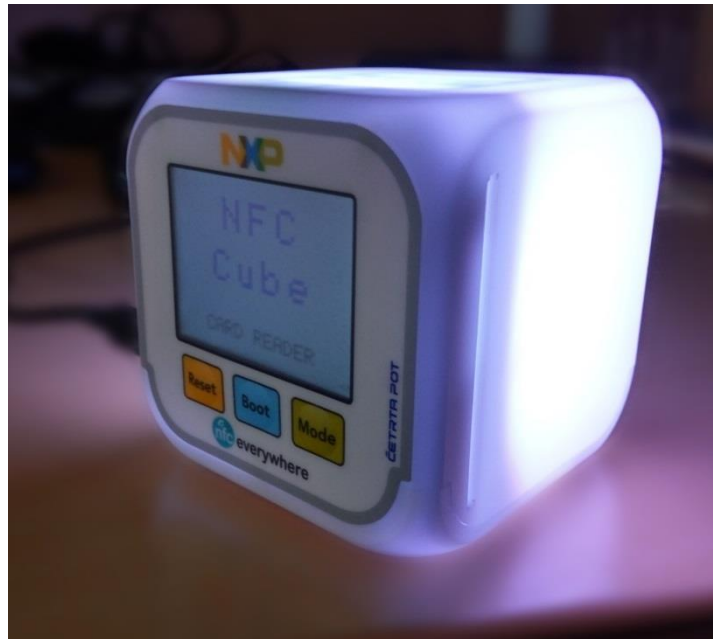


# NFC Cube User Manual

Cube Firmware Version 3.9



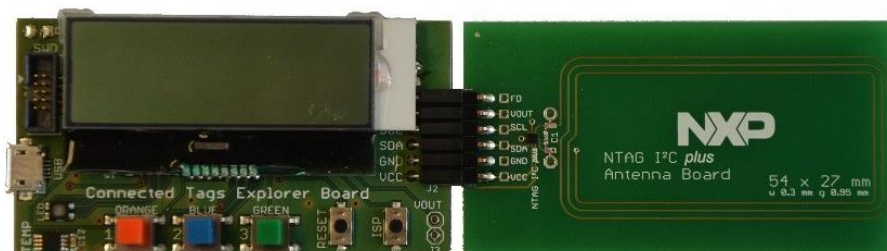
## Introduction

The NFC Cube kit is a set of tools to demonstrate Near Field Communication (NFC) and the variety of use cases enabled by NXP's NFC solution, and what are the use cases that are offered by this standard and by the NXP products.

It consists of:

- An NFC Cube, with an integrated NFC micro controller
- A mobile application available for any NFC enabled Android phone
- A set of smartcards to demonstrate key NFC use cases

The NFC Cube kit is interoperable with our NTAG I<sup>2</sup>C *plus* Explorer board, which enables you to demonstrate how two devices can communicate via NFC.



NTAG I<sup>2</sup>C *plus* Explorer Kit

## NFC Cube

The NFC Cube is based on a PN7462AU NFC microcontroller.

The NFC Cube allows to:

- Read contactless and contact cards
- Communicate with a mobile phone, to read out the color history or set a color to the NFC Cube.
- Exchange data with the NTAG I<sup>2</sup>C *plus* Explorer board
- Act as a CCID PC/SC reader



Connected to a PC, the NFC Cube can be used as a CCID PC/SC reader for all ISO/IEC 15693, ISO/IEC 14443 and MIFARE cards.

### Power supply

The NFC Cube works in standalone mode, just connected to a power supply with a USB plug, or connected to a PC, for example when used in CCID reader mode.

You can also use 4 AAA 1.5V batteries. The battery compartment is located on the bottom of the NFC Cube.

