

## Customer Application Development Flow

Here, the flow for customer application development is described. nRF5 SDK provided by Nordic includes various sample software. Based on this, customer's application can be developed for customer's specification, function addition and modification. Moreover, LAPIS Technology provides the original sample software, and refer to also here.

### STEP.1

#### Base Sample Software Selection

Introduce the sample software.

The customer's application can be efficiently developed by selecting near sample software.

[Go >>](#)



### STEP.2

#### Software Development Environment Construction

The software development environment of compiler and the debugger are prepared.

[Go >>](#)



### STEP.3

#### Customer's Application Development

After the software development environment is prepared, actually, let's start the software development.

Introduce the usage the development tools.

[Go >>](#)

## Step.1 Base Sample Software Selection

### Step.1-1 Sample Software Selection

LAPIS Technology provides the sample software shown in the following table (some under development).

Customers can modify freely and use free of charge.

Table. Sample Software Provided by LAPIS Technology

Sample software name	Intended use and application	Download site
Software for serial communication	<ul style="list-style-type: none"> <li>Enables Bluetooth low energy wireless communication easily using simple AT commands.</li> <li>Using this sample software, the devices which have been controlled via UART can be made wireless easily.</li> </ul>	Refer to the LAPIS Technology's wireless support site. <a href="https://www.lapis-semi.com/cgi-bin/MyLAPIS/regi/login.cgi">https://www.lapis-semi.com/cgi-bin/MyLAPIS/regi/login.cgi</a>
Software for remote control	<ul style="list-style-type: none"> <li>This can be used for a Bluetooth low energy wireless remote control.</li> </ul>	Refer to the LAPIS Technology's wireless support site. <a href="https://www.lapis-semi.com/cgi-bin/MyLAPIS/regi/login.cgi">https://www.lapis-semi.com/cgi-bin/MyLAPIS/regi/login.cgi</a>
Software for sensing and logging	<ul style="list-style-type: none"> <li>This can be used for an application that collects data by sensing various types of sensors/devices.</li> </ul>	Expected to be disclosed in March 2021.

Nordic provides various types of sample software. The following introduces some of them. The following table shows the sample software provided as application examples with nRF5 SDK v17.0.2. In addition, a throughput measurement application, current consumption measurement application, multi-protocol application, etc. are provided as evaluation applications.

**[Note]** The amount of memory used by SoftDevice varies depending on the type of SoftDevice (Bluetooth low energy protocol stack library provided by Nordic). Therefore, some combinations of the sample software and SoftDevice do not work for MK71511.

Table. Sample Software Provided by Nordic (Classified by Application)

Application	Sample software summary	GAP Role		SoftDevice		
		Central	Peripheral	S112	S132	S140
LED Lighting	Button side for LED application.	●			●	●
	LED side for LED application.		●	●	●	●
Beacon	Beacon application for iBeacon.		●	●	●	●
	Beacon application for Eddystone.		●	●	●	
	Beacon for Bluetooth standard. When button is pressed, it transits from System-Off state, and start to transmit the advertising packet.		●	●	●	●
Lost article Tracker	Node application for Tile. OTA function Tile is had.		●	●	●	●
Serial communication	Button side of multi-connection application between one button device and some LED devices.		●		●	●
Multi-connection (1:N)	Button side of multi-connection application between one button device and some LED devices.	●			●	●
	LED side for LED application.		●	●	●	●
Multi-connection (N:1)	Button side for LED application.	●			●	●
	LED side of multi-connection application between one LED device and some button devices.		●	●	●	●
Multi-connection for UART Command I/F	Multi-connection application for UART command application. Advertise, "connect", "disconnect" and etc. are controlled by an original command.	●	●		●	●
Data Relay	The collector receives data from Heart rate monitor, Running Speed and Cadence (RSC) sensor, switches function to sensor (peripheral) and it is relayed to smartphone.	●	●		●	●
	RSC profile for sensor side.		●		●	●
	Heart rate monitor profile for sensor side.		●		●	●
NFC Pairing	Pairing using NFC. Central side.	●			●	
	Pairing using NFC. Legacy pairing (JW), Legacy pairing (OOB), and Secure connection (OOB) can be selected with the push-button. The smartphone with NFC can be used for the peer device.		●		●	

The following table shows the sample software provided as application examples of Bluetooth standard profiles with nRF5 SDK v17.0.2.

Table. Sample Software Provided by Nordic (Classified by Profile)

Bluetooth GATT Base Profile	Sample software summary	GAP Role		SoftDevice		
		Central	Peripheral	S112	S132	S140
Heart Rate	Data collector side for Heart Rate Profile. The heart rate data is received, and output it via UART.	●			●	●
	Sensor side for Heart Rate Profile.		●		●	●
Heart Rate (+ NFC Pairing)	Collector side for Heart Rate Profile. The heart rate data is received, and output it via UART. NFC pairing version.	●			●	
	Sensor side for Heart Rate Profile. NFC pairing version.		●	●	●	●
	Sensor side for Heart Rate Profile. Ferrets version.		●		●	
Blood Pressure	Server for Blood Pressure Profile. The blood pressure simulation data is transmitted by push-button.		●	●	●	●
Glucose	Sensor side (Server) for Glucose Profile. Glucose data is created by push-button.		●	●	●	●
Health Thermometer	Sensor side for Health Thermometer Profile. Thermometer simulation data is transmitted by push-button.		●	●	●	●
Continuous Glucose	Sensor side for Continuous Glucose Monitoring Profile.		●	●	●	●
Running Speed and Cadence	Collector side for Running Speed and Cadence Profile. The data is received, and output it via UART.	●			●	●
	Sensor side for Running Speed and Cadence Profile (RSCP). The simulation data for RSCP and Battery Service are transmitted periodically.		●		●	●
Cycling Speed and Cadence	Sensor side for Cycling Speed and Cadence Profile (CSCP). The simulation data for CSCP and Battery Service are transmitted.		●		●	●
Proximity	Reporter side for Proximity Profile and locator side for Fide Me Profile.		●	●	●	●
Immediate Alert	Reception side of Immediate Alert Notification. Peripheral device of ISA is connected by pairing (JW), it can try until max. device number of multi-connections. When the Immediate Alert Service is received, LED3 is indicated.	●			●	●
	Transmission side for Immediate Alert Notification. At pressing the button, the alert level does toggle in order of 0->1->2->0.		●	●	●	●
Link Loss	Reporter for Link Loss Service.		●	●	●	●
Alert Notification	Reporter for Alert Notification Profile. Alert is notified to smartphone by pressing the button and status is indicated to UART.		●	●	●	●
Current Time	Client side for Current Time Service. Time data is received by pressing the button and it is indicated to UART.		●	●	●	●
Indoor Positioning	Initiator for Indoor Positioning Profile.	●			●	
	Acceptor for Indoor Positioning Profile.		●		●	
Location and Navigation	Server side for Location and Navigation Profile. The control from client side is output to UART.		●		●	●
Human Interface Device	Keyboard application for Human Interface Device (HID) over GATT profile. "hello" character is transmitted by pressing the button.		●	●	●	●
	Mouse application for Human Interface Device (HID) over GATT profile. Mouse pointer is moved to Upper, Lower, Left and Right. Apply Swift pairing (Simple pairing) function.		●	●	●	●
Object Transfer	Client side for Object Transfer Service (OTS).	●			●	●
	Server side for Object Transfer Service (OTS).		●		●	●
Bond Management	Server for Bond Management Service.		●		●	●
Nordic UART	Client side for Nordic UART Service (NUS). It automatically connects to peripheral device of NUS.	●			●	●
	Nordic UART Service (NUS) is controlled on console by Python script.		●		●	●
Apple Notification Center	Client side for Apple Notification Center Service (ANCS). Button operation and status is indicated to UART.		●	●	●	●

