How to port the NFC Reader Library to K64F

Jordi Jofre (Speaker)
Angela Gemio (Host)

Webinar instructions

Audio settings:

- You are in “listen only” mode due to possible background noise
- Set mic & speakers option (headset + external mic advised)

For questions:

- Write them in section “Questions” of your GoToWebinar panel
- The host will receive and compile them for the Q&A time

Materials will be made available to you

The session will be recorded for on-demand viewing

Please answer the evaluation questions after session.

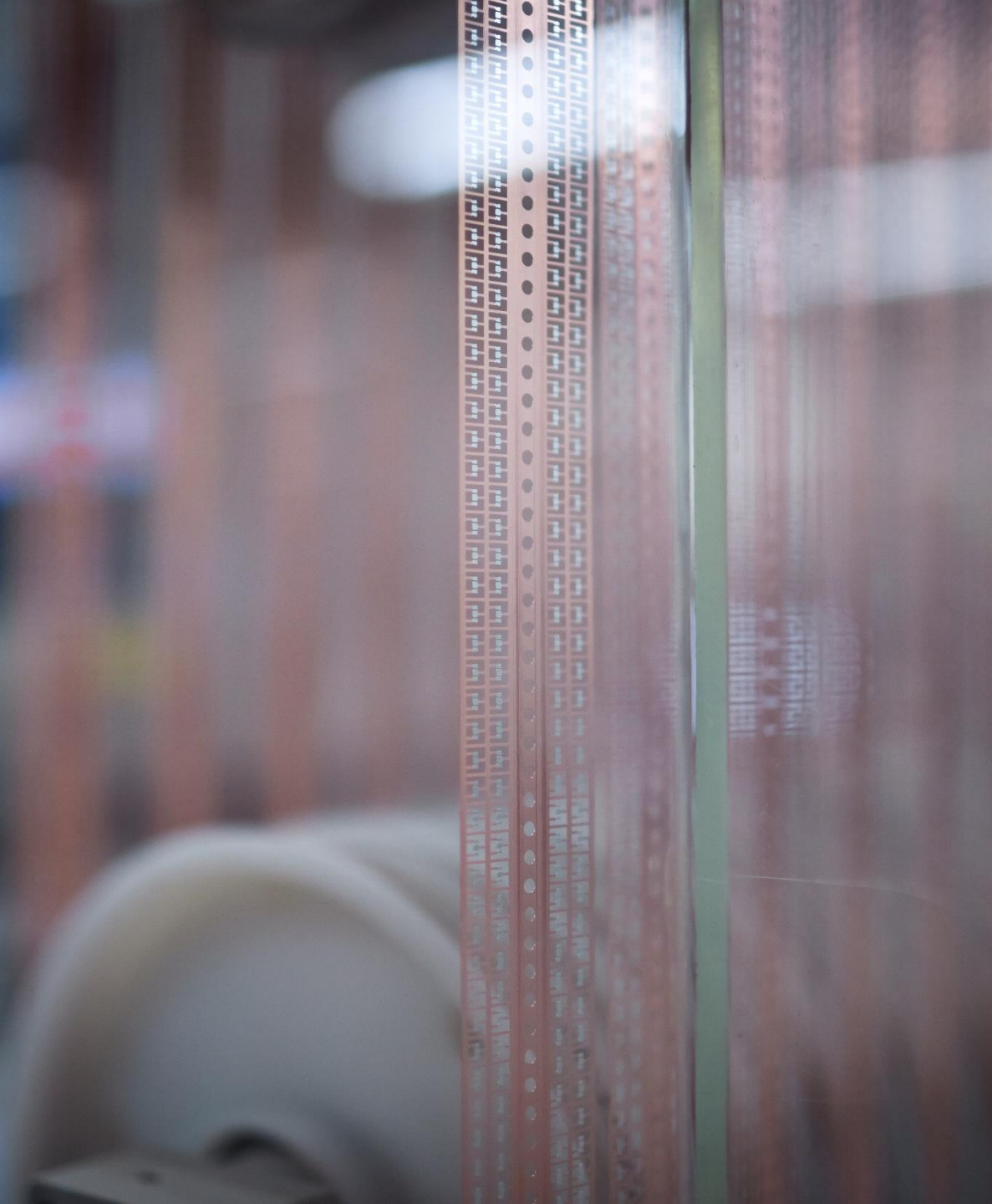
Scheduled sessions for 11/10/2017
10:00 am - 10:30 am CET
05:00 pm - 05:30 pm CET

HOW TO PORT THE NFC READER LIBRARY TO K64F

WEBINAR SERIES:
NFC SOFTWARE INTEGRATION

JORDI JOFRE
NFC READERS
NFC EVERYWHERE
11/10/2017

SECURE CONNECTIONS
FOR A SMARTER WORLD



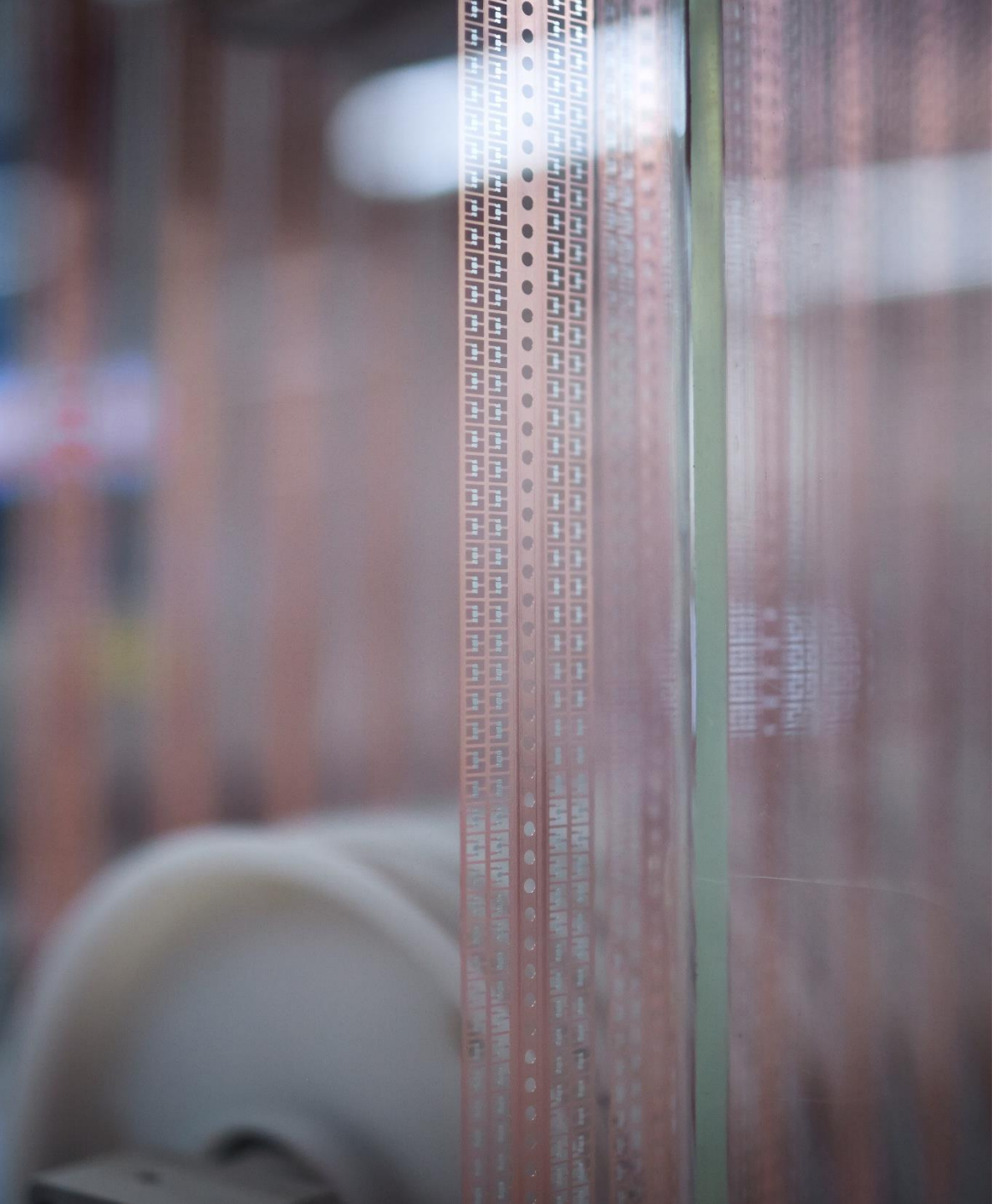
Agenda

NFC software integration webinar series

Session I, 14th September
How to integrate NFC frontends in Linux.

Session II, 28th September
How to integrate NFC controllers in Linux.

Session III, 11th October
How to port the NFC Reader Library to K64F.



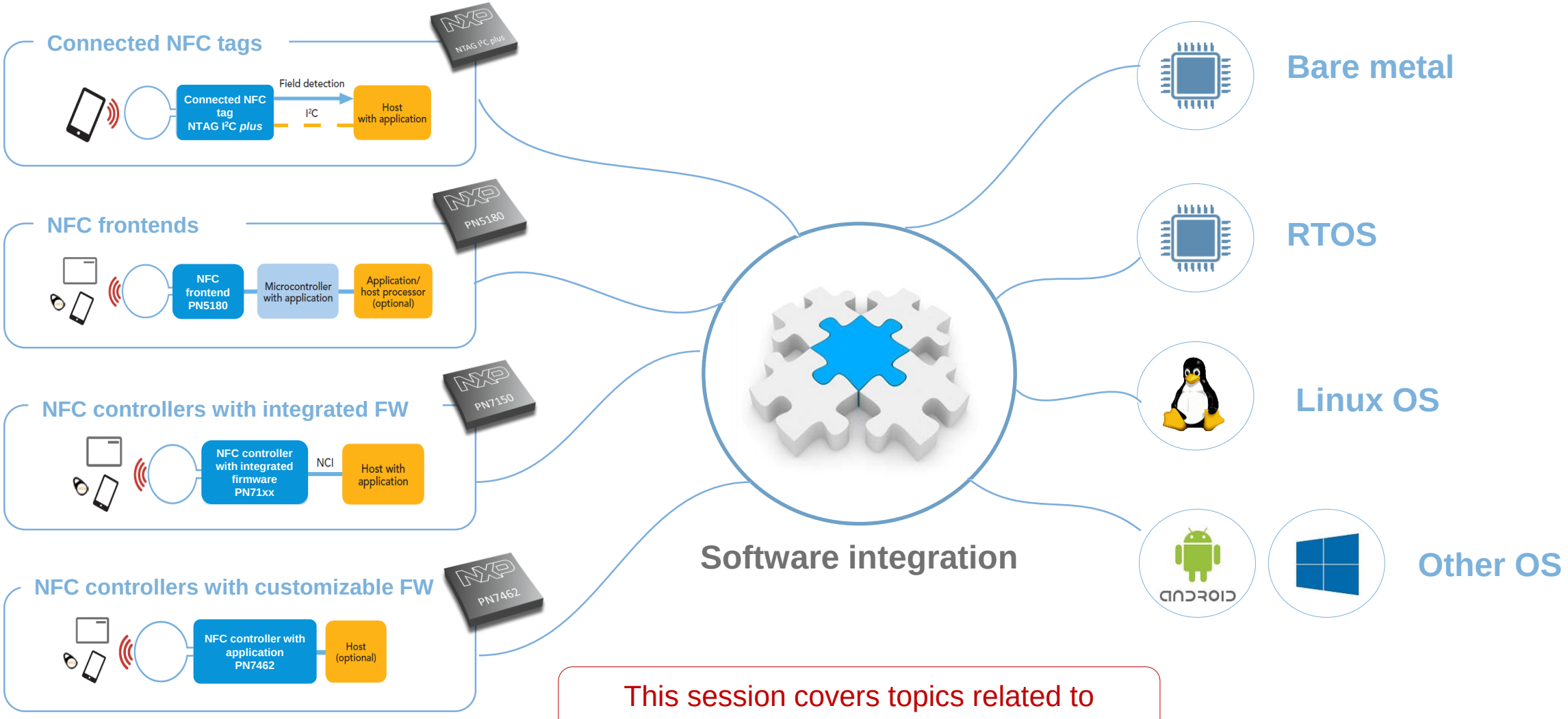
Agenda

NFC software integration webinar series

Session III, 11th October
How to port the NFC Reader Library to K64F

- NFC Reader Library positioning and architecture
- **Hands-on:** NFC Reader Library porting to K64F.
- General considerations to port NFC Reader Library to your target MCU.
- Q&A

NXP software support for NFC integration in any platform



This session covers topics related to NFC reader software integration in bare metal and RTOS systems.

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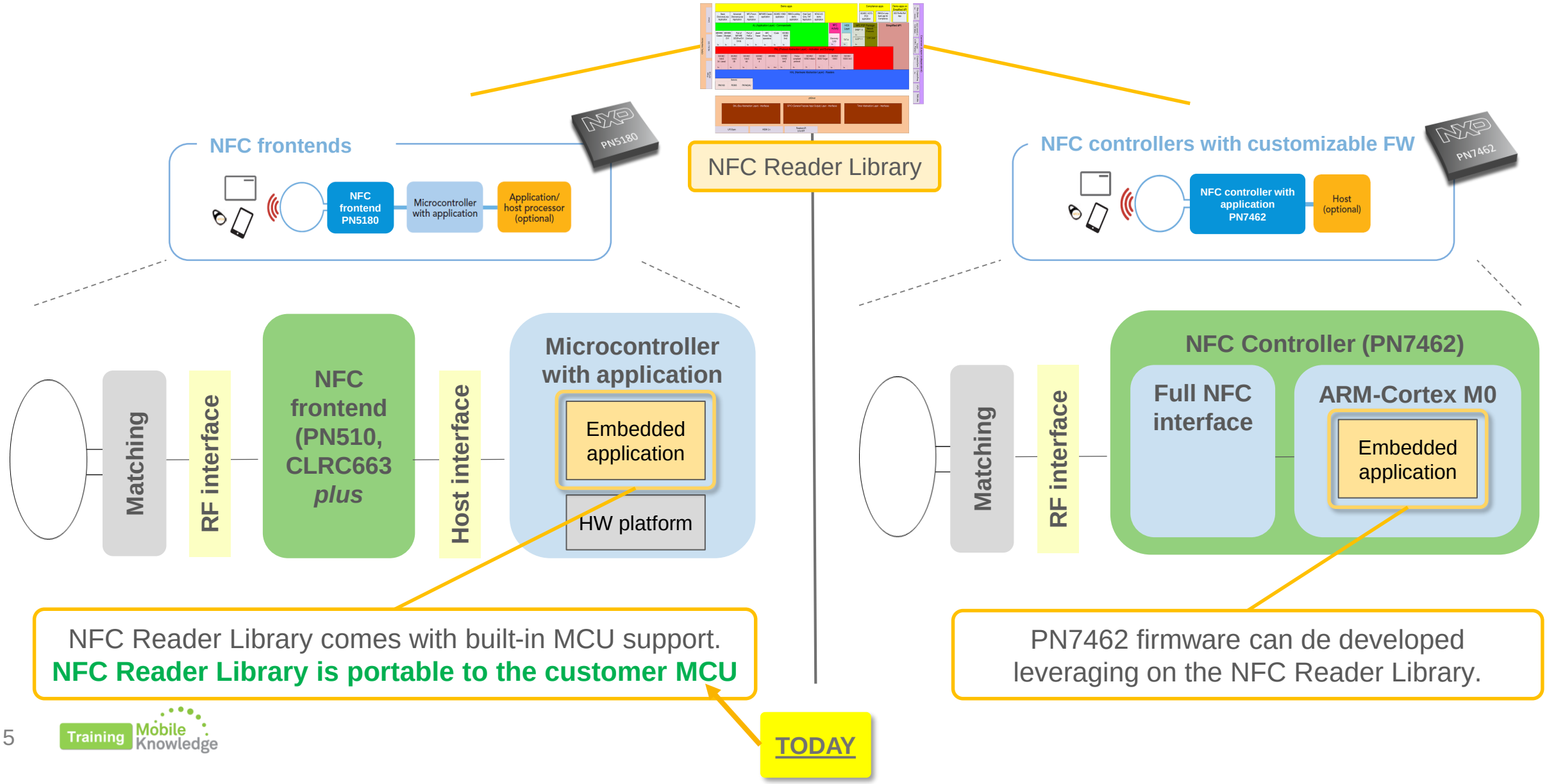
NFC Reader Library integration for RTOS and non-RTOS systems