### Setting the operating mode

The NFC Cube has a button called “Mode”. Pressing the Mode-button switches between three different operating modes:

- **PC/SC & Demo Mode** (white display): This is the main mode, where the NFC Cube can be used in stand-alone mode with tags and NTAG I<sup>2</sup>C *plus* Explorer board. When connected to a PC via USB, the cube also works as a PC/SC reader.
- **Phone Mode** (yellow display): used for communication with an NFC mobile having the NFC Cube Android app installed
- **PC/SC only Mode** (purple display): used for pure PC/SC communication.

### Reading cards

The NFC Cube can read all ISO/IEC 15693, ISO/IEC 14443 and NFC Forum compliant cards and tags, as well as T=0 and T=1 cards.

The antenna is located on the top of the NFC Cube and allows to read cards at a distance of up to 13 cm, depending on the protocol and the type of cards used.

When a card is presented, the NFC Cube will display some information stored on the card. When “known use case” cards are identified, the NFC Cube will act accordingly and provide more information if relevant.

### Communication with phone

When starting, the NFC Cube is by default in “PC/SC & Demo Mode” (card reader mode). To communicate with the phone, the NFC cube uses “Phone Mode” (card emulation), to be detected as a card (NFC Tag Type 4) by any NFC enabled mobile phone.

To ensure stable communication between the two devices, the phone shall be placed to a distance of 1 cm or less from the top of the NFC Cube.

**Note:** Some phones are also supporting card emulation mode. When the NFC Cube is in “PC/SC & Demo Mode”, just approach your phone to the antenna, and it might be detected as a card (most of phones are detected either as ISO14443 cards or Felica card).

## Upgrading the NFC Cube FW:

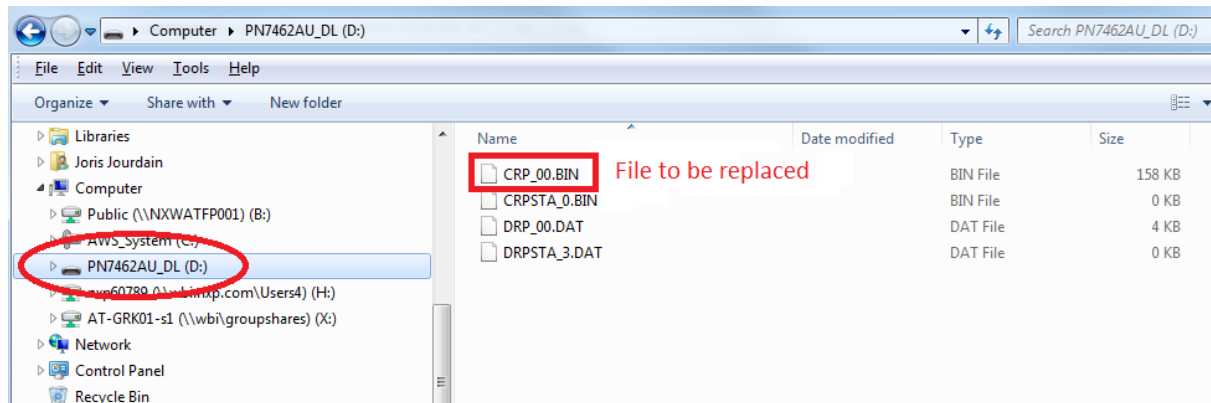
It is possible to load new firmware (FW) in the NFC Cube. If you want to update your FW version you can use the USB mass storage mode.

To enter this mode you need to press the buttons “Boot” and “Reset”.

Press first “Boot”, hold this button and press “Reset”.

Release “Reset” and then “Boot”.

Now you can see the NFC Cube as an USB mass storage disk in your PC explorer window.



- ⇒ Erase the file : CRP\_00.BIN
- ⇒ Copy the “.bin” file provided for the upgrade.

Note: There is no need to rename the “.bin” file before loading the file in the NFC Cube. This will be done automatically by the NFC Cube.

To reboot with the new firmware, press “Reset”.

Note: The current firmware version is displayed at the bottom right corner of the NFC Cube display.