### **Step.1-2 Downloading & Installing Nordic nRF5 SDK**

Sample software provided by Nordic is bundled to nRF5 SDK provided by Nordic. nRF5 SDK can be obtained free of charge via the following link.

A blue rectangular button with a white border and a drop shadow, containing the word "Download" in white text.

Unzip the downloaded ZIP file to the arbitrary folder.

**[Note]** Do not use a long path in the deep hierarchy or a name containing double-byte characters for the folder where the file is unzipped.

### **Step.1-3 Installing LAPIS Technology's Sample Software**

If the sample software provided by LAPIS Technology is selected at Step.1-1, copy the software downloaded from the LAPIS Technology's wireless support site to the folder where the nRF5 SDK file was unzipped. For the folder to unzip the file, refer to the instruction manual of the sample software.

If the sample software provided by Nordic is selected, proceed to Step.2-4

## **Step.2 Software Development Environment Construction**

### **Step.2-1 Selecting Software Development Environment**

The following development tools can be used as the software build environment.

Segger Embedded Studio, which can be used free of charge, is recommended for the software development for Nordic chips.

The following part describes environment construction using Segger Embedded Studio as an example.

- SEGGER Embedded Studio
- Arm<sup>®</sup> Keil<sup>®</sup> MDK
- IAR Embedded Workbench (EWARM)
- gcc

### **Step.2-2 Installing Segger Embedded Studio**

Download Segger's IDE (Integrated Development Environment) "Embedded Studio for ARM" via the following link. This application is a tool to build and debug the software created by a customer. To write a HEX file after a build, proceed to Step.2-4.

A blue rectangular button with a white border and a drop shadow, containing the word "Download" in white text.

Execute the downloaded installation file. Perform the installation following instructions from the installer, and Embedded Studio and J-Link Device Driver will be installed.

### Step.2-3 Activating Segger Embedded Studio

To use Segger Embedded Studio, activation (license authentication) is required first. When Embedded Studio is started for the first time, the following window appears to notify that license authentication has not been done. The [Continue] button is pushed in this window.

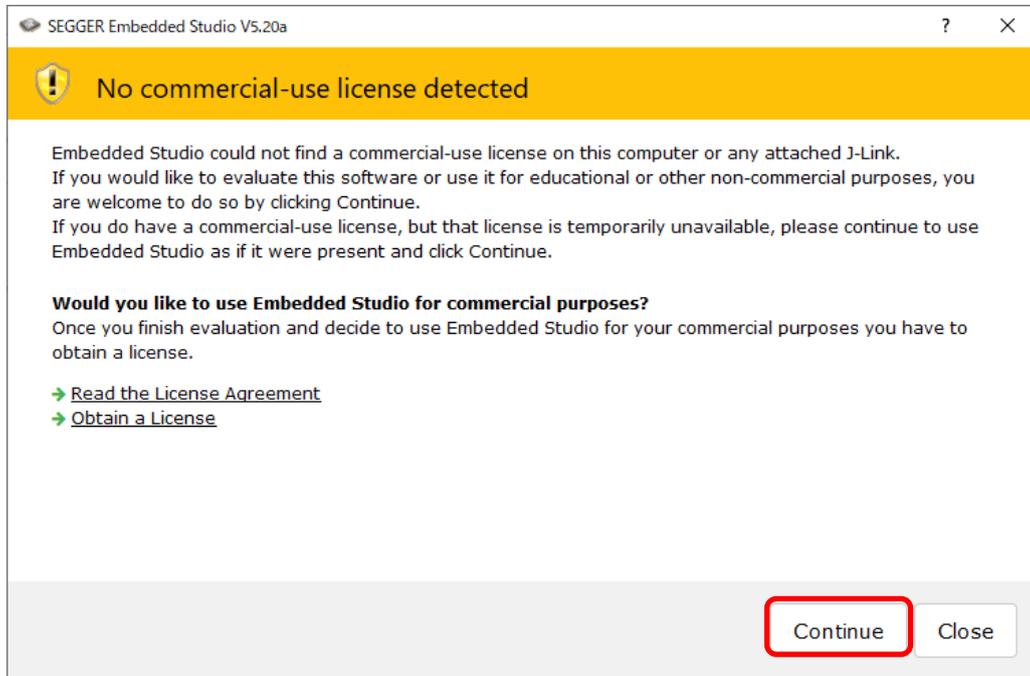


Figure. Initial Window Prompting User to Perform Activation

The activation can be done from the following link.

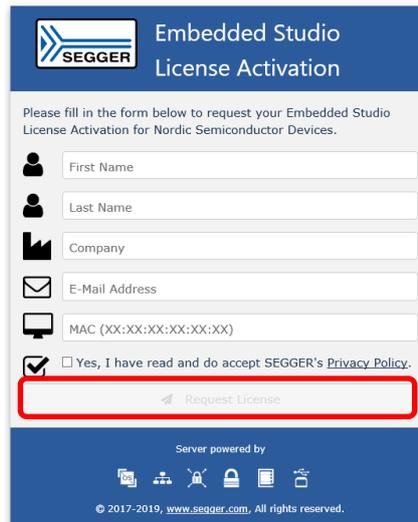


MK715x1 is equipped with a Nordic chip, and therefore the free license applies. For this detail, refer to the following link.



After entering the required items in the following activation window, the [Request License] button becomes active. Click the button. The activation key will be sent to the specified email address.

**[Note]** An error may occur when "Co., Ltd." is attached to the company name.



**Embedded Studio License Activation**

Please fill in the form below to request your Embedded Studio License Activation for Nordic Semiconductor Devices.

First Name

Last Name

Company

E-Mail Address

MAC (XX:XX:XX:XX:XX)

Yes, I have read and do accept SEGGER's [Privacy Policy](#).

Server powered by

© 2017-2019, [www.segger.com](http://www.segger.com). All rights reserved.

Figure. Activation Window

For the entering MAC address, the MAC address of the PC used needs to be checked and entered. Select [Tools] -> [License Manager...] from the Embedded Studio menu and then select [Diagnose Problems] in the [License Manager] window to check the MAC address of the PC used.

