' is deprec
ated: Pass a chrono duration, not an integer microsecond count. For example use '10ms' rather than '10000'. [since mbed-os-6.0
.0] [-Wdeprecated-declarations]
[Warning] NanostackRfPhyAtmel.cpp@368,63: 'void mbed::TickerBase::attach_us(mbed::Callback<void(), us_timestamp_t)' is deprec
ated: Pass a chrono duration, not an integer microsecond count. For example use '10ms' rather than '10000'. [since mbed-os-6.0
.0] [-Wdeprecated-declarations]
```

처음 Import 시 필요한 Python module 을 설치하여 다소 시간이 소요됩니다.

• Target board name
• Serial port

컴파일 완료 후 컴파일 된 바이너리를 보드로 자동 다운로드 하는 옵션

• Compiler version check

CLI - Blinky Example (step 2)

- Ex) Windows
 - 프로젝트 생성을 위한 workspace 폴더 생성 및 mbed-os-example-blinky 예제 다운로드 & 컴파일 절차

```
mbed-os\features          84(+84)    0(+0)    40(+40)
mbed-os\hal                1464(+1464) 8(+8)    130(+130)
mbed-os\platform           5886(+5886) 260(+260) 357(+357)
mbed-os\rtos               7062(+7062) 168(+168) 6228(+6228)
mbed-os\targets            11196(+11196) 8(+8)    976(+976)
Subtotals                  31848(+31848) 2560(+2560) 7880(+7880)
Total Static RAM memory (data + bss): 10440(+10440) bytes
Total Flash memory (text + data): 34408(+34408) bytes

Image: .\BUILD\DISCO_L475VG_10T01AWGCC_ARM\mbed-os-example-blinky.bin
1개 파일이 복사되었습니다.

C:\Users\DM_Lee\workspace\mbed-os-example-blinky>
```

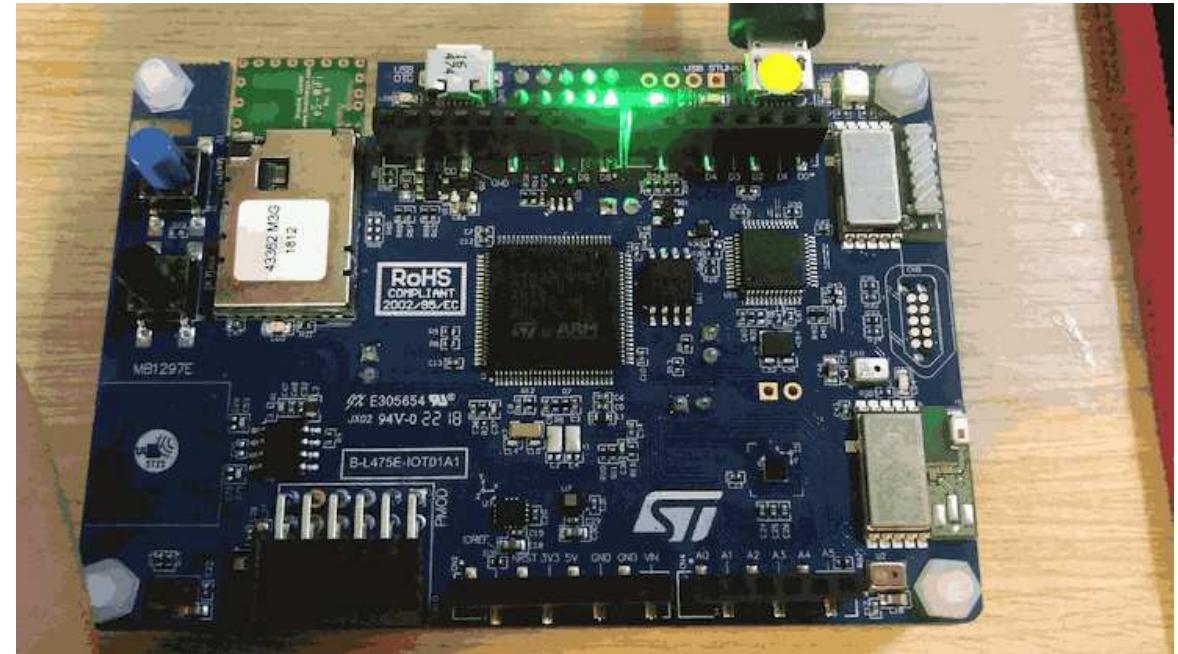
- 컴파일 완료 후 디바이스로 빌드 이미지 복사됨

CLI - Blinky Example (step 3)