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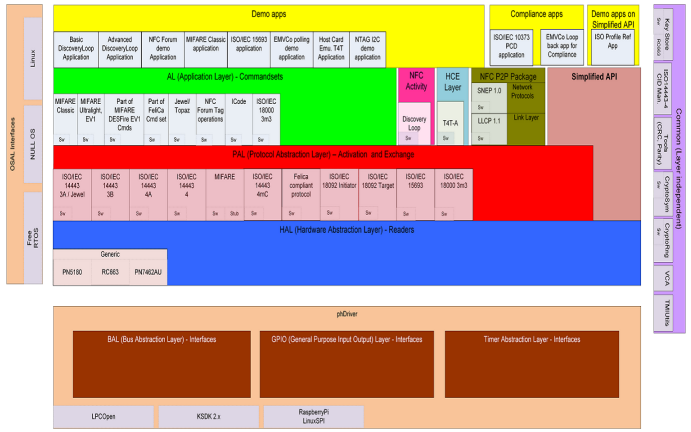
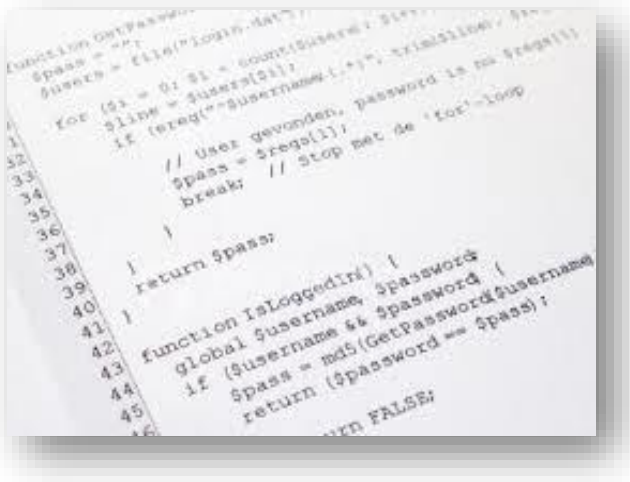
NFC Reader Library contents and architecture

NFC Reader Library release contents

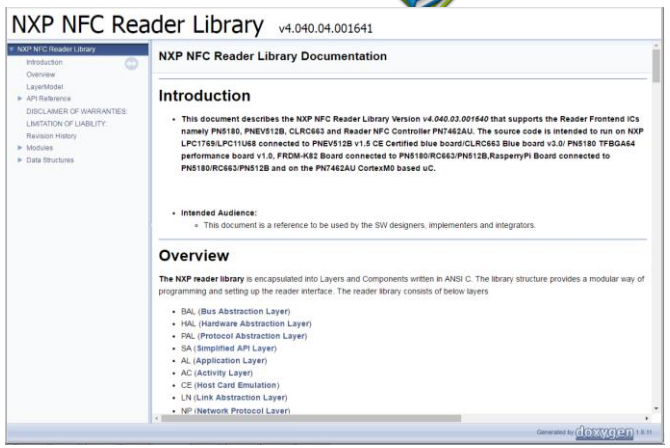
NFC Reader Library API



Software examples



Documentation



NFC Reader Library API:

- Freely downloadable.
- Full implementation of all NFC protocols
- NDA version with full support for MIFARE DESFire EV2 and MIFARE Plus EV1
- SW package for MCUXpresso

Software examples:

- BasicDiscoveryLoop
- AdvancedDiscoveryLoop
- NFCForum
- MIFARE Classic
- ISO15693
- EMVCo Loopback
- ….

Documentation:

- API documentation
- Generated from source file annotations
- Provided as HTML document

Info and more information: www.nxp.com/pages/:NFC-READER-LIBRARY

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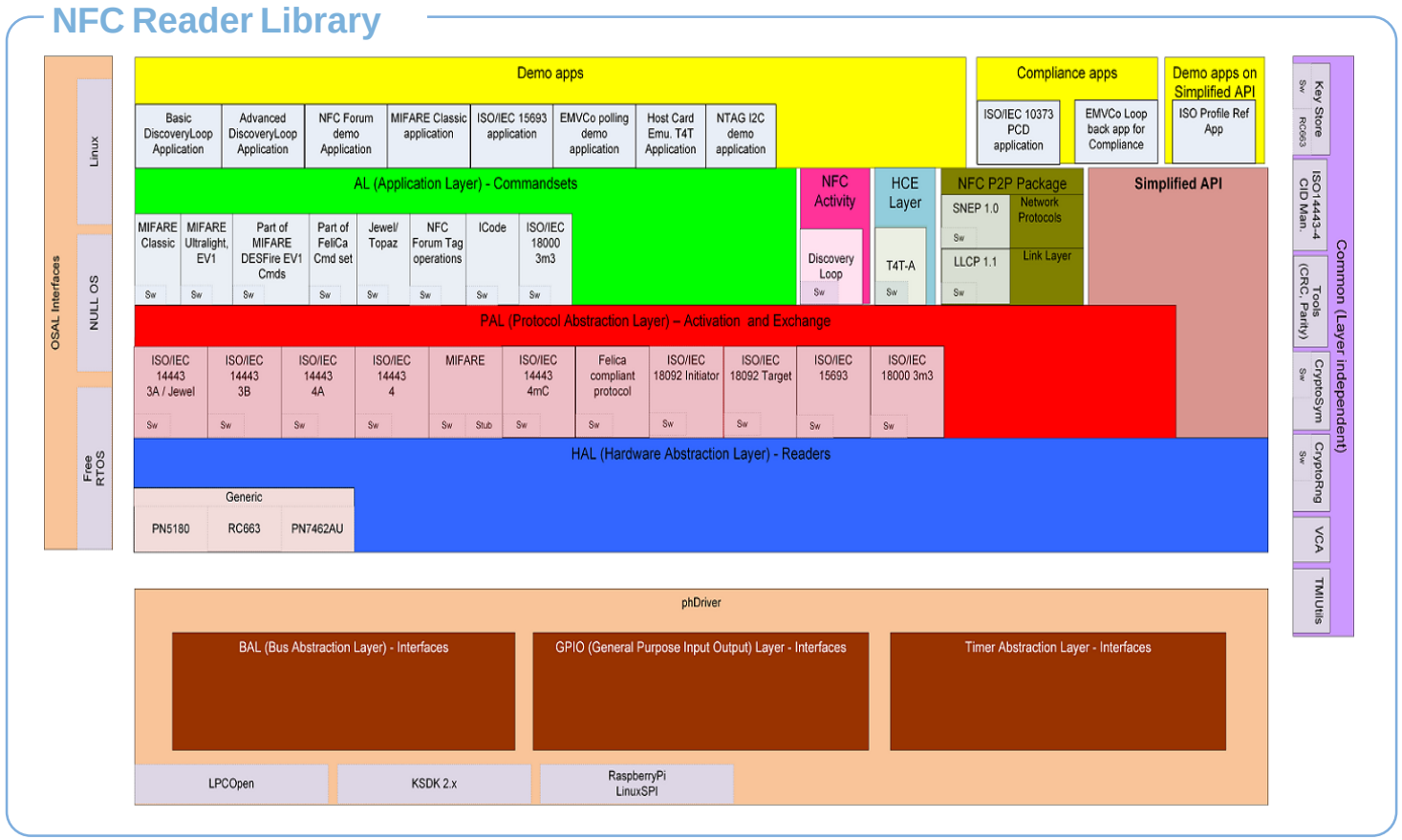
NFC Reader Library support for multiple products and platforms



Supported products:*

- CLRC663 *plus*
- PN5180
- PN7462AU

Supported dev boards:*

- CLEV6630B
- PNEV5180B
- PNEV7462B

Supported platforms:*

- LPC1769, LPC11U68
- FRDM-K82F
- Raspberry Pi Model 3
- *… and portable to other MCUs and platforms.*

Info and more information: www.nxp.com/pages/:NFC-READER-LIBRARY

* NFC Reader Library v5.02.00

Today, we port NFC Reader Library to FRMD-K64F board !

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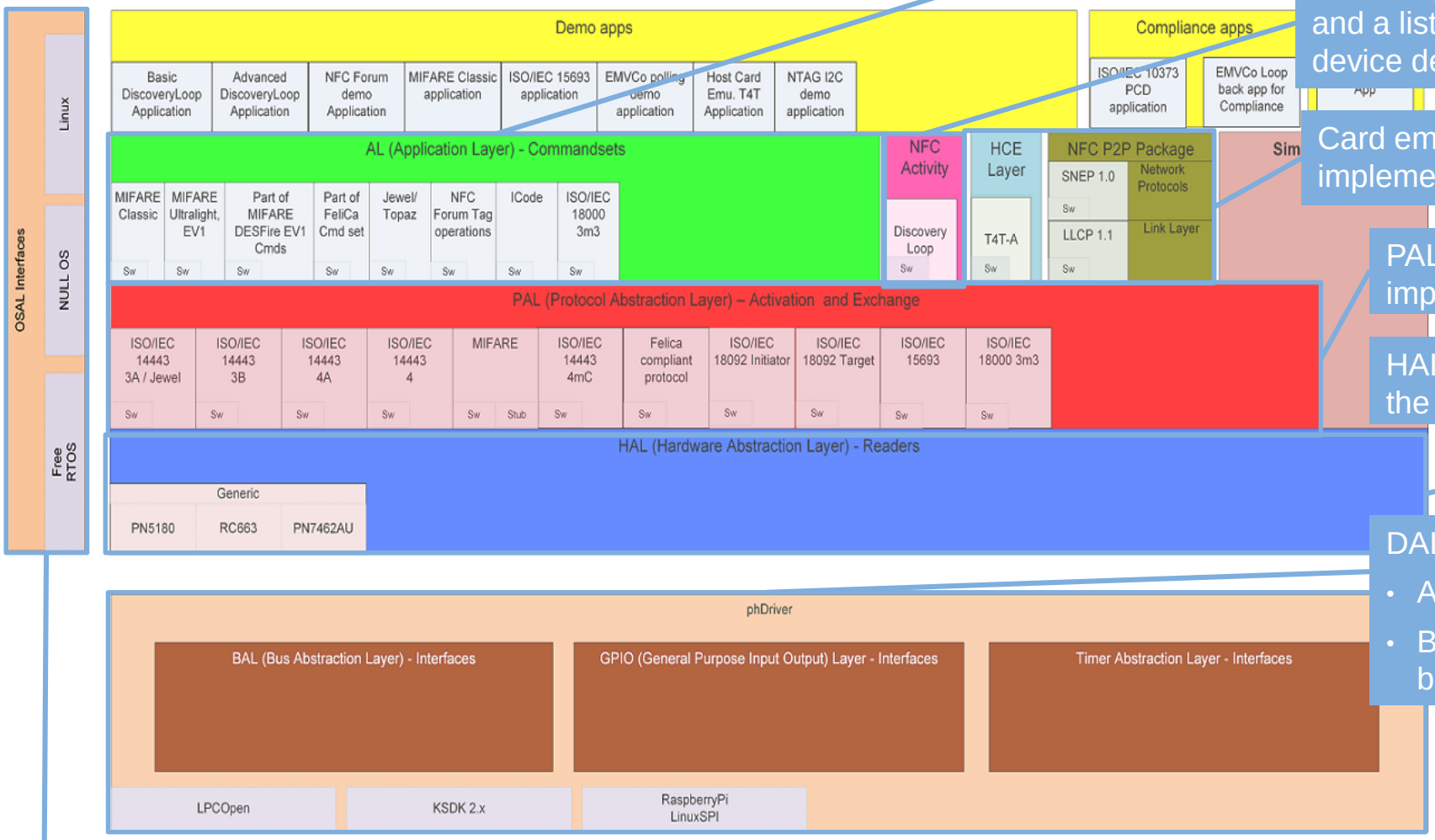
NFC Reader Library architecture



AL contains application-specific implementations for various contactless cards (card command sets)

Discovery loop component implements a poll mode* and a listen mode** for contactless card and NFC device detection

Card emulation (HCE) and P2P NFC modes implementation

PAL components contain hardware-independent implementations of contactless protocols

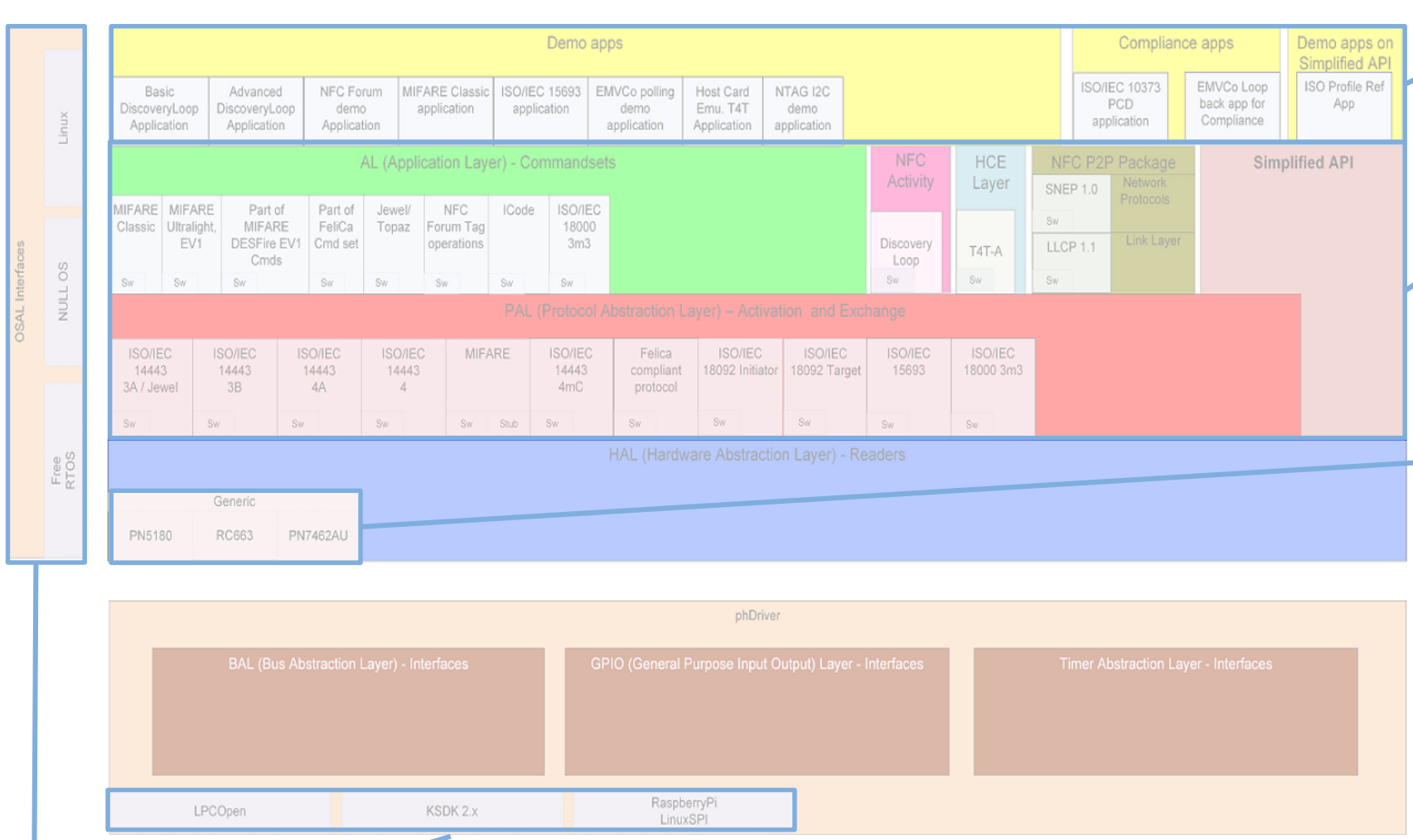
HAL components abstract the functionality of the NFC reader IC to a generic interface

DAL provides:

- API to abstract MCU GPIO functionalities
- BAL abstraction layer for the interface between host MCU and the NFC reader IC

OSAL which abstracts the OS simplifying development in multiple SW platforms

NFC Reader Library architecture (II)



11 software examples available to be tested and re-used.