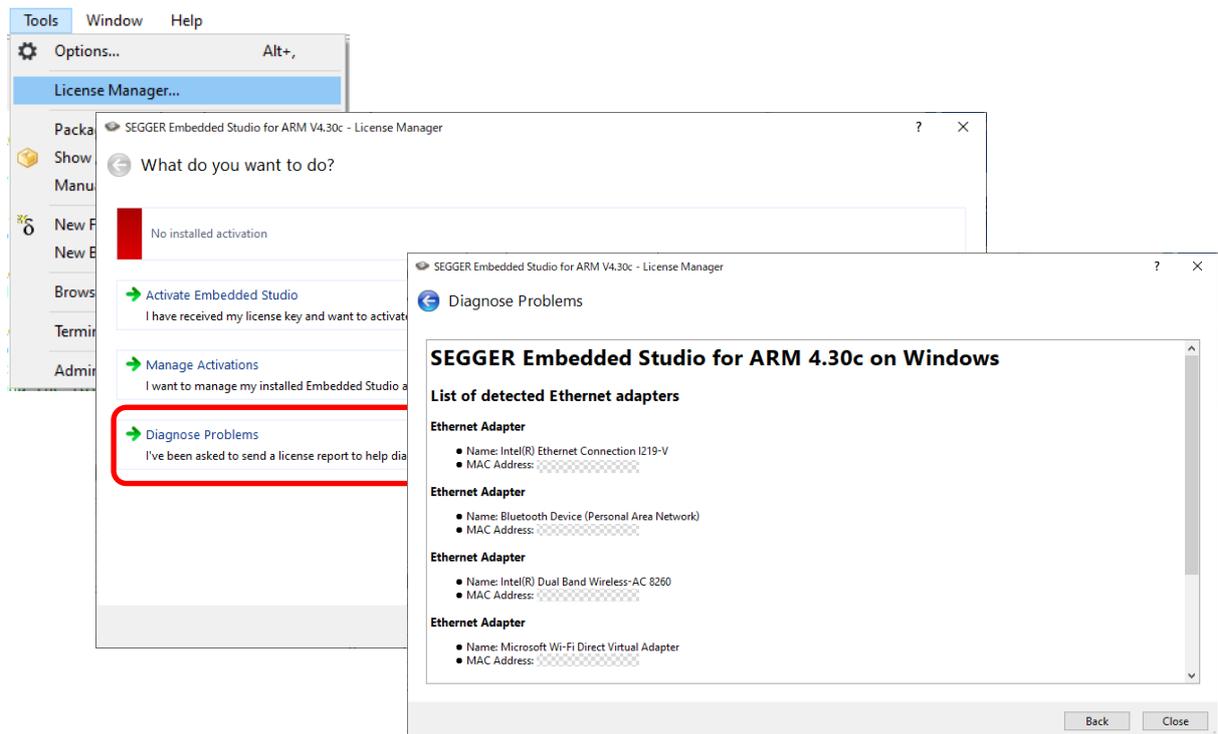


Figure. MAC Address Confirmation Window

Copy the activation key specified in the email sent from Segger with Ctrl + C. Select [Tools] -> [License Manager...] from the Embedded Studio menu and then select [Activate Embedded Studio] in the [License Manager] window. The [License Manager] window will be displayed with the activation key entered. Click the [Install License] button located in the lower left section.

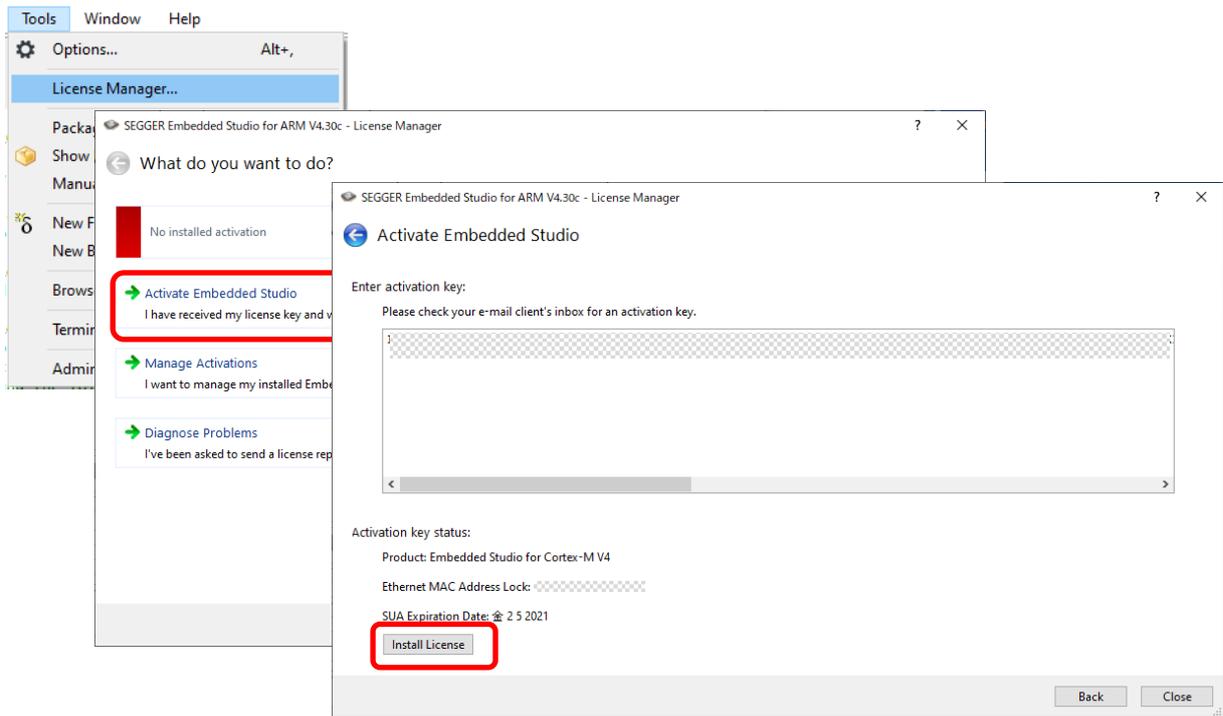


Figure. License Key Input Window

When the license installation is performed successfully, the following window is displayed.