```
Compile [ 99.7%]: trng_api.c
Compile [ 99.8%]: stm_spi_api.c
Compile [ 99.9%]: us_ticker.c
Compile [100.0%]: watchdog_api.c
Link: mbed-os-example-blinky
Elf2Bin: mbed-os-example-blinky
Module      .text    .data    .bss
[fill]        66(+66)   4(+4)   28(+28)
[lib]Wc.a     4756(+4756) 2108(+2108) 89(+89)
[lib]Wgcc.a   832(+832)  0(+0)   0(+0)
[lib]Wmisc    224(+224)  4(+4)   28(+28)
main.o       48(+48)   0(+0)   0(+0)
mbed-osWcomponents 36(+36)   0(+0)   4(+4)
mbed-osWdrivers   194(+194)  0(+0)   0(+0)
mbed-osWfeatures  84(+84)   0(+0)   40(+40)
mbed-osWhal    1464(+1464) 8(+8)   130(+130)
mbed-osWplatform 5886(+5886) 260(+260) 357(+357)
mbed-osWrtos    7062(+7062) 168(+168) 6228(+6228)
mbed-osWtargets  11196(+11196) 8(+8)   976(+976)
Subtotals    31848(+31848) 2560(+2560) 7880(+7880)
Total Static RAM memory (data + bss): 10440(+10440) bytes
Total Flash memory (text + data): 34408(+34408) bytes

Image: .\WBUILD\DISCO_L475VG_IOT01AWGCC_ARM\mbed-os-example-blinky.bin
1개 파일이 복사되었습니다.