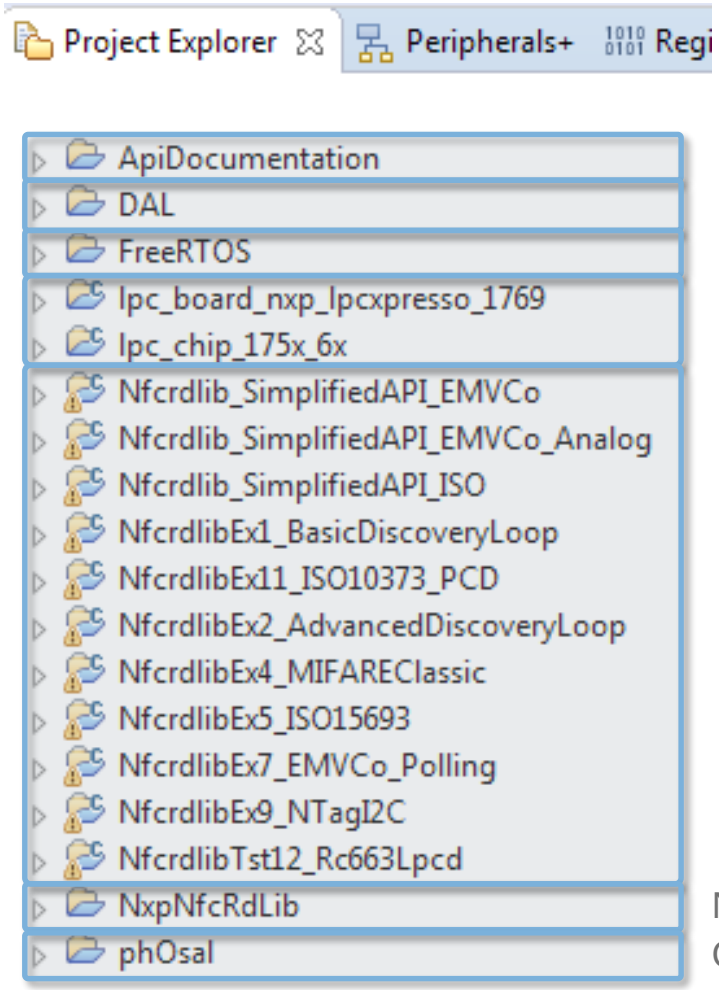
AL and PAL layers are **hardware and platform independent**, so they can be used on top of any supported NFC IC and MCU since they have no adaptation

HAL is **platform independent**, so NXP NFC readers can be used on top of any MCU since they have no adaptation

The software examples can be imported and run the supported platforms without any adaptation.

Support for other platforms requires adaptations in OSAL and DAL.

NFC Reader Library structure



API documentation
Driver abstraction layer
FreeRTOS support

Platform support

NFC Reader Library examples

NFC Reader Library source code
OS abstraction layer

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NFC Reader Library porting to K64F

Main steps

Main steps for NFC Reader Library porting to FRDM-K64F

NFC Reader Library package for FRDM-K82F

Without FRDM-K64F support

Prepare the HW for software development.

Get the SDK package for FRDM-K64F board with MCUXpresso Config tools.

Set up MCUXpresso workspace.

Change project configuration settings in the SW examples ported.

Code changes for adding FRDM-K64F support in DAL and adapt application HW initialization instructions.

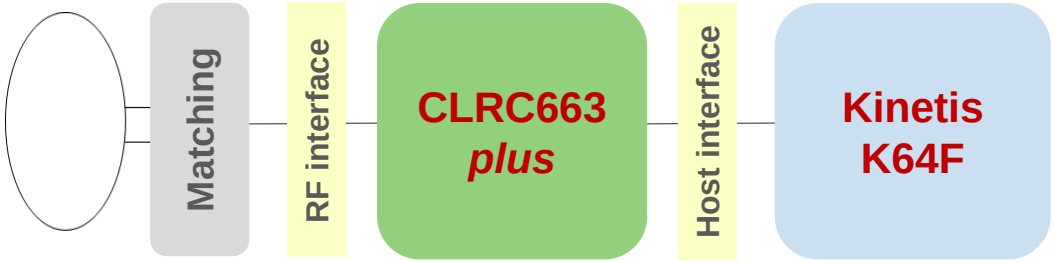
With FRDM-K64F support

NFC Reader Library porting to K64F

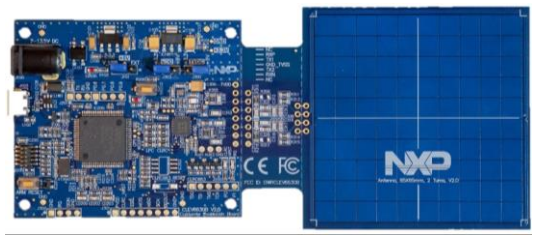
Setup

HW design:

We select CLRC663 *plus and* Kinetis K64F ICs for designing an NFC reader



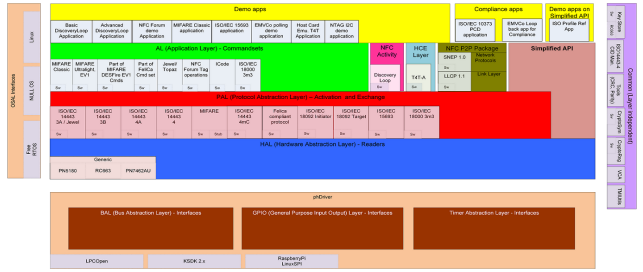
Prototype with NXP reference dev boards



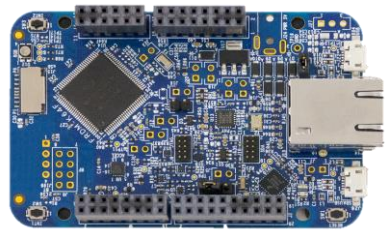
CLEV6630B

SW development:

NFC Reader Library supports CLRC663 *plus* but no driver is available for K64F



Port NFC Reader Library to K64F host MCU



FRDM-K64F

Key message: NFC Reader Library SW stack can be easily adapted to support your target MCU!

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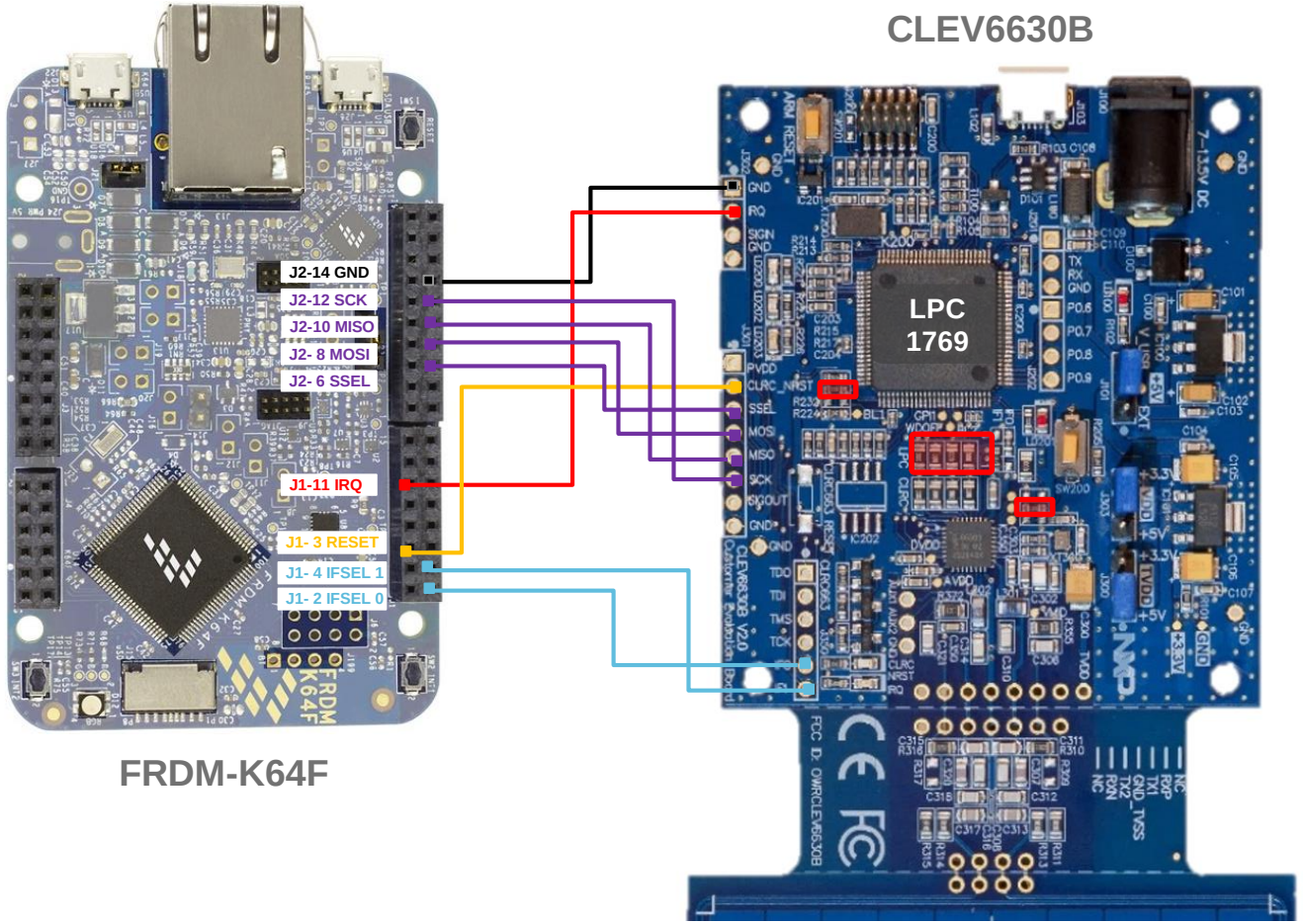
NFC Reader Library porting to K64F

Setting up the hardware

CLEV6630B board wiring with FRDM-K64F board

Pin function	FRDM-K64F	CLEV6630B
MOSI	J2-8	MOSI
MISO	J2-10	MISO
SCK	J2-12	SCK
SSEL	J2-6	SSEL
RESET	J1-3	CLRC_NRST
IRQ	J1-11	IRQ
IFSEL0	J1-2	IF0
IFSEL1	J1-4	IF1
GND	J2-14	GND



Resistors that need to be removed to decouple the LPC1769 MCU from CLEV6630 and connect K64F MCU. Described in AN11908 doc.

Key message: CLEV6630B boards enables easy connection to your target MCU!

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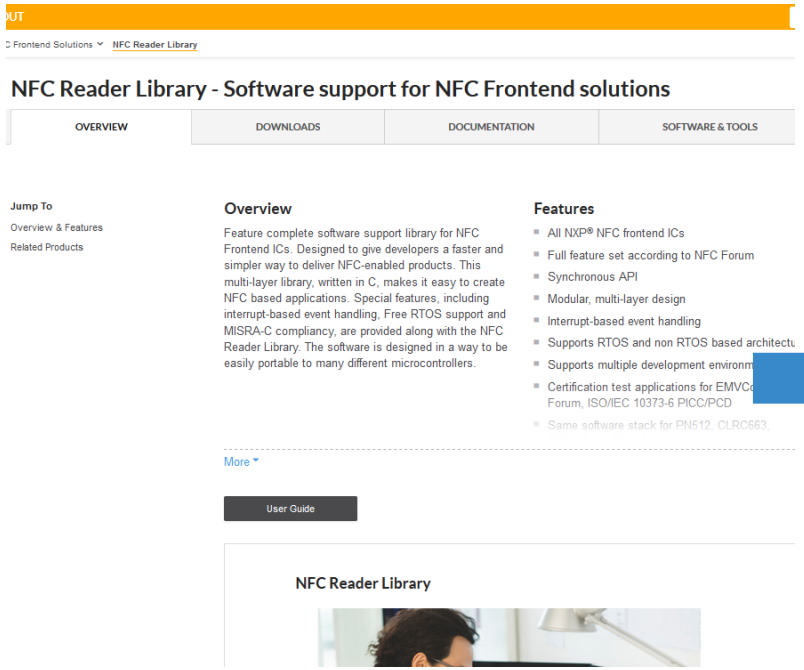
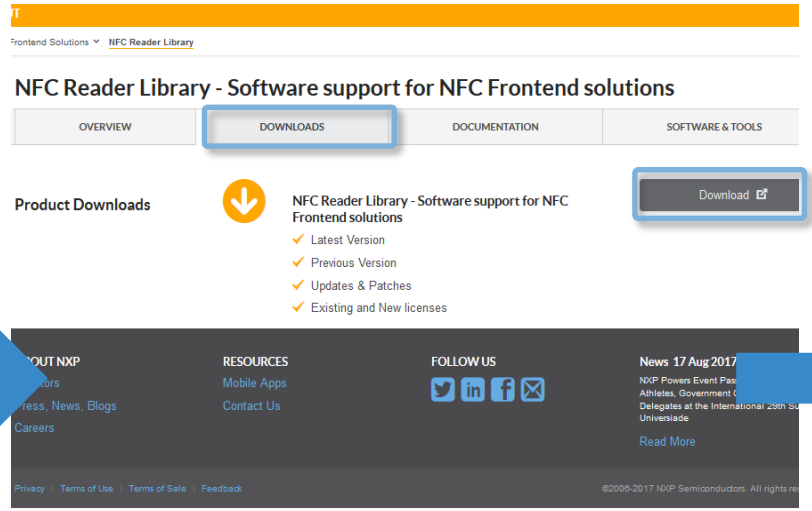
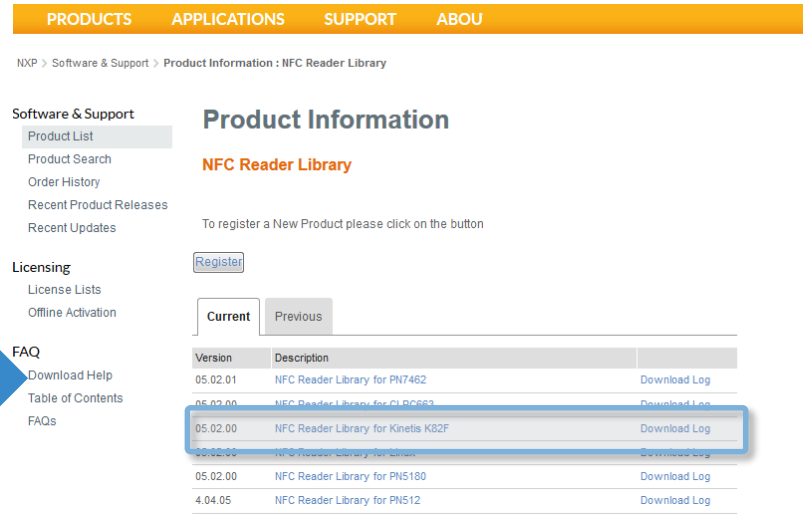
NFC Reader Library porting to K64F