## Clock

The NFC Cube offers on its back side an alarm clock. This clock is independent from the NFC functionality and has its own power supply thanks to two little batteries located on the bottom of the NFC Cube.

## The cards

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### Introduction

The NFC Cube supports all ISO/IEC 15693, ISO/IEC 14443 and NFC Forum compliant cards and tags, including the “Use case cards” which are part of this kit. The following chapters will give more details about these “Use case cards”

### Color card

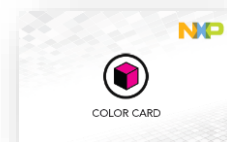
#### Card description

A color card is used to change the color on the NFC Cube. The color cards are based on NTAG216.

NFC Forum T2T card must be used for Color Cards. They embed an NDEF message with the RGB color values. (R = red, G = green, B = blue).

Example:

- NDEF message: RGB:FF0000.
- Color is red.



#### How to demonstrate

Tap the card on the NFC Cube and it will read out the message and change its color.

*Note: When presenting two color cards, the NFC Cube will add the RGB values and display the resulting color*

*Example: adding RGB:FF0000 (red) to RGB:00FF00 (green) will result into RGB:FFFF00 (yellow)*

#### How to create a color card

To create a color card you can use two ways:

- Use the NFC Cube mobile app
  - Open the side menu and go to the “set Color” screen.
  - Choose a color
  - Tap the card to the phone: the color card is programmed
- Use the NXP’s NFC TagWriter mobile application and got to “Write Tags”.
  - Choose to write a text.
  - The message shall be in this form RGB:xxxxxx.
  - Tap the card on the phone and you created a color card.

### ACCESS cards

#### Card description

The Access cards used for the demonstration are based on NTAG216 (NFC Forum Type 2 Tag). They allow to show an access control use case. DESFire cards can also be used.

There are two cards available: “access granted” or “access denied”.

There are two NDEF messages on the card :

- The first message is an NDEF text message with “ACCESS GRANTED” or “ACCESS DENIED”.
- The second message is an NDEF VCard message on it.

How to demonstrate

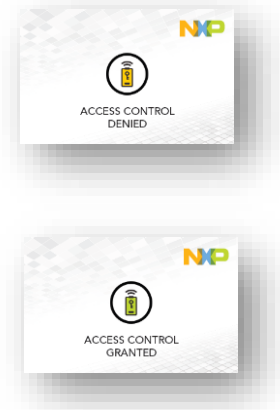
Tap the card on the cube. The NFC Cube blinks in Green or Red, depending on the card used.

The NFC Cube screen shows : “ACCESS GRANTED” or “ACCESS DENIED” plus the name of the contact from the VCard.

How to create a ACCESS card

To create an Access card you can use two ways:

- Use the NFC Cube mobile application
  - Open the side menu and go to the “Create Access Tag” screen
  - Choose between “ACCESS GRANTED” or “ACCESS DENIED”
  - Type the name to be written in the vCard field
  - Tap the card on the phone and you created an ACCESS card.
- Use the NXP’s NFC TagWriter mobile application and got to “Write Tags”.
  - Write “ACCESS GRANTED” or “ACCESS DENIED” on the card.
  - Then write a VCard on the card. Don’t forget to enable the checkbox “Write more NFC Tags successive”
  - Tap the card on the phone and you created an ACCESS card.



## NFC cards

Introduction

The NFC Cube supports the following NFC tags: Tag Type 1, Tag type 2, Tag type 3, Tag type 4 and Tag type 5 as defined in the NFC Forum specification. The NFC Cube is able to identify specifically the following “well known type” defined by the NFC Forum:

- URL
- Pairing (Handover)
- Contact cards (vCard)

How to demonstrate

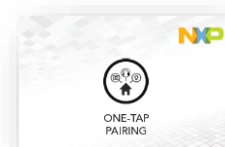
Tap the NFC Forum compliant card on the NFC Cube. The NFC Cube blinks in blue, and the screen display the tag type (1, 2, 3, 4 or 5).