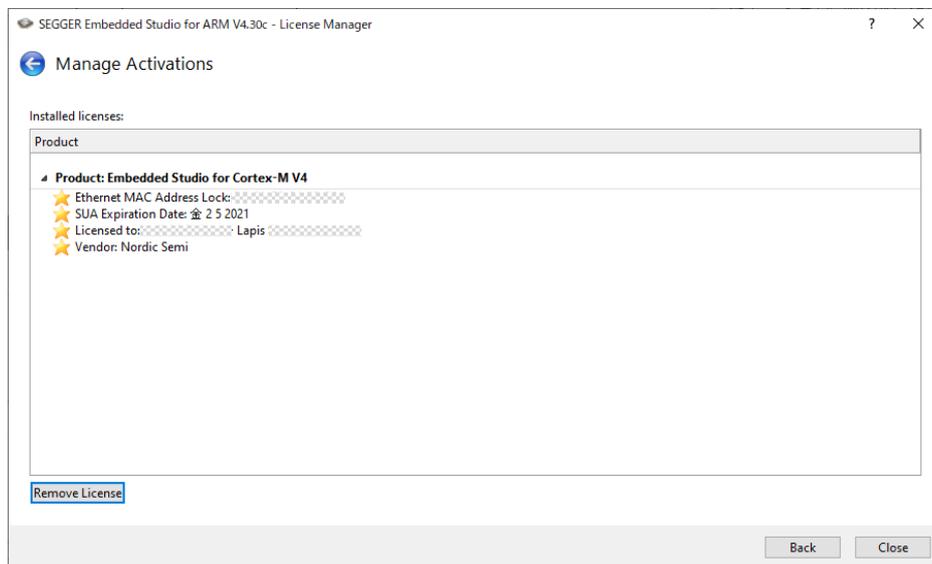


Figure. Window Displayed after License Key Input

The display at the top of the Embedded Studio window also shows that the license has been obtained as shown below.

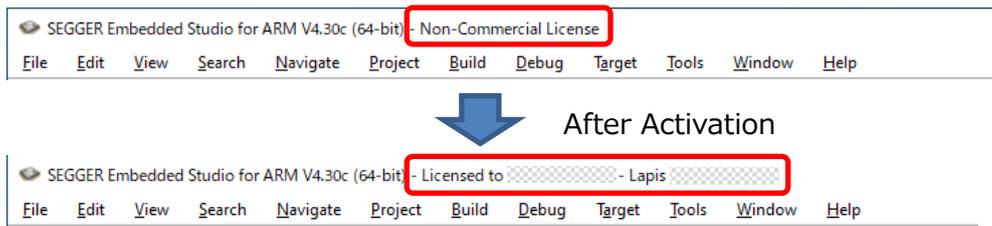


Figure. Display Examples before and after Activation

**[Note]** There may be a case that the display at the top of the Embedded Studio window does not change from "Non-Commercial License" after activation. In this case, license authentication will be reflected by opening the sample software project (for example, the following project) included in nRF5 SDK installed in Step.1-2. For how to open the project file, refer to Step.3-1. "**<nRF5 SDK>**" indicates the path to the folder where nRF5 SDK was installed.

[Example]

```
<nRF5 SDK>\examples\ble_central\ble_app_blinky_c\pca10040\s132\ses\
ble_app_blinky_c_pca10040_s132.emProject
```

#### **Step.2-4 Installing nRF Connect for Desktop**

Download Nordic's development application "nRF Connect for Desktop" via the following link. The "Programmer" in "nRF Connect for Desktop" is a tool to write an application or SoftDevice to the Flash ROM mounted on MK715x1 and delete or verify it.



Execute the downloaded installation file. "nRF Connect for Desktop" is installed, and it is started automatically. Next, execute the installation of "Programmer" with the "Install" button of "Programmer" of "nRF Connect for Desktop".

## Step.3 Customer's Application Development

### Step.3-1 Coding Application Program

Using Embedded Studio installed in Step.2-4, perform coding of an application. To use the sample software as it is, proceed to Step.3-4.

After starting Embedded Studio, select [File] -> [Open Solution...] from the menu. When the project file selection window opens, select a desired project file (\*.emProject) and then click the [Open] button. When the project opens, select a source code from the left pane of GUI and correct it as needed.

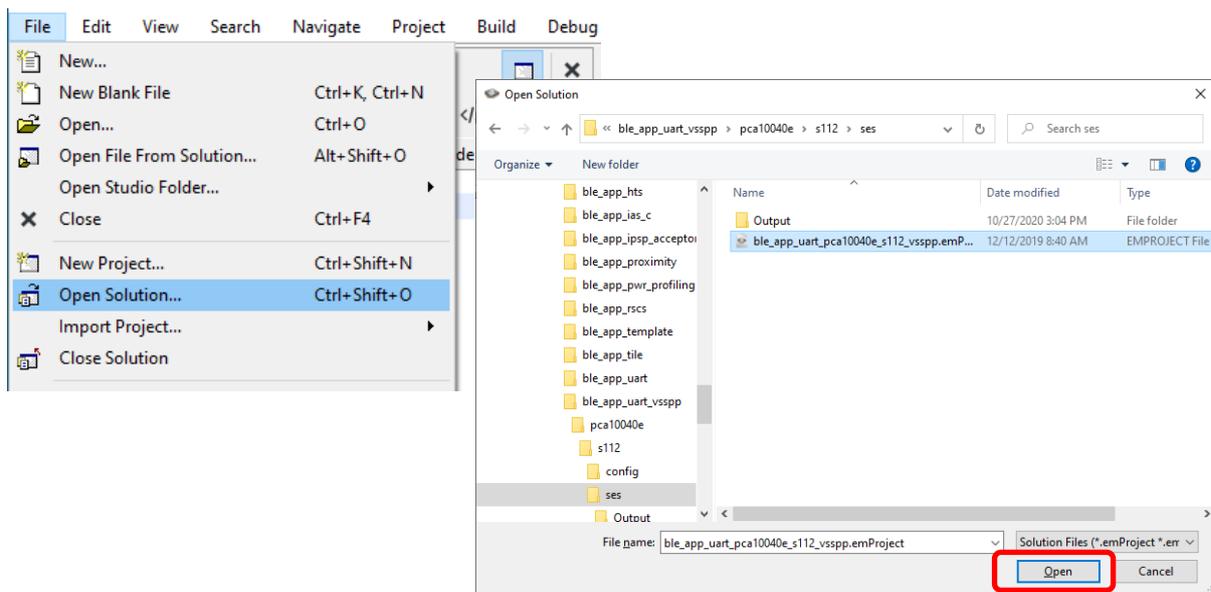


Figure. Opening Project File

The sample software included in Nordic nRF5 SDK is stored in the following folder. "<nRF5 SDK>" indicates the path to the folder where nRF5 SDK was installed.

Table. nRF5 SDK Sample Software Storage Folder

Storage folder	Sample software type
<nRF5 SDK>\examples\ble_peripheral	For peripheral device
<nRF5 SDK>\examples\ble_central	For central device
<nRF5 SDK>\examples\ble_central_and_peripheral	For both peripheral and central devices

Storage folders of various types of sample software exist under the above folders.

### Step.3-2 Building Application Program

When coding of an application is completed, perform a build.

From the Embedded Studio menu, select [Build] -> [Build <project name>] to start a build. When the build is completed normally, "Build complete" is displayed in the lower pane of GUI.