Setting up the dev. environment

Get latest NFC Reader Library release







Step 1:

Browse to www.nxp.com/pages/:NFC-READER-LIBRARY

Step 2:

Go to ***Downloads*** tab and click ***download*** button

Step 3:

Download ***NFC Reader Library for Kinetis K82F*** package

NFC Reader Library porting is done starting from the Kinetis K82F package

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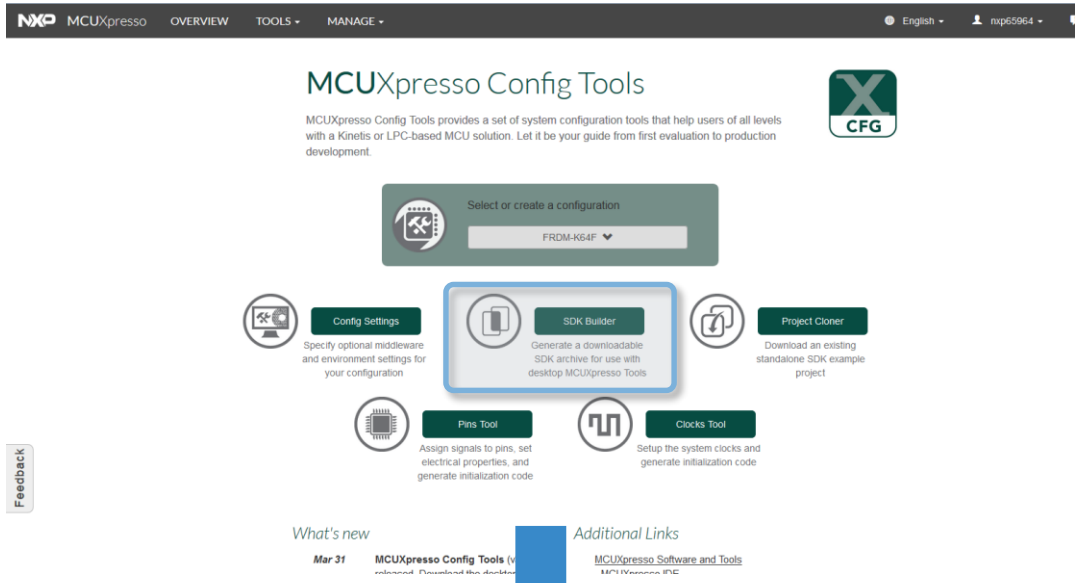
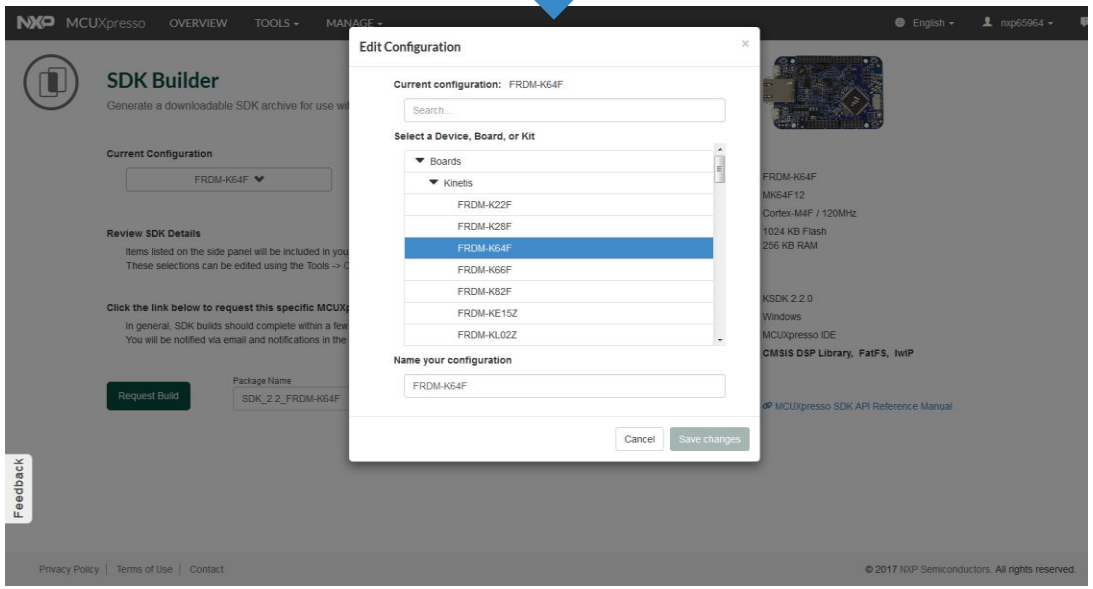
Generate a downloadable SDK package for FRDM-K64F board



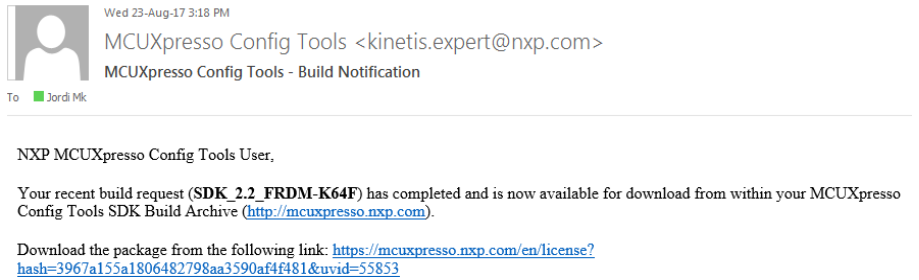
Step 1: Go to MCUXpresso Config tools.

- Browse to https://mcuxpresso.nxp.com
- Select ***SDK Builder***

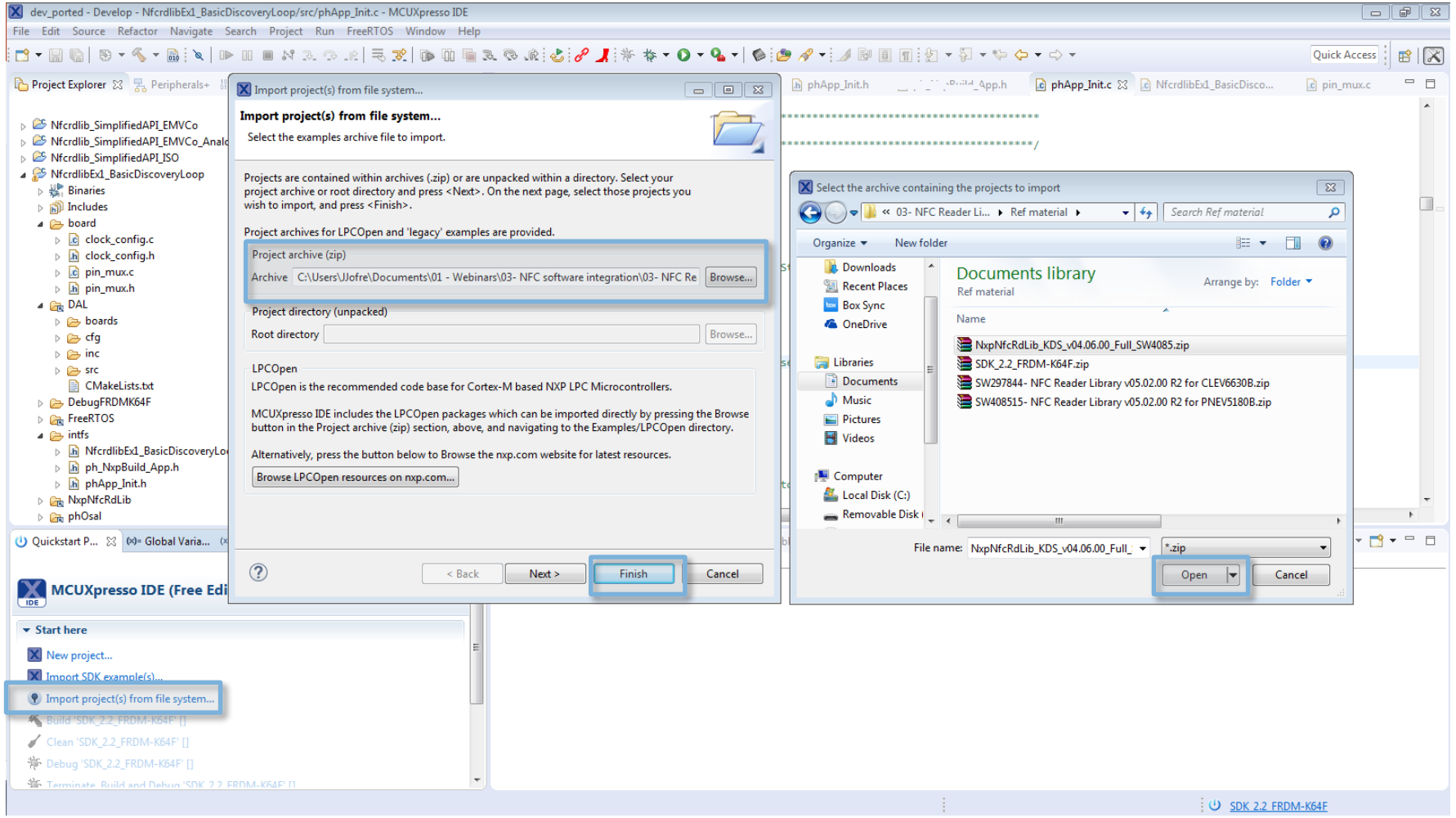


Step 2: Customize SDK package for your MCU.

- Select ***FRDM-K64F*** in the ***Current Configuration*** drop down menu.
- Select ***Request Build***.
- Download your custom SDK package.



Import NFC Reader Library into MCUXpresso workspace



Import NFC Reader Library package into MCUXpresso IDE

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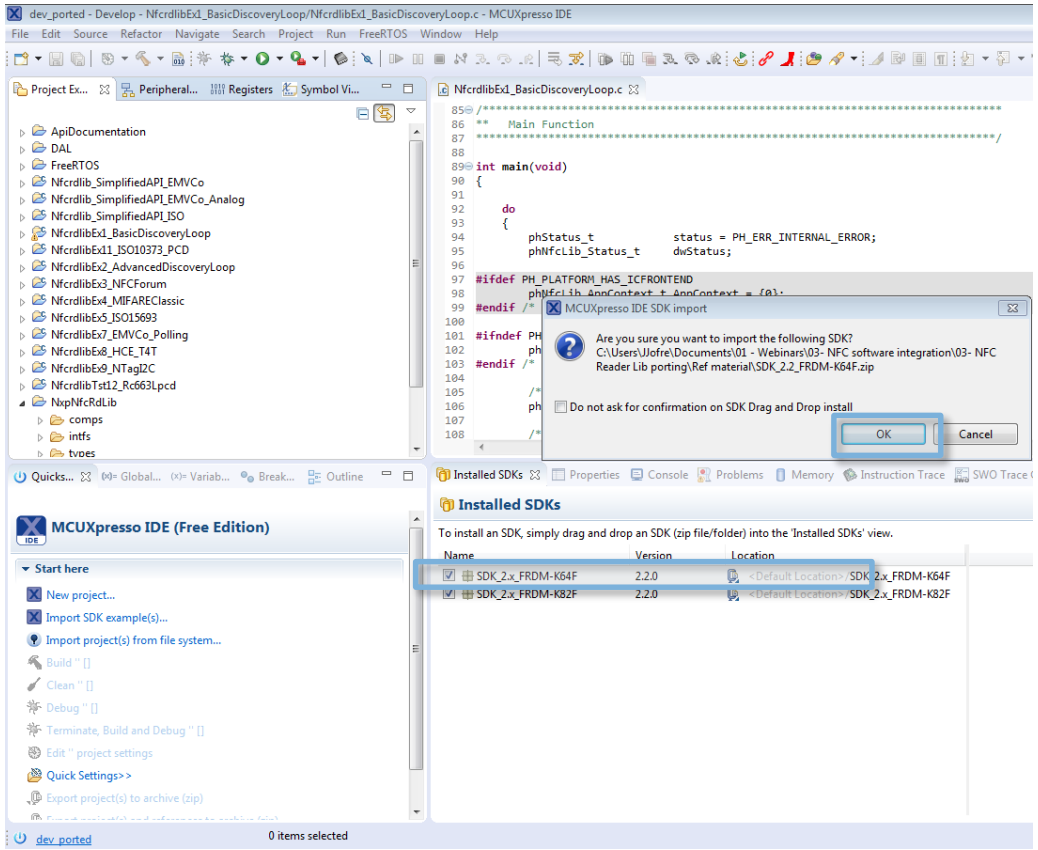
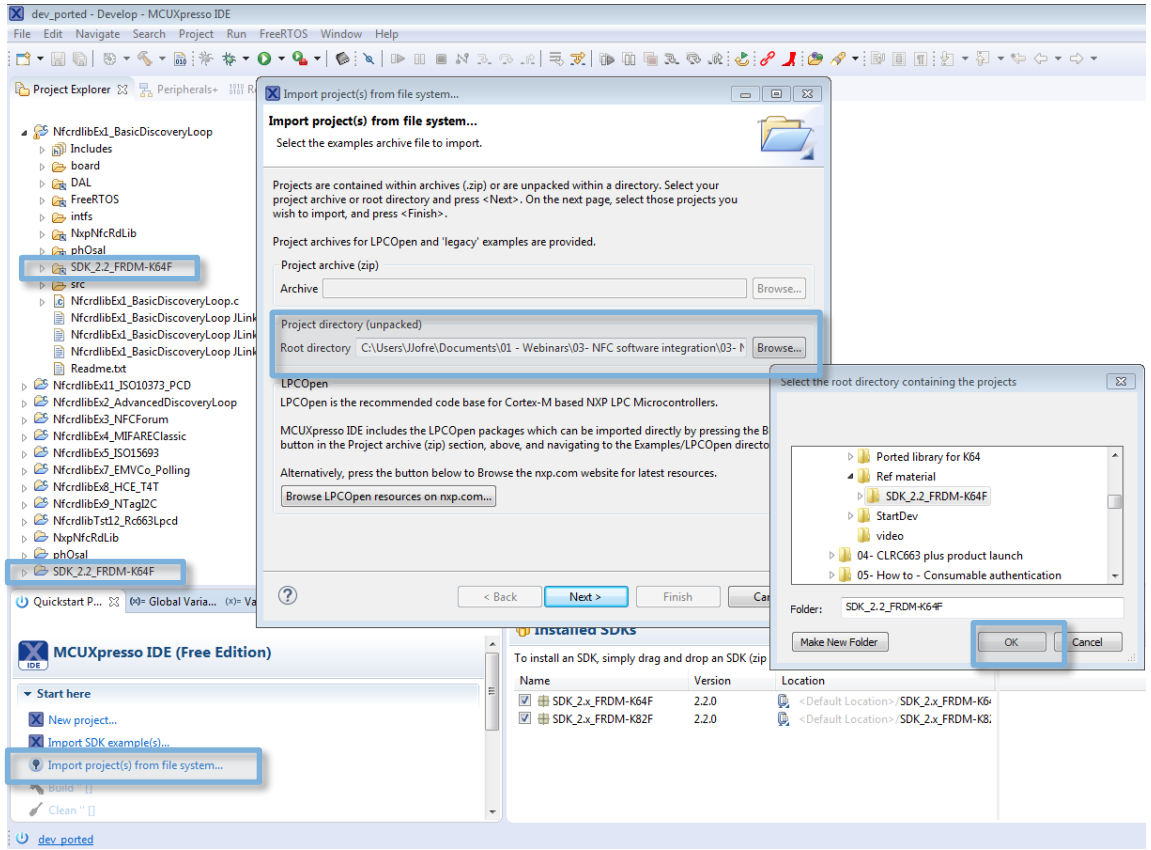
Install and link FRDM-K64F SDK into MCUXpresso workspace



Drag and drop the FRDM-K64F SDK into *Installed SDKs* tab of MCUXpresso IDE



Import FRDM-K64F SDK into workspace and link it with the software examples.