When a known use case is detected, the NFC Cube displays the information related to the use case: URL, pairing information, contact name.

Bluetooth cards:

A Bluetooth card stores the information about a Bluetooth network and how to connect to it. Tap it on the top of the NFC Cube, and it will display the Bluetooth network name and the Bluetooth MAC address.

*Note: if you read this card with your phone, and if no “card reader application” is open, the phone opens a dialog box offering to connect to the Bluetooth network.*



How to create a Bluetooth card:

There are two ways to create a Bluetooth card

- Use the NFC cube mobile application,
  - Open the side menu and click on “Bluetooth”.
  - Set a random Bluetooth MAC address.
  - Present the card to the phone and you created a Bluetooth network card.
  
- Use the NXP’s NFC TagWriter mobile application
  - Go to “Write Tags”.
  - Choose Bluetooth.
  - You can create a network according to the Bluetooth list of your phone, or a new Bluetooth network.
  - Tap the card on the phone and you created a Bluetooth network card.

### WLAN cards:

A WLAN card stores the information about a WLAN network and how to connect to it.

*Note : If you read this card with your phone, and if no “card reader application” is open, the phone opens a dialog box displaying the WLAN network SSID name.*

#### How to create a WLAN card:

To create a WLAN card you can use two ways:

- Use the NFC Cube mobile application
  - Open the side menu and go to the “WiFi” screen.
  - Enter a random WLAN name.
  - Tap the card on the phone and you created a WLAN network card.
  
- Use the NXP’s NFC TagWriter mobile application
  - Chose “Write Tags”
  - Select WLAN.
  - You can create a network according to the WLAN list of your phone), or a new WLAN network.
  - Tap the card on the phone and you created a WLAN card.

### NDEF URL cards:

A URL card stores a URL (for example: <http://www.nxp.com>) in an NDEF message.

Tap the card on the top of the NFC Cube: the stored URL is displayed on the screen.

#### How to create a URL card:

- Use the NXP’s NFC TagWriter mobile application
- Chose “Write Tags”,
- Select Link. Don’t write any title
- Select URL website and enter the wed address (<http://www.nxp.com>)
- Tap a card on the phone and you created a URL card.



NDEF VCard cards:

A VCard will store a contact (like visit card) on the card. If you tap the card to the NFC Cube you will see “Welcome, Mr/Mrs” plus the name of the contact on the screen.



*How to create a contact vCard:*

- Use the NXP's NFC TagWriter mobile application
- Chose “Write Tags”
- Select New dataset then “ Business card
- Chose a contact from your phone directory
- Present a card to the phone and you created a VCard.

### Tamper Tags (not included in the NFC Cube kit)

The NFC Cube also supports tags based on the NTAG 213 Tag Tamper. For details on Tamper Tags please have a look at <https://www.nxp.com/products/:NT2H1311TTDUF>.

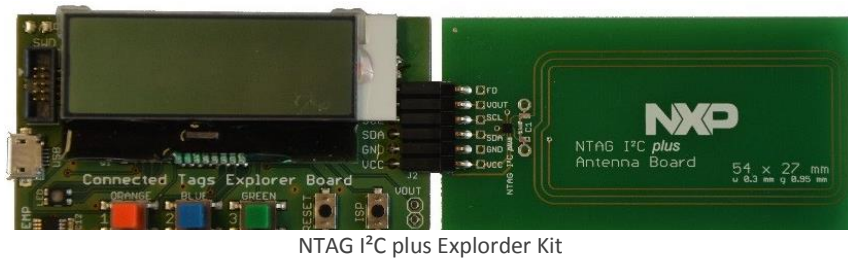
As a first step a Tamper Tag needs to be personalized. For this the Android app “NXP Product Authentication” (<https://play.google.com/store/apps/details?id=com.nxp.nxpproductauthentication.-demo>) can be used.