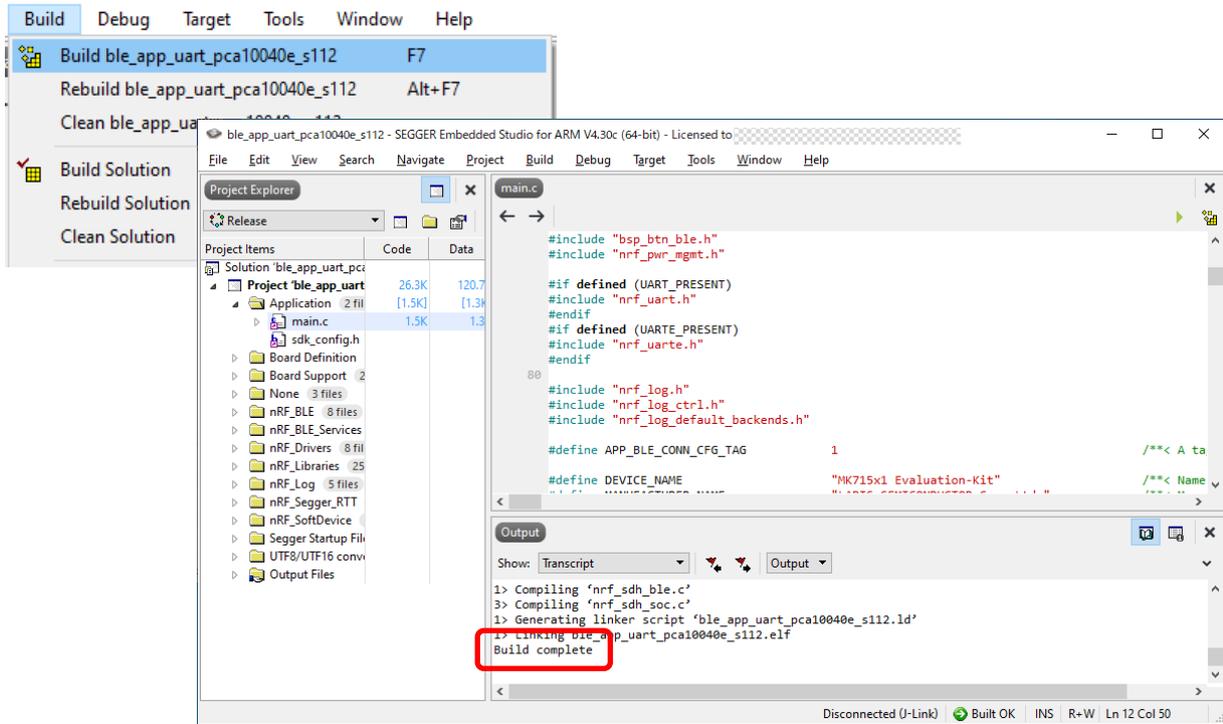


Figure. Building Project

**Step.3-3 Writing Application Program**

When building of an application is completed, perform writing to the evaluation /development board. The evaluation board and J-Link are connected to PC by USB connection. The figure below is connected externals at using MK71521EK1 and J-Link LITE. The Pin No.1 is connected with the red line of cable.

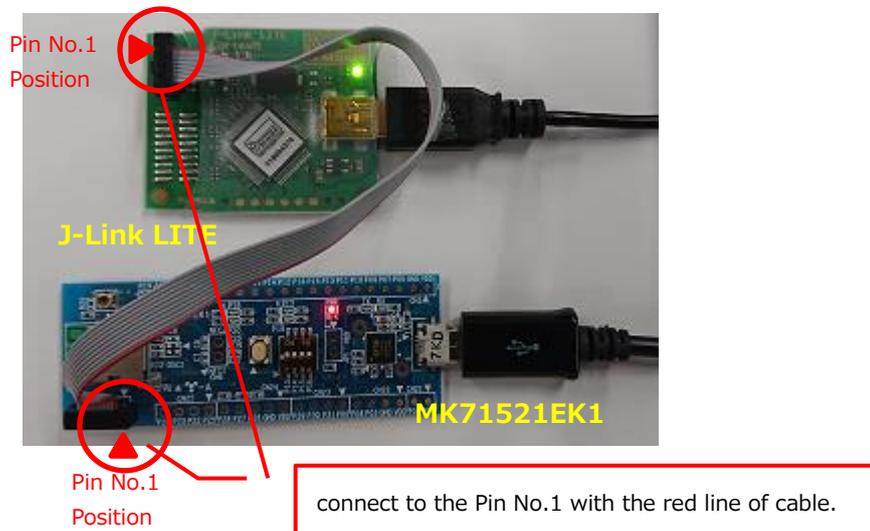


Figure. Connecting MK715x1 Evaluation Kit with J-Link LITE

From the Embedded Studio menu, select [Target] -> [Connect J-Link]. The display at the bottom of the GUI window changes from "Disconnected (J-Link)" as shown in the following figure.

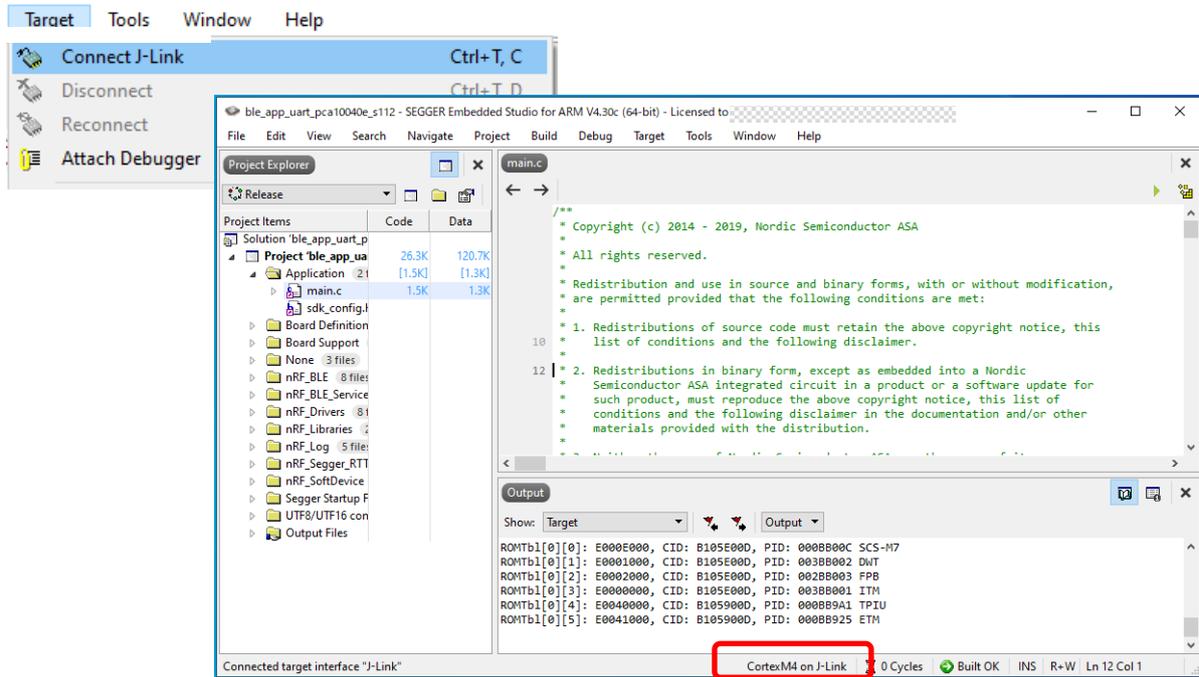


Figure. Connecting J-Link with Target Board

From the Embedded Studio menu, select [Target] -> [Erase All] to erase the Flash ROM. The following message will be displayed in the lower pane of GUI.