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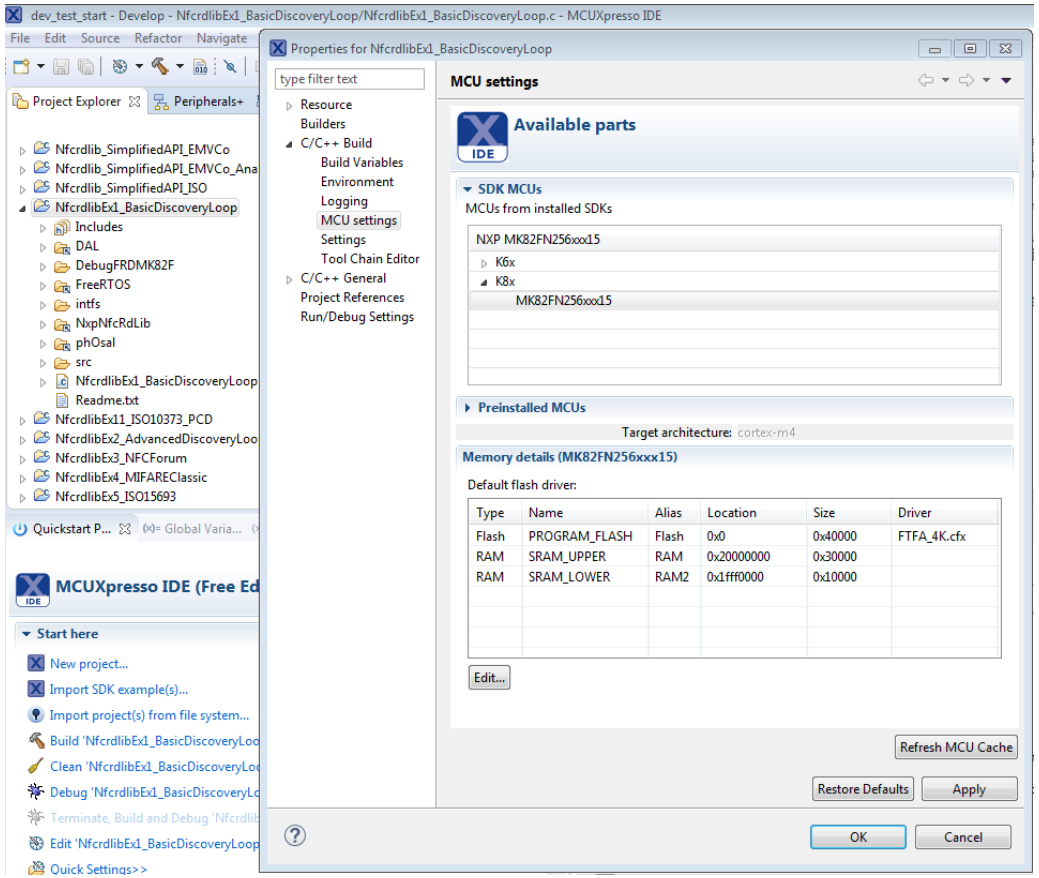
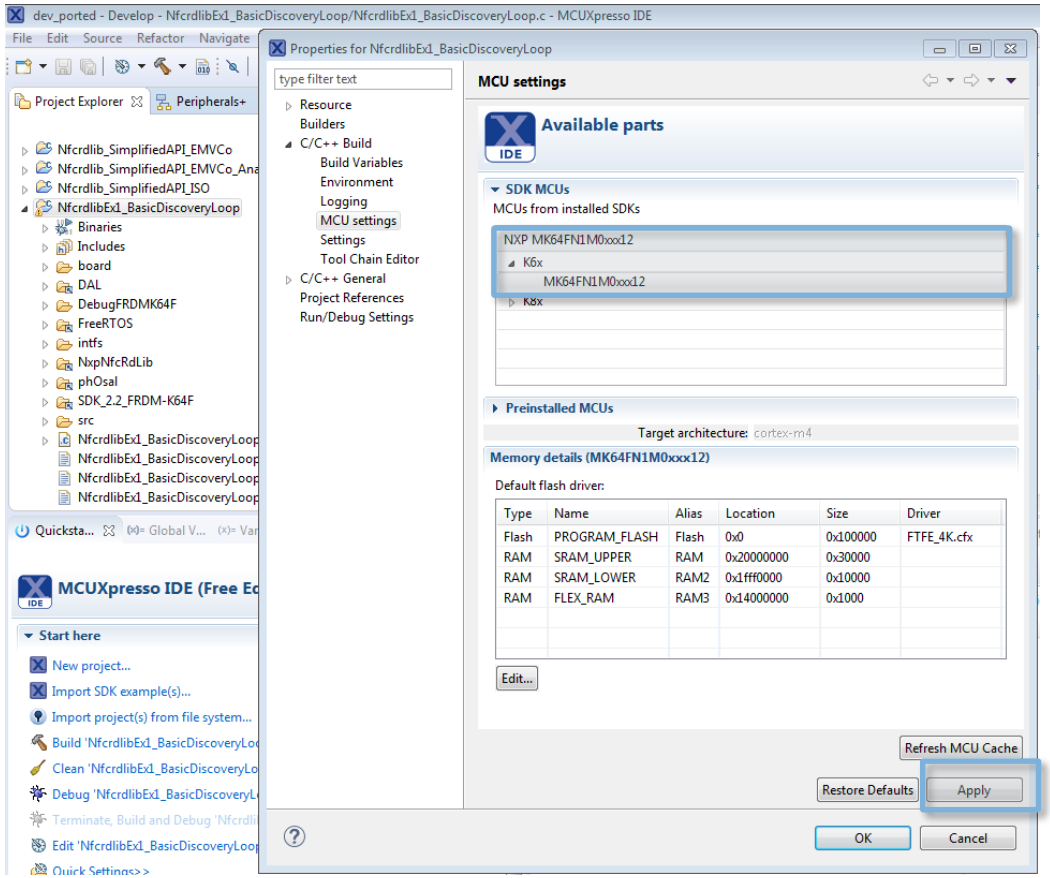
NFC Reader Library porting to K64F

Configuration changes

Select FRDM-K64F SDK in the project MCU settings



NFC Reader Library NfcrdlibEx1 for FRDM-K82F



NFC Reader Library NfcrdlibEx1 ported to FRDM-K64F

In *Project properties → MCU settings:*

Change SDK MCU to FRDM-K64F SDK

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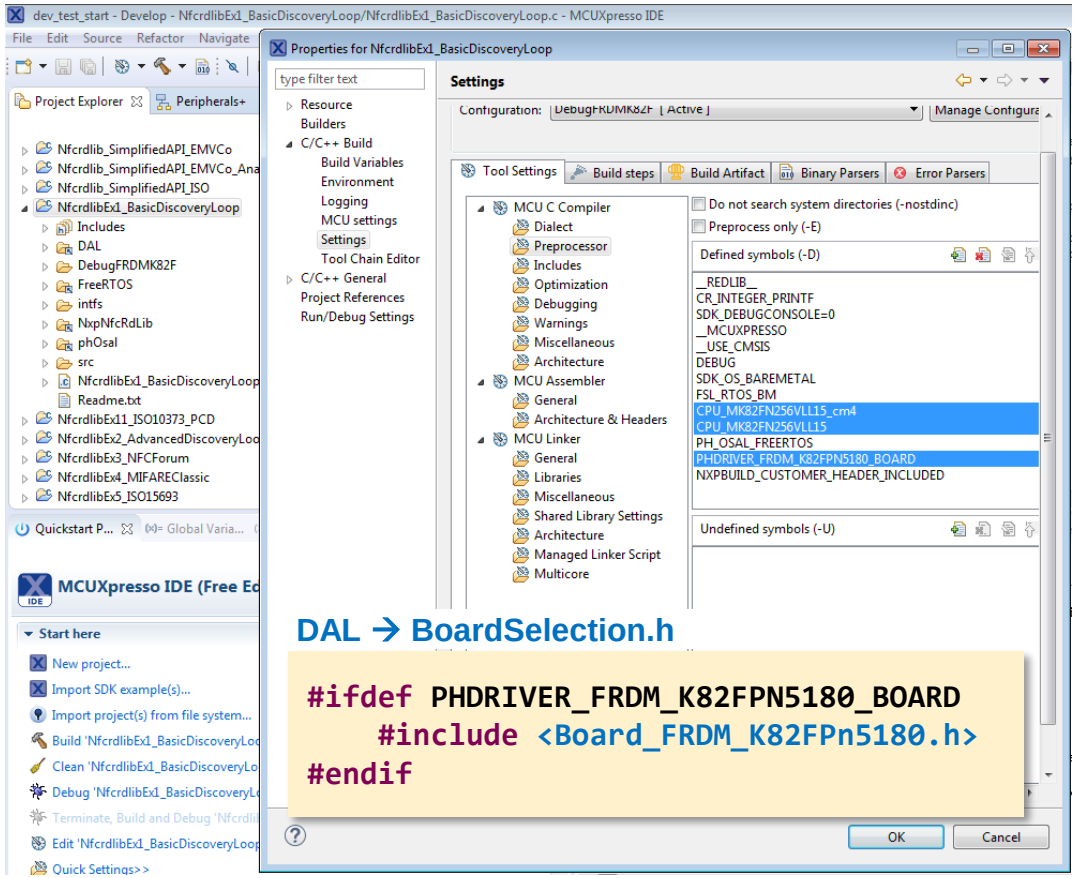
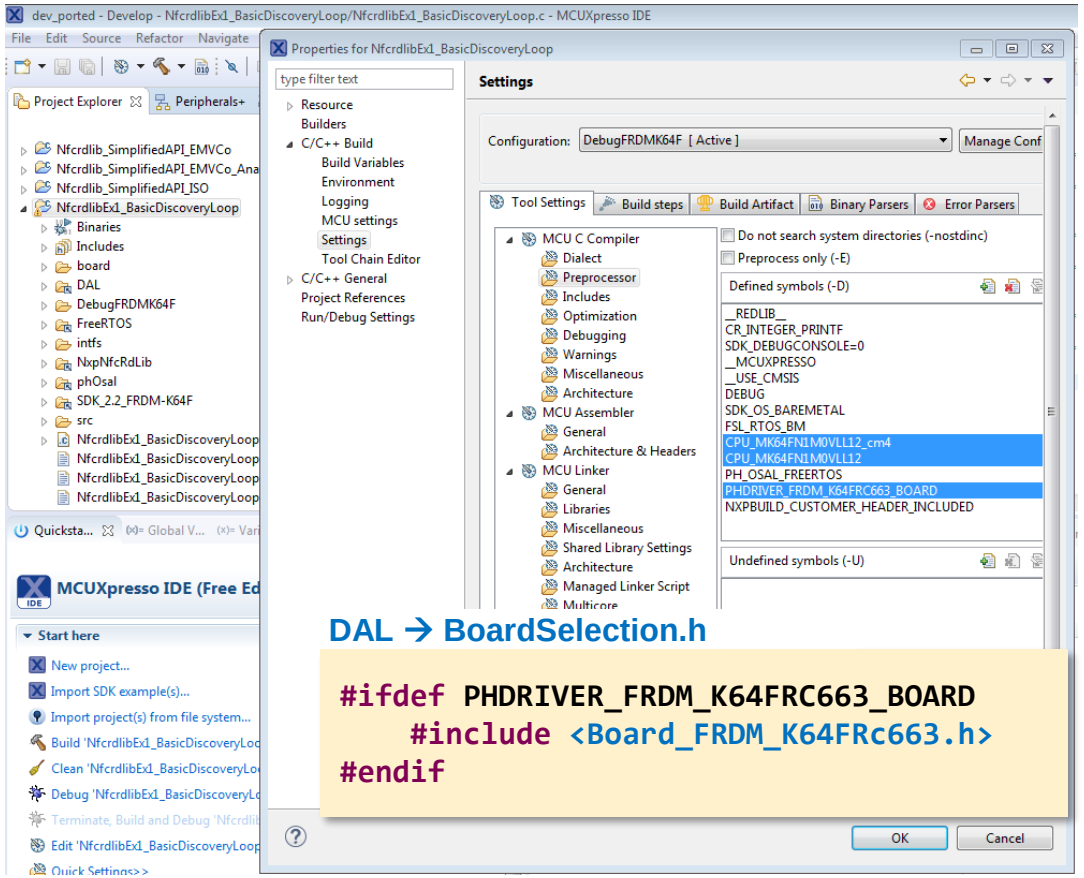
Define FRDM-K64F SDK preprocessor symbols in the project



DAL → BoardSelection.h

```
#ifdef PHDRIVER_FRDM_K82FPN5180_BOARD
    #include <Board_FRDM_K82FPn5180.h>
#endif
```

NFC Reader Library NfcrdlibEx1 for FRDM-K82F



DAL → BoardSelection.h

```
#ifdef PHDRIVER_FRDM_K64FRC663_BOARD
    #include <Board_FRDM_K64FRc663.h>
#endif
```

NFC Reader Library NfcrdlibEx1 ported to FRDM-K64F

In *Project properties → Settings → Preprocessor:* Change preprocessor defined symbols