Depending on the status of Tamper Tag, the NFC Cube shows the following result in the “PC/SC & Demo-Mode”:

- “Tamper Loop incorrect” + red color blinking: the Tamper Tag is not yet personalized
- “Tamper Loop correct” + green color blinking: the Tamper Tag is personalized and the tamper loop is closed.
- “Tamper Loop open” + red color blinking: The Tamper Tag is personalized and the tamper loop is broken.

## NTAG I<sup>2</sup>C *plus* Explorer Board

The NFC Cube application is compliant with the “NTAG I<sup>2</sup>C *plus* Explorer Board”. This allows you to show how devices can exchange data using NFC technology, in both directions: from the NFC Cube to the NTAG I<sup>2</sup>C *plus* Explorer Board, and the other way around.



For more details about the NTAG I<sup>2</sup>C *plus* Explorer Kit, please visit [www.nxp.com/demoboard/OM5569-NT322E](http://www.nxp.com/demoboard/OM5569-NT322E).

How to demonstrate

Ensure the NFC Cube is in card reader mode.

Tap the NTAG I<sup>2</sup>C *plus* board on the top of the NFC Cube: the NFC Cube will send the color information to the NTAG I<sup>2</sup>C *plus* Explorer Board. The board will display the RGB code on its screen, and change the integrated LED accordingly.

Note: With the latest firmware of the NTAG I<sup>2</sup>C *plus* Explorer Board (October 2017), the NFC Cube also displays the temperature of the temperature sensor on its display.

An update of the application firmware of the NTAG I<sup>2</sup>C *plus* Explorer Board can easily be done by powering the Explorer board via the USB interface connected to a PC. During power-up the ISP button must be pressed. Once the ISP button is released the Explorer Board will be recognized as drive at the PC. Simply copy the firmware file (e.g. NTAG\_I2C\_Explorer\_Demo.bin) to this drive and remove the USB connection. Once the Explorer Board is repowered, the new firmware is installed.

Using the board's buttons allows to update the content of the NTAG I<sup>2</sup>C *plus* chip. The NFC Cube continuously read the content of the tag, and any modification will be reflected on the NFC Cube.

Example:

- Press the Red button on the NTAG I<sup>2</sup>C *plus* Explorer board : the NFC Cube color will turn red and both displays will be update accordingly

*Note: It is possible to press simultaneously on two buttons of the explorer board to create various combination of colors*

## Contact cards

Introduction

The NFC Cube detects contact cards who support T=0 and T=1 protocols. It shows the ATR on the cube's screen, and enables any CCID application from the PC to communicate with the cards

How to demonstrate

Insert the card on the right side of the screen. The ATR of the card will be displayed.

Banking cards can be used: the NFC Cube will identify which type of banking is used, and display the information on the screen.



## NFC Cube Android app:

### Introduction

The NFC Cube Android app enables the user to communicate with the NFC Cube. It offers the following possibilities:

- Change the NFC Cube's color
- Program several colors on the NFC Cube
- Read the history of the colors displayed by the NFC Cube

The Android application also allows to create the use case cards



### Installing the NFC Cube Android application


The NFC Cube Android application is available on Google play store (NFC Cube).

<https://play.google.com/store/apps/details?id=com.nxp.nfccube>

Simply follow the instruction as for the installation of any mobile application

### Launching the application

There are 2 ways to launch the NFC Cube Android application:


-  Click on the application logo. The application will start and allow to read the NFC Cube color history (latest 10 colors displayed by the NFC Cube).
- Tap the phone on the top of the NFC Cube : The NFC Cube application will start automatically, and display the history of all colors displayed by the NFC Cube.