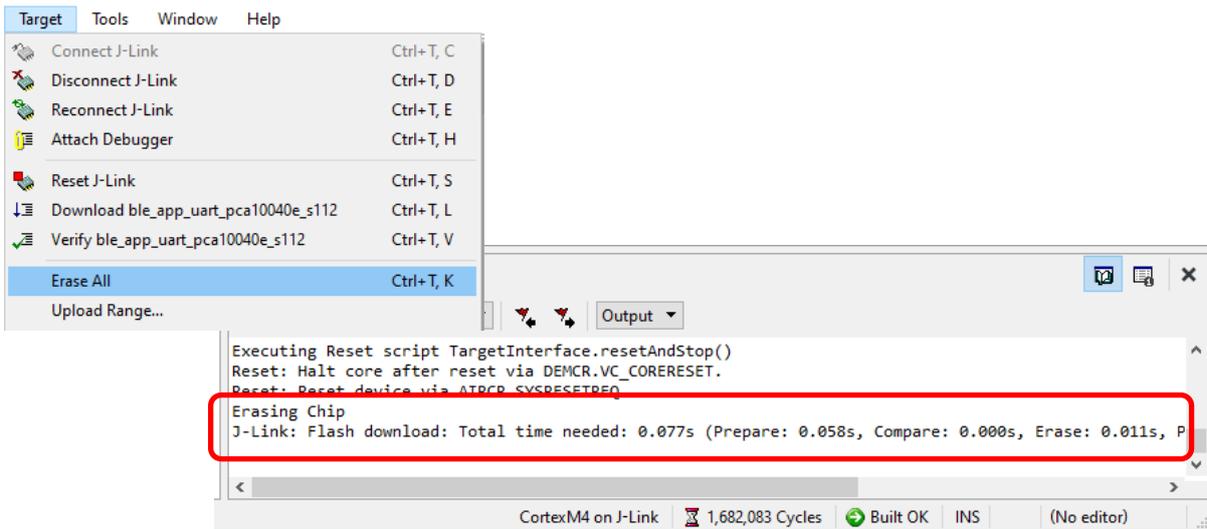


Figure. Erasing Flash ROM

From the Embedded Studio menu, select [Target] -> [Download <project name>] to perform writing to the Flash ROM. The application program and SoftDevice will be written.

When writing is completed, "Download successful" will be displayed in the lower pane of GUI, and the written application program will be executed automatically.

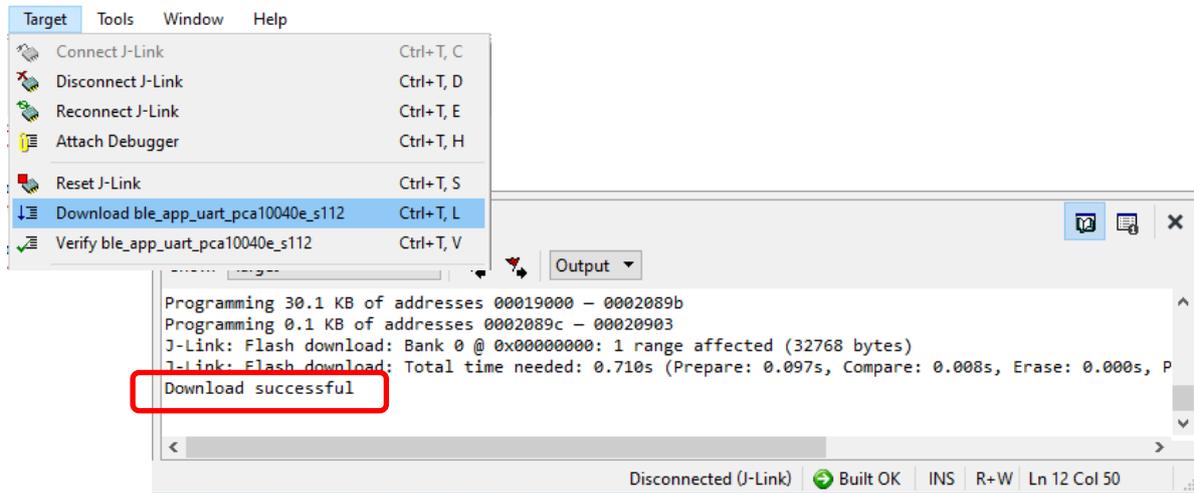


Figure. Writing Program with Embedded Studio

### Step.3-4 Writing Built Program

Programmer of nRF Connect for Desktop installed by Step.2-4 is used for writing builded application program and SoftDevice. The connection of the evaluation board and J-Link LITE is similar to Step.3-3.

First of all, Programmer is started from nRF Connect for Desktop, Programmer is connected with J-Link LITE by "Select device" on the left of GUI.