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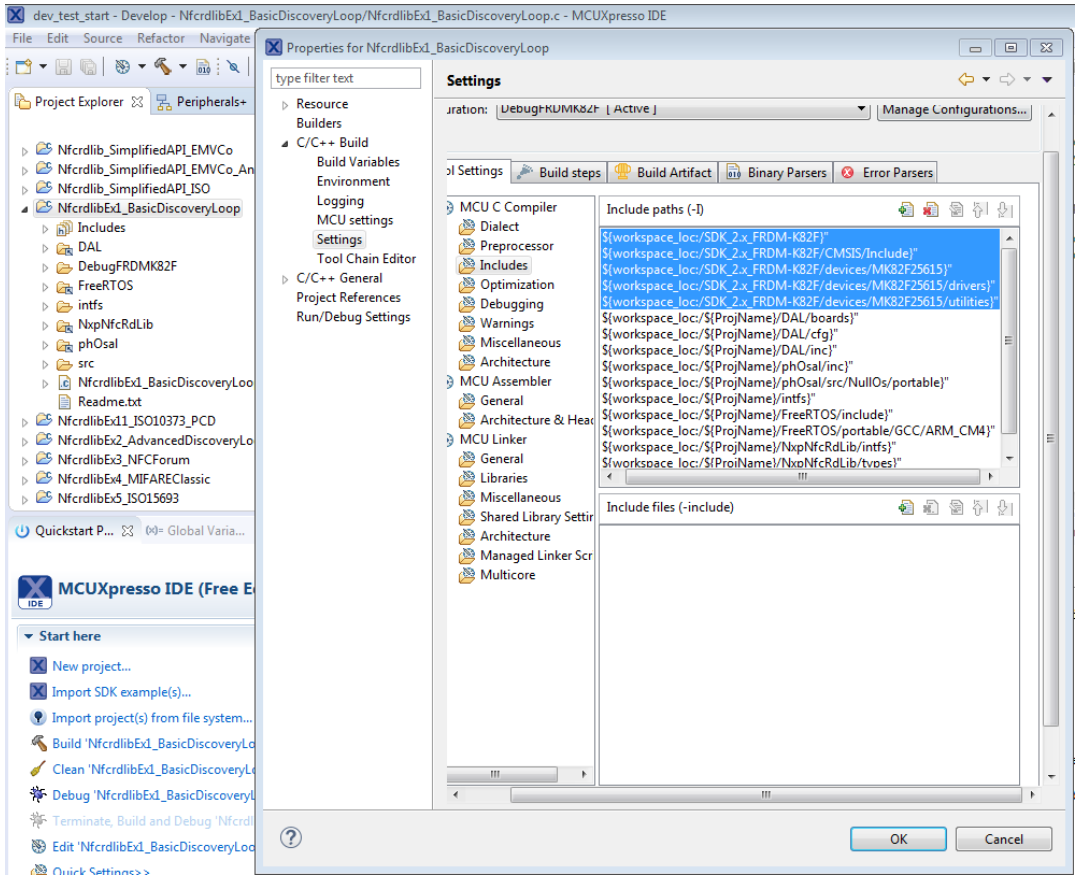
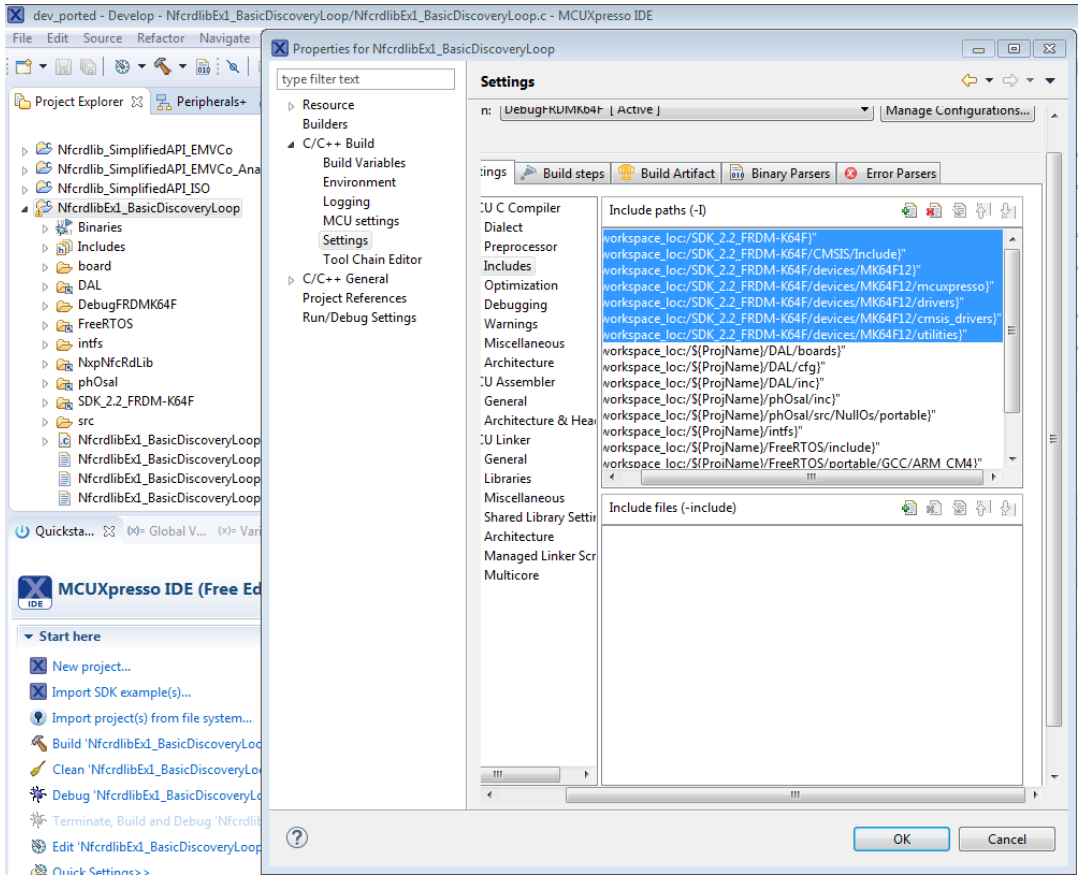
Add include paths for FRDM-K64F SDK files



NFC Reader Library NfcrdlibEx1 for FRDM-K82F



NFC Reader Library NfcrdlibEx1 ported to FRDM-K64F

In *Project properties → Settings → Includes:*

Add include paths for FRDM-K64F SDK files

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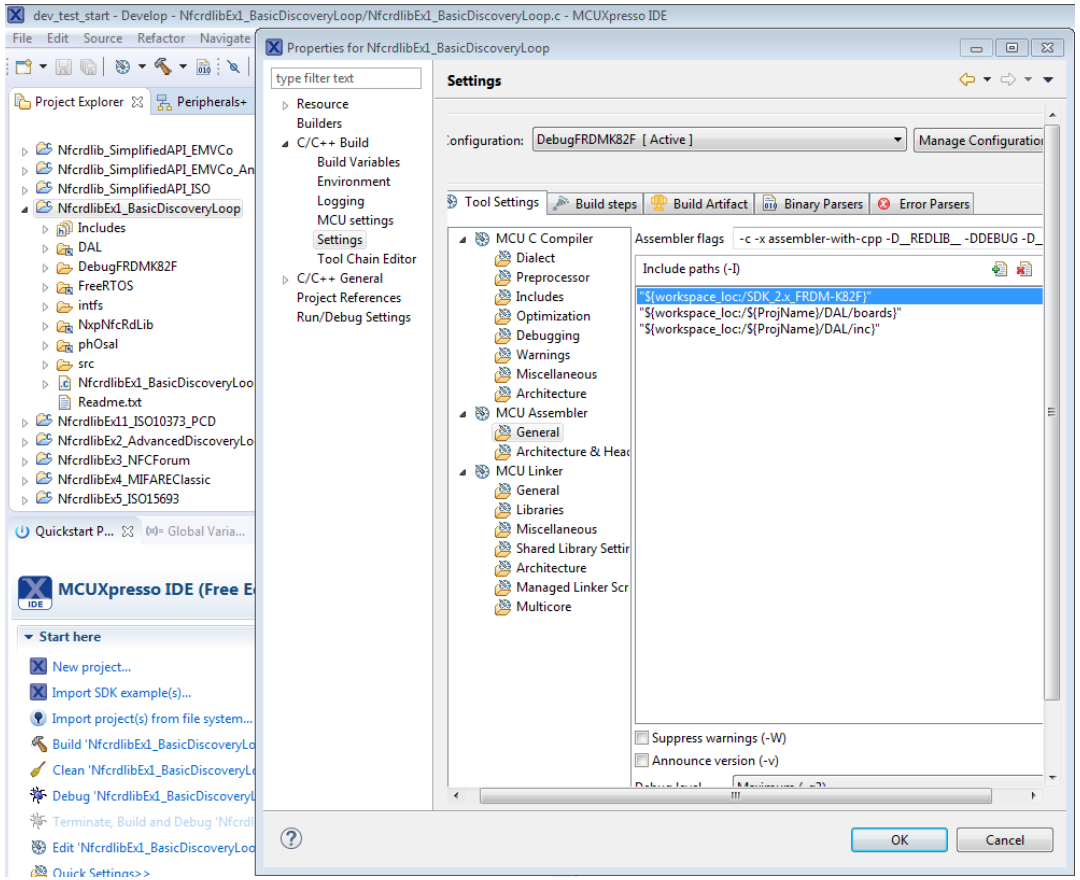
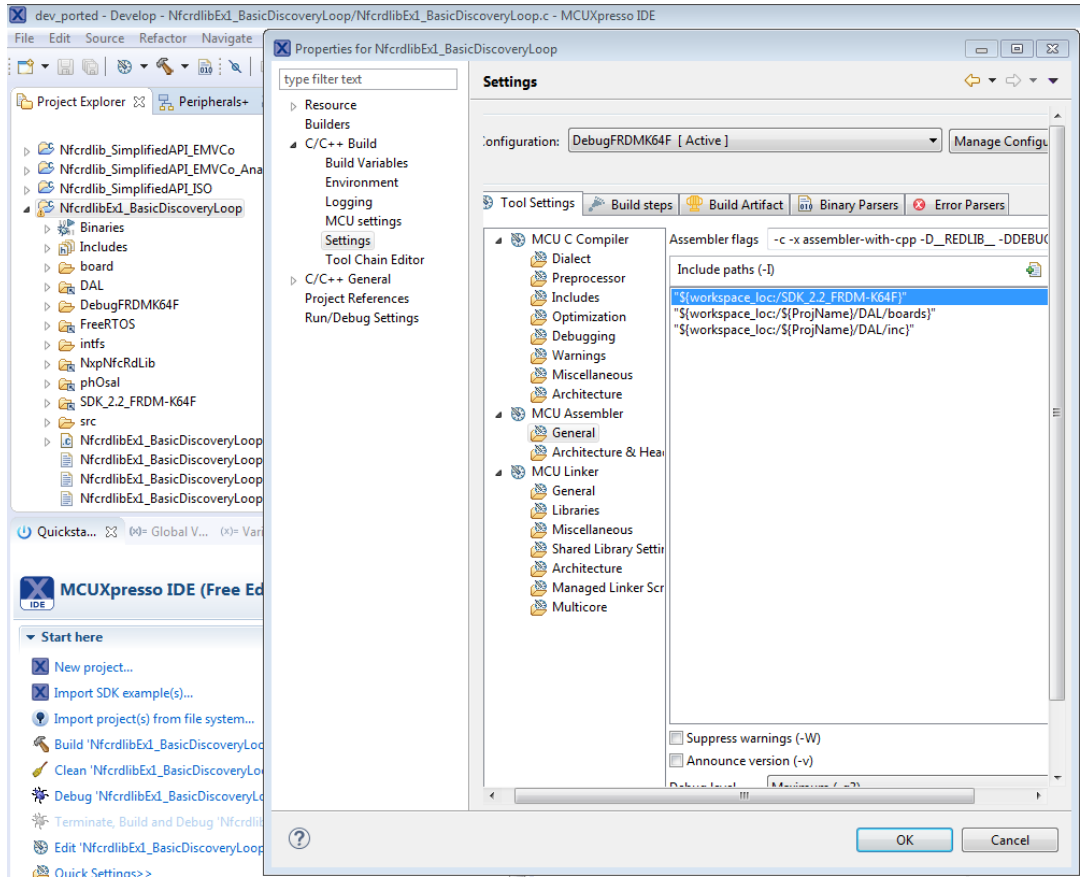
Add include path for FRDM-K64F MCU assembler



NFC Reader Library NfcrdlibEx1 for FRDM-K82F



NFC Reader Library NfcrdlibEx1 ported to FRDM-K64F

In *Project properties → Settings → MCU assembler:*

Add include path for MCU assembler

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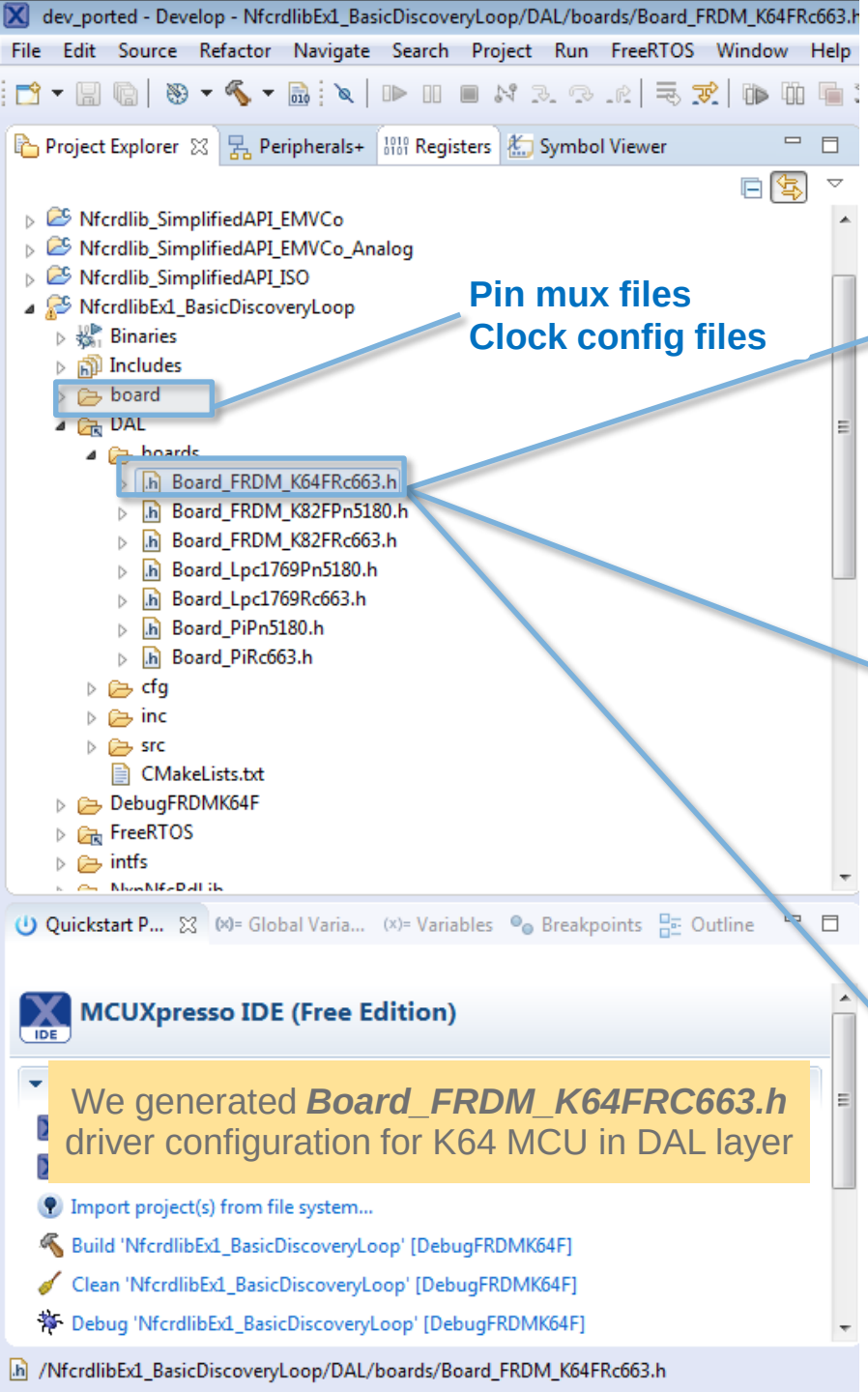
NFC Reader Library porting to K64F