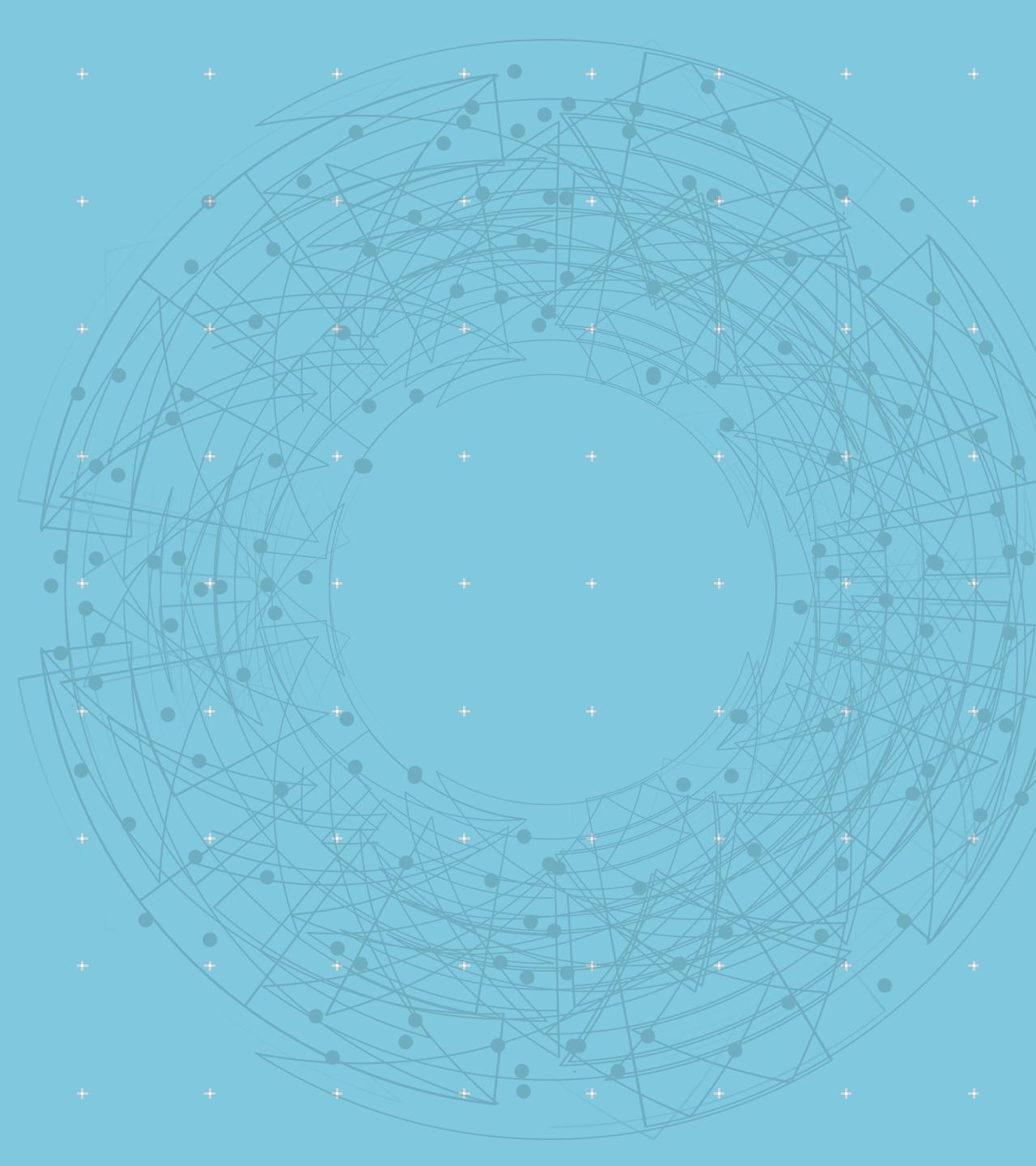
C:\Users\DM_Leew\workspace\mbed-os-example-blinky>
```



- Compile Speed
 - Windows < Linux <= Mac

CLI - 기타

- Visual studio code 와 Mbed CLI를 함께 사용할 수 있습니다.
 - Vscode + Mbed CLI + OpenOCD 환경으로 실시간 디버깅이 가능합니다.
 - <https://cafe.naver.com/mbedkoreanforum/921>



Sub Tool Mbed Simulator

Mbed simulator

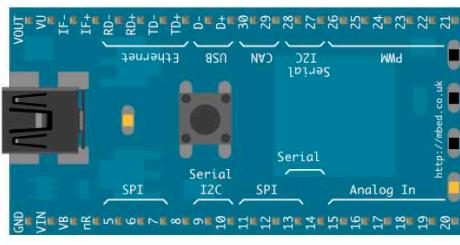
- <https://simulator.mbed.com/>
- Youtube Open Hours - Mbed OS Simulator - Jan Jongboom : <https://youtu.be/DxTetwYsXvo>

Arm Mbed OS simulator

How to debug | GitHub project

Blinky + Load demo Run + Add component

```
1 #include "mbed.h"
2 #include "C12832.h"
3
4 C12832 lcd(SPI_MOSI, SPI_SCK, SPI_MISO, p8, p11);
5
6 DigitalOut led(LED1);
7
8 int main() {
9     while (1) {
10         lcd.locate(0, 3);
11         lcd.printf("Hello from the simulator!");
12
13         led = !led;
14         printf("Blink! LED is now %d\n", led.read());
15
16         wait_ms(500);
17     }
18 }
```



C12832 (p5, p6, p7)

Hello from the simulator!

Serial output

```
Blink! LED is now 1
Blink! LED is now 0
Blink! LED is now 1
Blink! LED is now 0
Blink! LED is now 1
```



Thank You
Danke
Merci

谢谢
ありがとう
Gracias
Kiitos
감사합니다