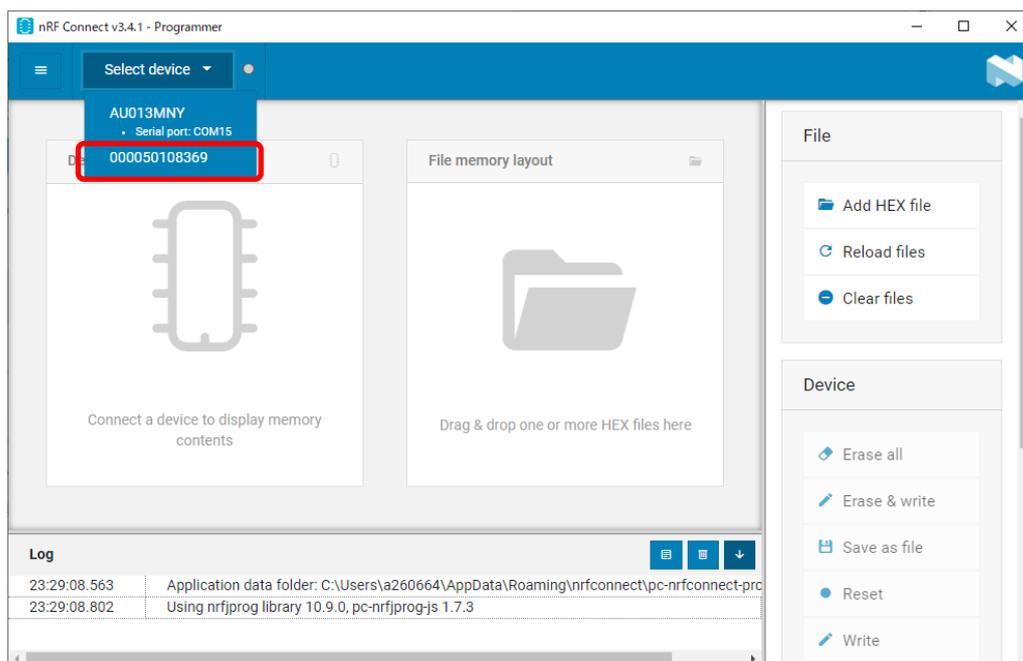


Figure. Connect Programmer and J-Link LITE

Next, the application program and SoftDevice are read to Programmer. The [Add HEX file] button in the window is pressed, the HEX file of the application program and SoftDevice is selected. The memory layout of the HEX file is displayed in the "File memory layout" area when succeeding in reading the HEX file.

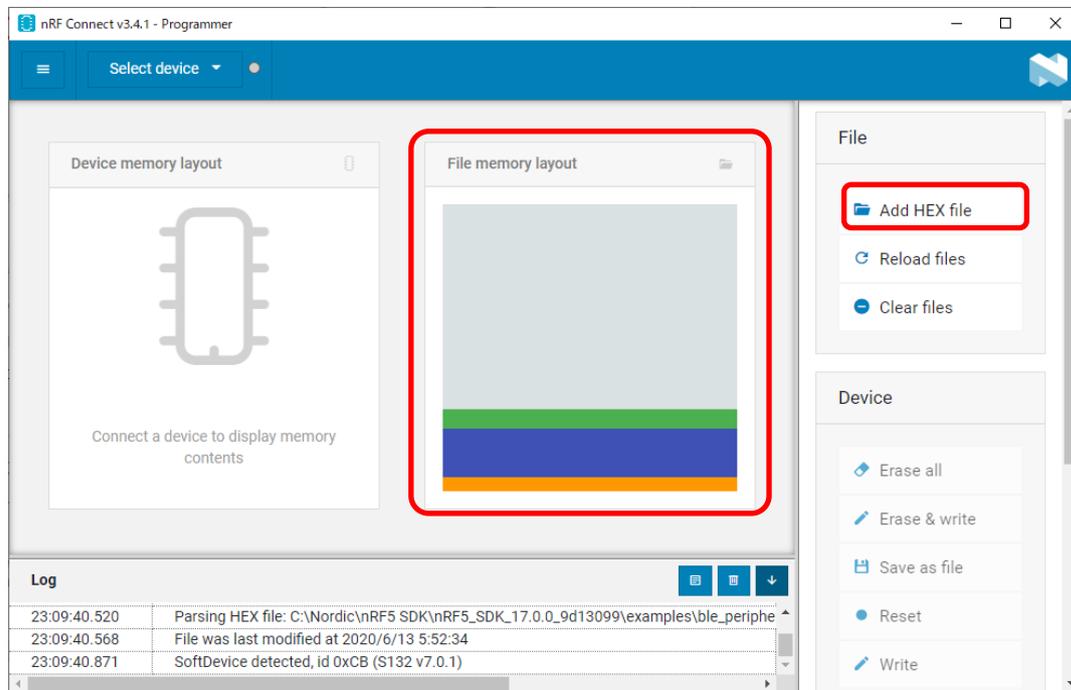


Figure. Read application program / SoftDevice with Programmer

The sample software included in Nordic nRF5 SDK is stored in the following folder.

Table. nRF5 SDK Sample Software Storage Folder

Storage folder	Sample software type
<nRF5 SDK>%examples%ble_peripheral	For peripheral device
<nRF5 SDK>%examples%ble_central	For central device
<nRF5 SDK>%examples%ble_central_and_peripheral	For both peripheral and central devices

"<nRF5 SDK>" indicates the path to the folder where nRF5 SDK was installed.

The HEX file of the application program is prepared in the "hex" folder under two hierarchies of the above-mentioned folder.

[Example] <nRF5 SDK>%examples%ble\_peripheral% ble\_app\_alert\_notification%hex

Refer to the manual attached to each sample software For HEX being offered from LAPIS Technology.

Because the HEX file of Nordic sample software is included of application program and SoftDevice, the reading operation is executed once. But, Programmer needs to add the HEX file for SoftDevice because the created HEX file according to Step.3-2 procedure does not include SoftDevice

The HEX file of SoftDevice is stored in the following folder. Identification number of SoftDevice of application program is confirmed, and SoftDevice is selected.

SoftDevice folder : **<nRF5 SDK>**¥components¥softdevice¥sXXX¥hex

SoftDevice HEX file: sXXX\_nrf52\_Y.Y.Y\_softdevice.hex

"**<nRF5 SDK>**" is installed folder path for RF5 SDK. "XXX" and "Y.Y.Y" are identification number and version for SoftDevice.

Next, the application program and SoftDevice are written from Programmer. Writing is executed by [Erase & write] button. Writing is completed after a few seconds pass, and the memory layout of the written program is displayed in the "Device memory layout" area.