Code changes



DAL driver adaptation for FRDM-K64F

Board Pin/Gpio configurations

```
#define PHDRIVER_PIN_RESET ((GPIO_PORT_B << 8) | 19)  /**< Reset pin, Pin13, GPIOA, PORTA */
#define PHDRIVER_PIN_IRQ ((GPIO_PORT_C << 8) | 0)   /**< IRQ pin, Pin7, GPIOC, PORTC */
```

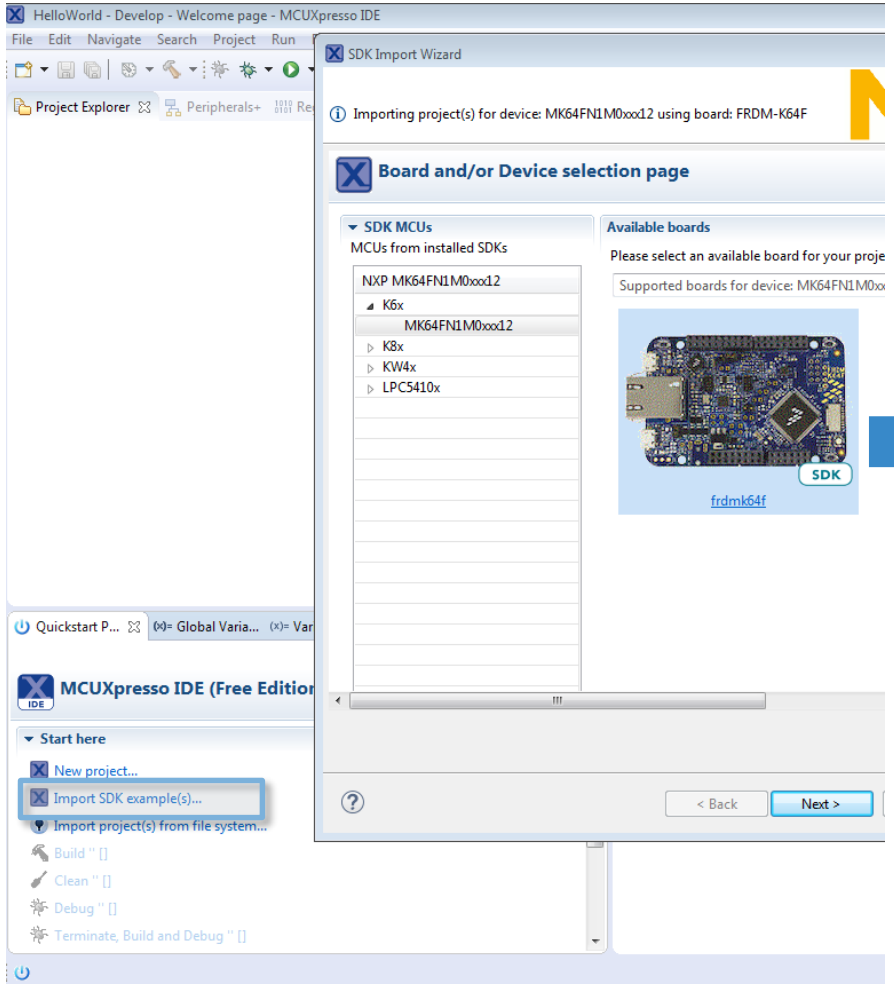
SPI configuration

```
#define ENABLE_PORT_SSP_1   kCLOCK_PortD//SCK
#define PORT_SSP_1          PORTD
#define FIRST_PINNUM_SSP    1

#define ENABLE_PORT_SSP_2   kCLOCK_PortD//MOSI
#define PORT_SSP_2          PORTD
#define SECOND_PINNUM_SSP   3

#define ENABLE_PORT_SSP_3   kCLOCK_PortD//MISO
#define PORT_SSP_3          PORTD
#define THIRD_PINNUM_SSP    2

#define PHDRIVER_PIN_SSEL  ((GPIO_PORT_D << 8) | 0)  /**< SSEL pin, Pin14, GPIOA, PORTA */
```

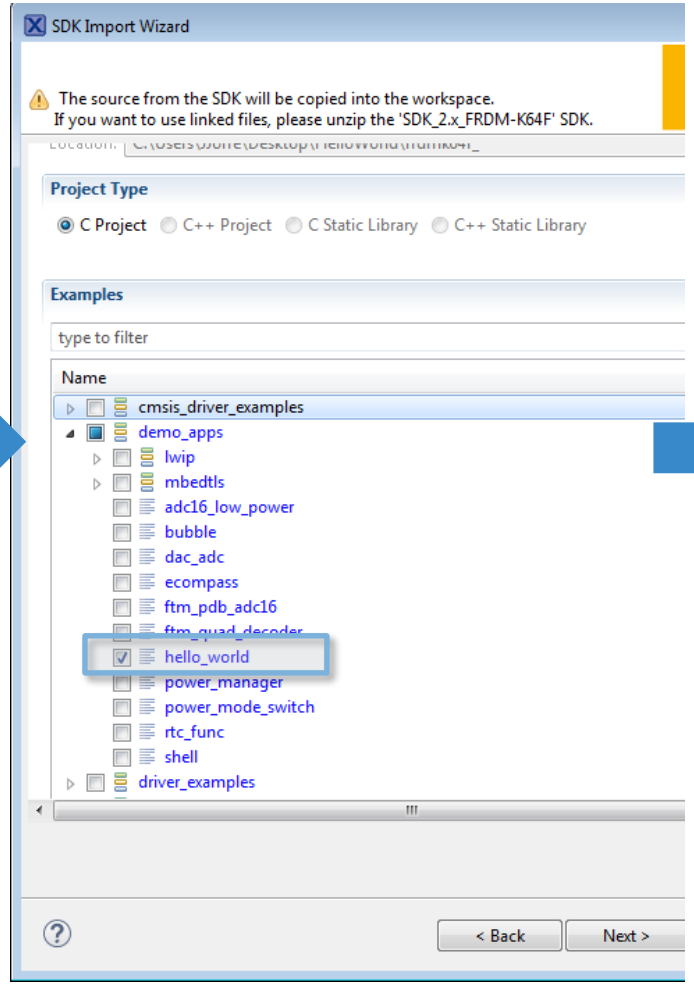
Timer configuration

```
#define PH_DRIVER_KSDK_PIT_TIMER          PIT
#define PH_DRIVER_KSDK_PIT_CLK            kCLOCK_BusClk
#define PH_DRIVER_KSDK_TIMER_CHANNEL      kPIT_Chnl_0    /**< PIT channel number 0 */
#define PH_DRIVER_KSDK_TIMER_NVIC         PIT0_IRQn
```

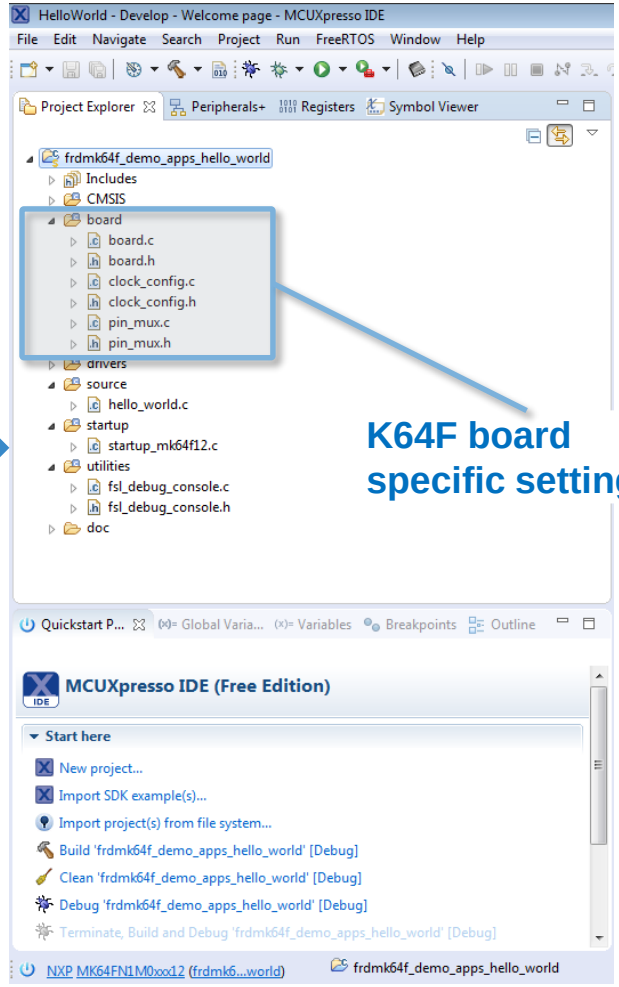
Use SDK examples to get K64F board specific configuration



1. Import K64F SDK examples



2. Select HelloWorld example



3. Use board folder source code as reference

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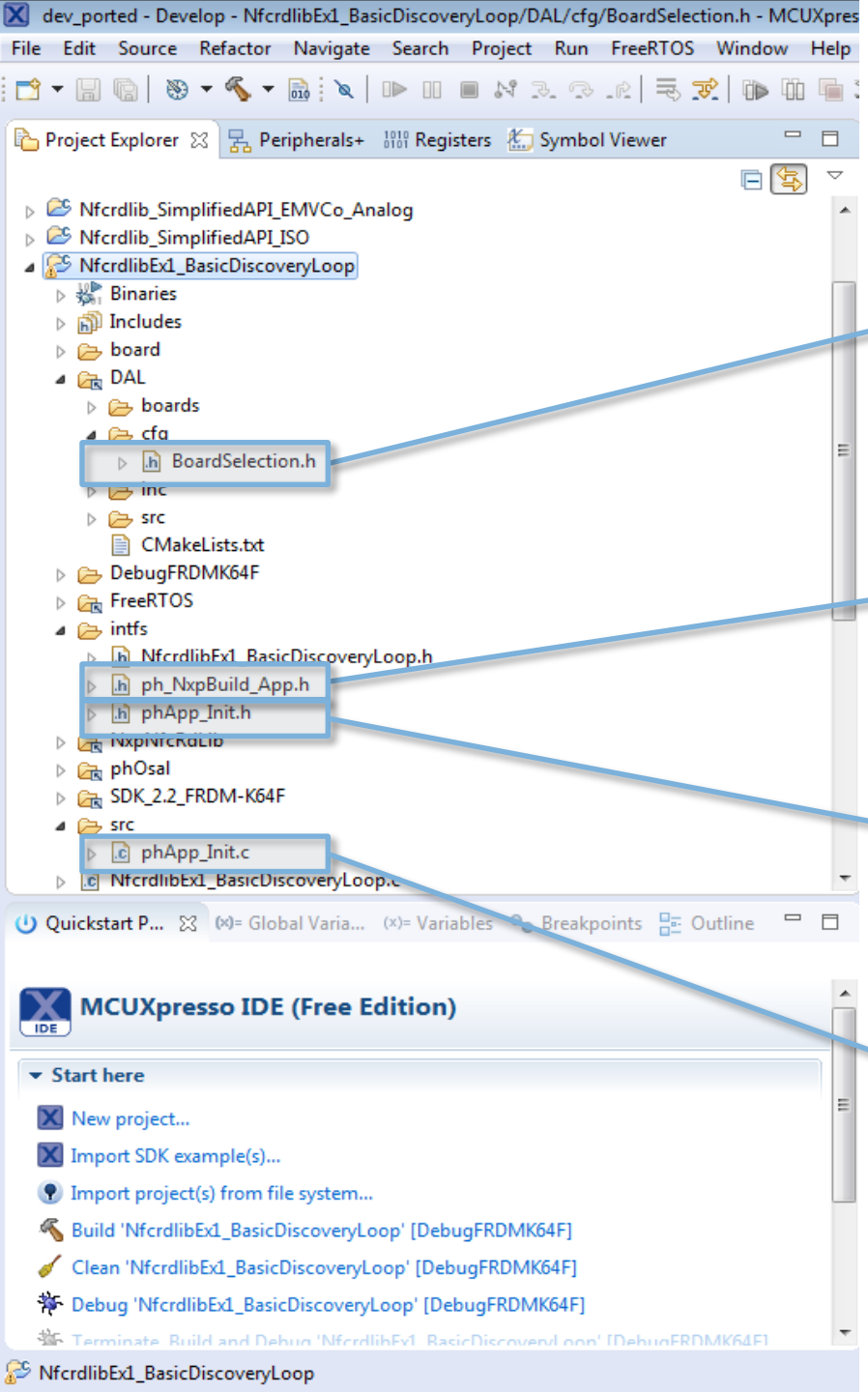