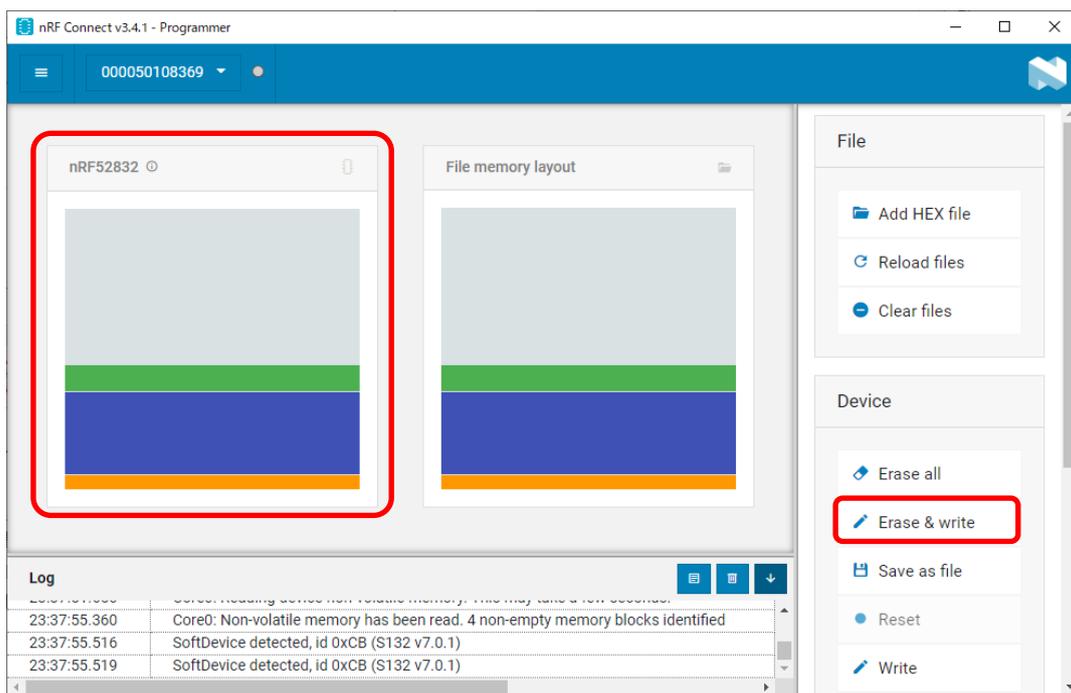


Figure. Write Application program / SoftDevice with Programmer

Finally, Programmer and J-Link LITE are disconnected by [Close device] on the left of GUI of Programmer.

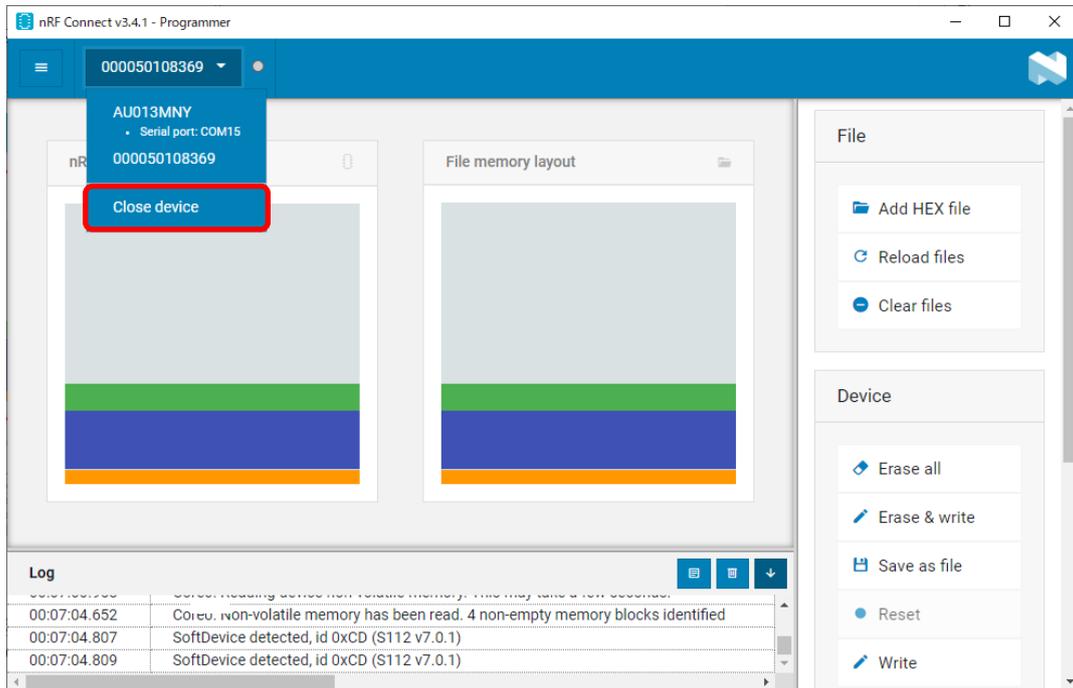


Figure. Disconnect to Programmer and J-Link LITE

### **Step.3-5 Checking the Operation of Application Program**

Check the operation of an application program. "BLE Tool", which is the application for smartphone/tablet terminal, is available for the case of using LAPIS Technology's sample software for serial communication. Refer to the following link and download the application to a smartphone/tablet terminal as needed.

Download

For "nRF Connect for Mobile" which is the application for Nordic smartphone/tablet terminal, refer to the following link.

Download

## Conclusion

The whole image of the software development environment that has been explained so far is shown below. Of course, the customer's board for the peer device can be used though the peer device is the smartphone.

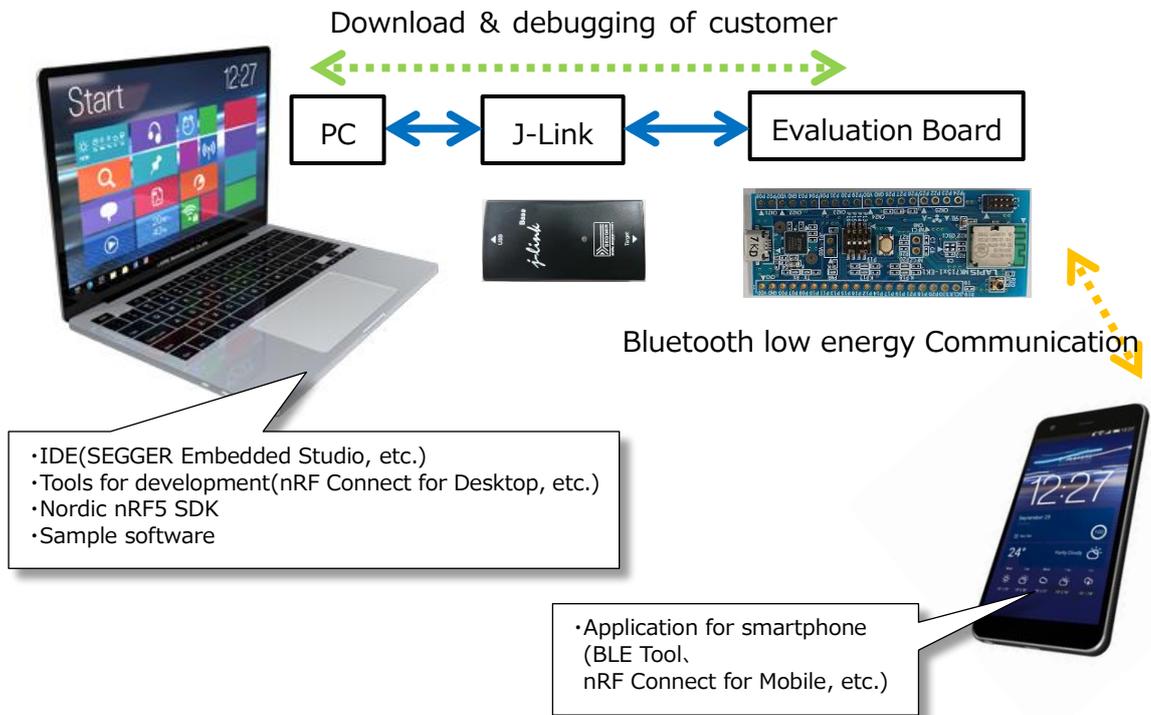


Figure. Software Development Environment