Added FRDM_K64F macro definitions

BoardSelection.h

```
#ifdef PHDRIVER_FRDM_K64FRC663_BOARD
    #include <Board_FRDM_K64FRc663.h>
#endif
```

phNxpBuild_App.h

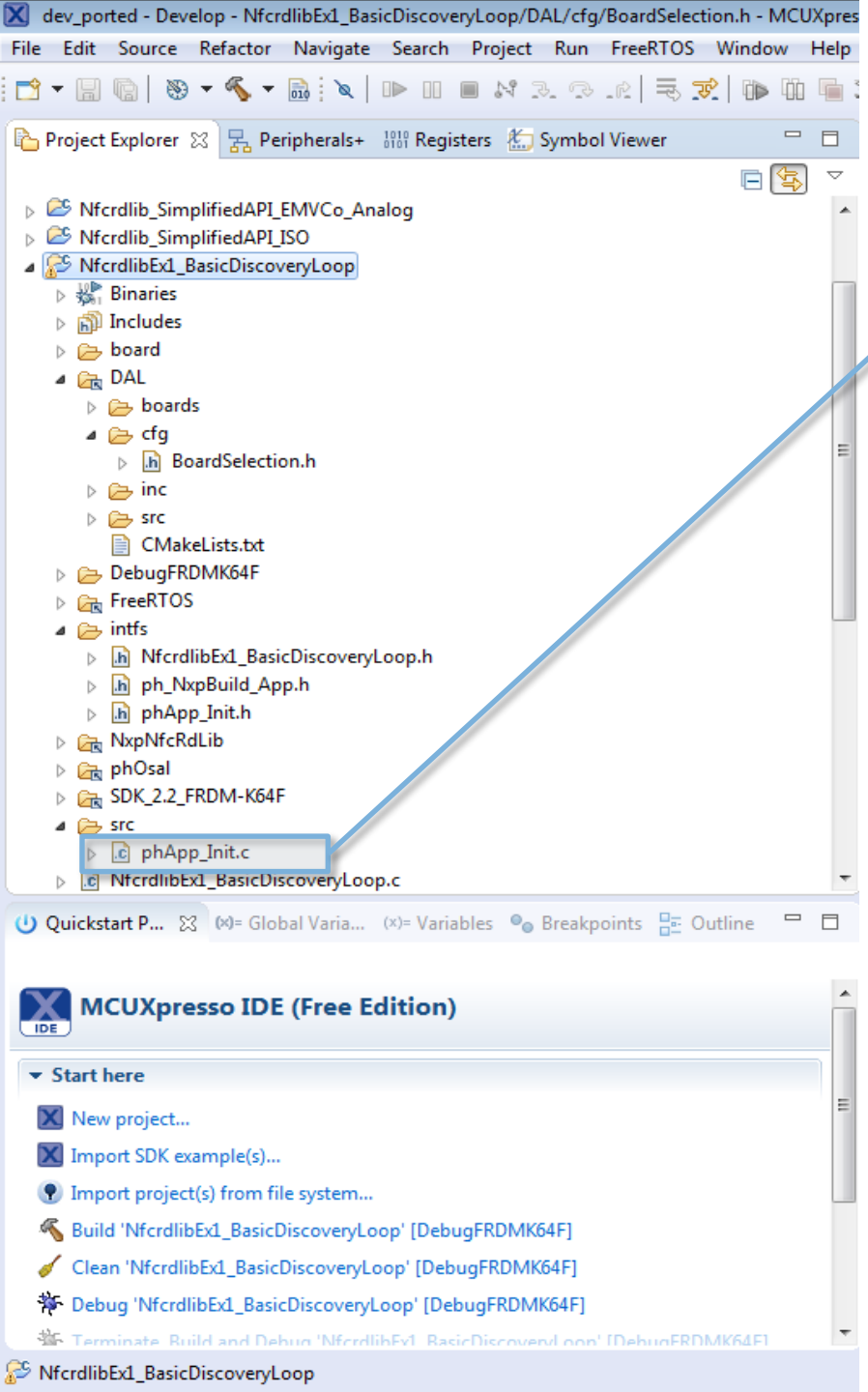
```
#if defined(PHDRIVER_LPC1769RC663_BOARD) \
    || defined(PHDRIVER_FRDM_K82FRC663_BOARD) \
    || defined(PHDRIVER_FRDM_K64FRC663_BOARD)
# define NXPBUILD__PHHAL_HW_RC663
```

phApp_Init.h

```
#if defined(PHDRIVER_FRDM_K64FRC663_BOARD)
#define PHDRIVER_KINETIS_K64
```

phApp_Init.c

```
#ifdef PHDRIVER_KINETIS_K64
static void phApp_K64_Init(void);
#endif /* PHDRIVER_KINETIS */
```



Add FRDM-K64F CPU initialization code

phApp_Init.c

```
void phApp_CPU_Init(void){
#if defined PHDRIVER_KINETIS
    phApp_K64_Init();
    ...
```

phApp_K64_Init() function

```
BOARD_BootClockRUN(); /* Code for BOARDClock Run configuration*/

SystemCoreClockUpdate();

PIT_GetDefaultConfig(&pitConfig);

PIT_Init(PIT, &pitConfig); /* Init pit module */

BOARD_InitPins(); /* Initialize UART pins below used to Print */
```

phApp_Init.c includes code specific to HW used (FRDM-K64F)

Clock and pin_mux config files were taken from FRDM-K64F SDK example

dev_ported - Develop - NfcrdlibEx1_BasicDiscoveryLoop/NfcrdlibEx1_BasicDiscoveryLoop.c - MCUXpresso IDE

File Edit Source Refactor Navigate Search Project Run FreeRTOS Window Help

Quick Access

Project Explorer | Peripherals+ | Registers | Symbol Viewer

- Nfcrdlib_SimplifiedAPI_EMVCo
- Nfcrdlib_SimplifiedAPI_EMVCo_Analog
- Nfcrdlib_SimplifiedAPI_ISO
- NfcrdlibEx1_BasicDiscoveryLoop
  - Binaries
  - Includes
  - board
  - DAL
  - DebugFRDMK64F
  - FreeRTOS
  - intfs
  - NxpNfcRdLib
  - phOsal
  - SDK_2.2_FRDM-K64F
  - src
  - NfcrdlibEx1_BasicDiscoveryLoop.c
  - NfcrdlibEx1_BasicDiscoveryLoop JLink DebugFRDMK64F.launch
  - NfcrdlibEx1_BasicDiscoveryLoop JLink default.launch
  - NfcrdlibEx1_BasicDiscoveryLoop JLink test.launch

NfcrdlibEx1_BasicDiscoveryLoop.c

```
85 /*****************************************************************************
86 **   Main Function
87 *****************************************************************************/
88
89 int main(void)
90 {
91
92     do
93     {
94         phStatus_t            status = PH_ERR_INTERNAL_ERROR;
95         phNfcLib_Status_t     dwStatus;
96
97 #ifdef PH_PLATFORM_HAS_ICFRONTEND
98         phNfcLib_AppContext_t AppContext = {0};
99 #endif /* PH_PLATFORM_HAS_ICFRONTEND */
100
101 #ifndef PH_OSAL_NULLOS
102         phOsal_ThreadObj_t BasicDisc;
103 #endif /* PH_OSAL_NULLOS */
104
105         /* Perform Controller specific initialization. */
106         phApp_CPU_Init();
107
```

Quickstart P... | Global Varia... | Variables | Breakpoints | Outline

MCUXpresso IDE (Free Edition)

Start here

- New project...
- Import SDK example(s)...
- Import project(s) from file system...
- Build 'NfcrdlibEx1_BasicDiscoveryLoop' [DebugFRDMK64F]
- Clean 'NfcrdlibEx1_BasicDiscoveryLoop' [DebugFRDMK64F]
- Debug 'NfcrdlibEx1_BasicDiscoveryLoop' [DebugFRDMK64F]
- Terminate, Build and Debug 'NfcrdlibEx1_BasicDiscoveryLoop' [DebugFRDMK64F]
- Edit 'NfcrdlibEx1_BasicDiscoveryLoop' project settings
- Quick Settings>>
- Export project(s) to archive (zip)
- Export project(s) and references to archive (zip)

Installed SDKs | Properties | Console | Problems | Memory | Instruction Trace | SWO Trace Config | Power Measurement Tool

No consoles to display at this time.

Writable | Smart Insert | 87 : 18

NXP MK64FN1M0xxx12 (Nfcrdli...ryLoop)

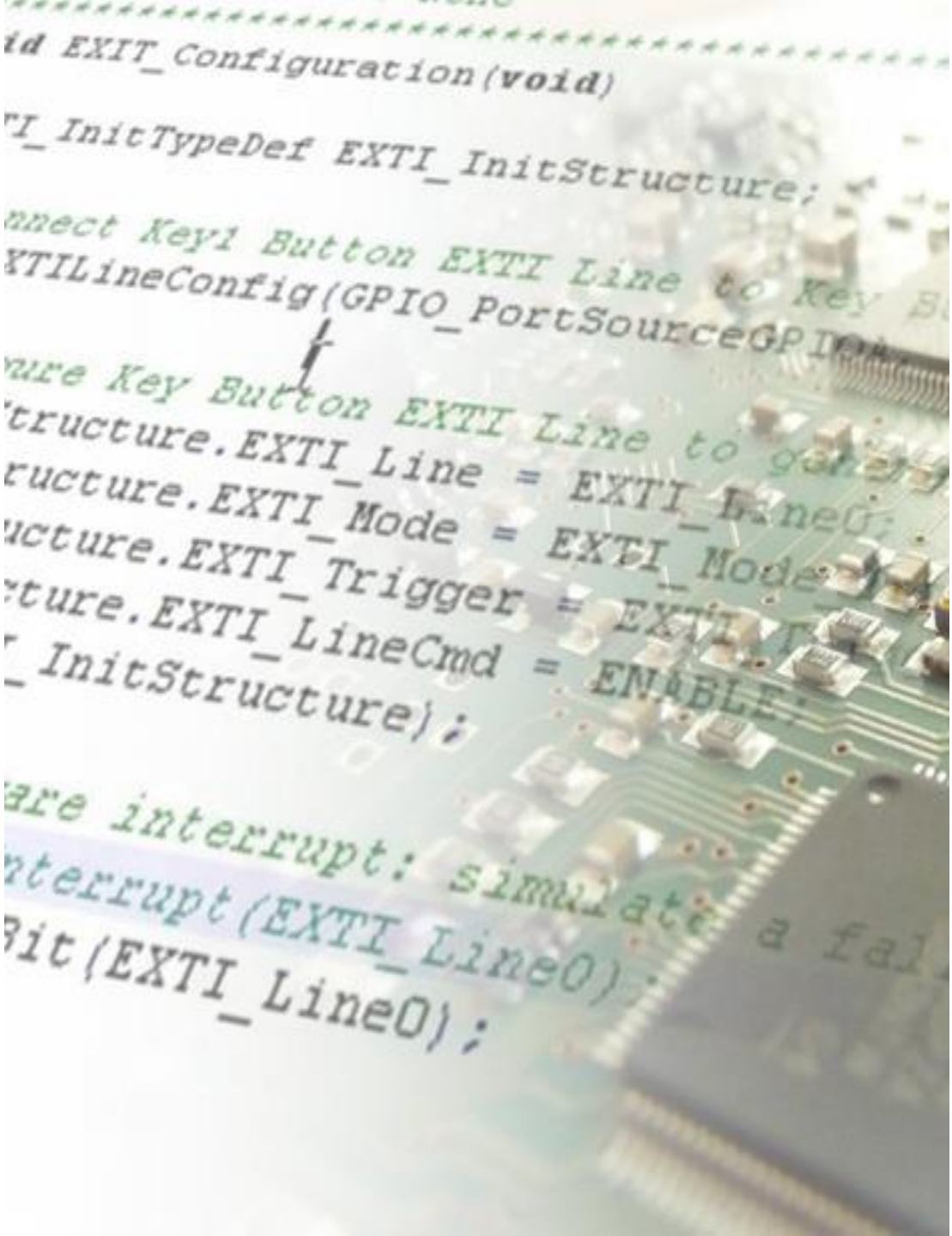
Wrap up & Q&A

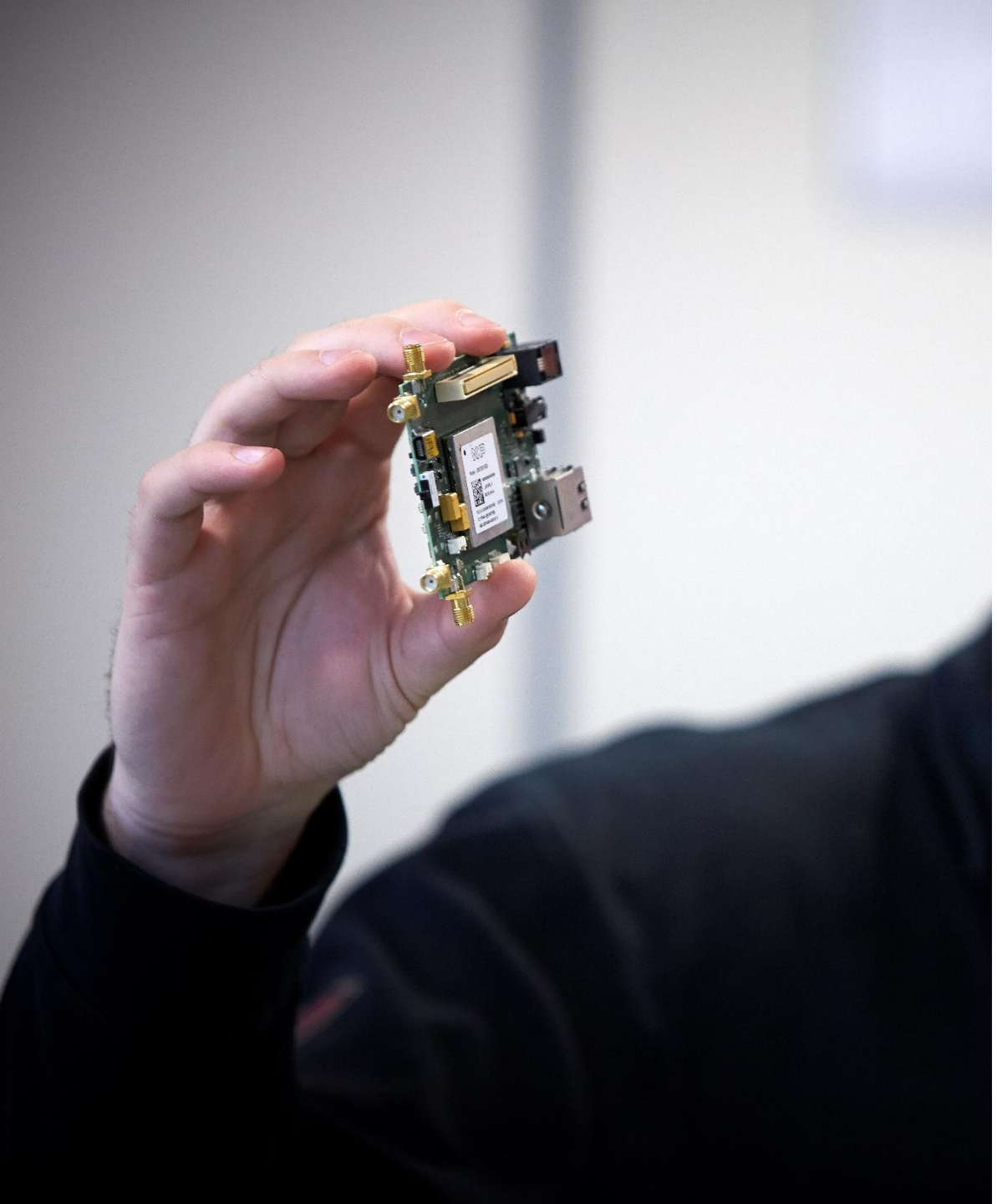
General considerations to port NFC Reader Library to your target MCU

- Adapt the MCU drivers → DAL Layer
  - Timers
  - Interrupts
  - GPIOs pin configuration
  - Host interface configuration

- Adapt the OS → OSAL layer
  - Porting the FreeRTOS
  - Porting to a different OS

- Adapt the sample projects
  - Project configuration settings, includes & macros
  - Main application HW init code (e.g. Clocks)





Reference links & info

- NFC Reader Library
  www.nxp.com/pages/:NFC-READER-LIBRARY
- CLRC663 *plus*
  www.nxp.com/products/:CLRC66303HN
- CLRC663 *plus* development kit
  www.nxp.com/demoboard/OM26630
- FRDM-K64F board
  www.nxp.com/demoboard/FRDM-K64F

MobileKnowledge

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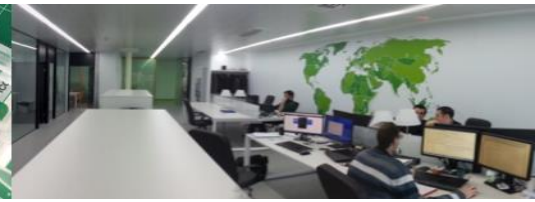
Embedded software for MCUs
JCOP, Java Card operating Systems
Hardware design and development
Digital, analog, sensor acquisition, power management
Wireless communications WiFi, ZigBee, Bluetooth, BLE
Contactless antenna RF design, evaluation and testing

MIFARE applications
End-to-end systems, readers and card-related designs
EMVco applications
Readers, cards, design for test compliancy (including PCI)
Secure Element management
GlobalPlatform compliant backend solutions
Secure services provisioning OTA, TSM services









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How to port the NFC Reader Library to K64F

Jordi Jofre (Speaker)
Angela Gemio (Host)

Thank you for your kind attention!

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