*Important note : To enable the application to run with the NFC Cube, ensure that the NFC Cube is in the correct mode using the NFC Cube's mode button.*



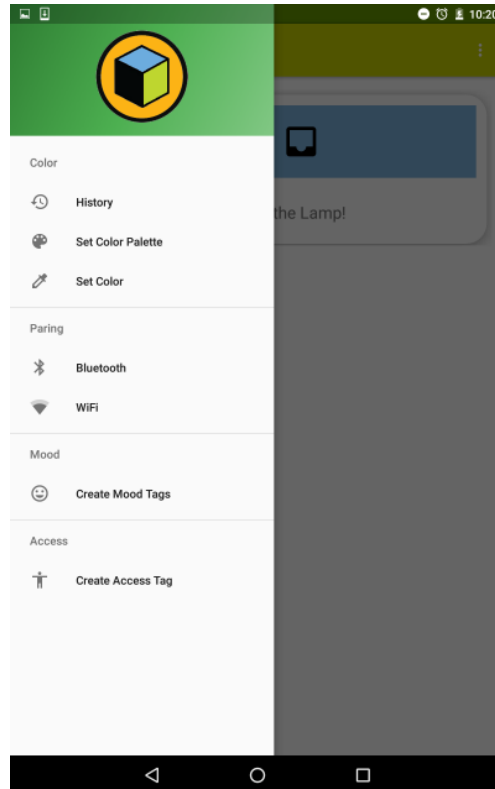
*Figure 1: If you are starting up the application you will see the first screen. On this screen you can read out the color history from the lamp. Tap the phone to the NFC cube and you will get indicated the last ten colors.*

### Application menu overview

Tap on  in the top left of the screen to open the side menu. On this Menu you can access all the functionalities of the application.

The menu features are:

- History
- Color Palette
- Bluetooth
- Tag creation
  - NFC tags (Bluetooth, Wifi)
  - Mood use case Tags
  - Access use case Tags



### History screen



The NFC Cube always stores the last ten colors in its memory. If you change the color on the NFC Cube, with a color card or with NFC Cube mobile application (menu: “set Color” or “set Color palette”) the chosen colors are stored in the history and are accessible to any mobile phone as an emulated “Tag Type 4”.

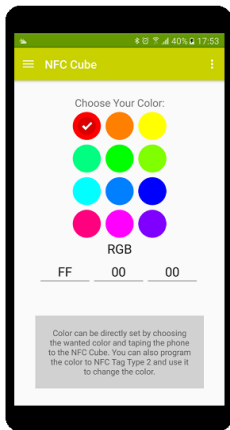
How to demonstrate

- ⇒ In the NFC Cube mobile application menu, select “History”
- ⇒ Present the phone on the top of the NFC Cube

**Note**

*If you tap an NFC phone with the NFC Cube Android application already installed, the application will start automatically and open the history menu, displaying the last 10 colors.*

### Set color screen



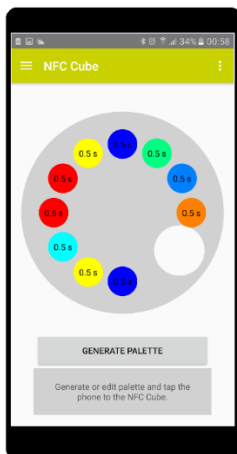
This screen enables to choose a color, and to send it to the NFC cube. It can also be used to create a color card.

#### How to demonstrate

Select a color and present the phone on the top of the NFC Cube. The NFC Cube color will change according to the selected color.

*Note: to create a color card, select a color and put the card behind the phone.*

### Set color palette screen



This feature allows to program the NFC Cube with a set of 10 colors, which will be displayed by the NFC Cube. By default, every color is displayed 0.5 seconds.

#### How to demonstrate

Click on Set Color Palette in the application menu. The palette appears on the screen.

The application automatically sets a random palette. You can create a new random palette using the “GENERATE PALETTE” button.

It is possible to modify the color of a palette by clicking directly on the color. It is then possible to change the color or the timing during which the color will be displayed by the NFC Cube.

### PC Software:

The PC software allows to display information about cards and any NFC objects presented in front of the reader. It allows to demonstrate the various use cases enabled by the RF interface like Banking, Access control, NDEF Messages and so on.

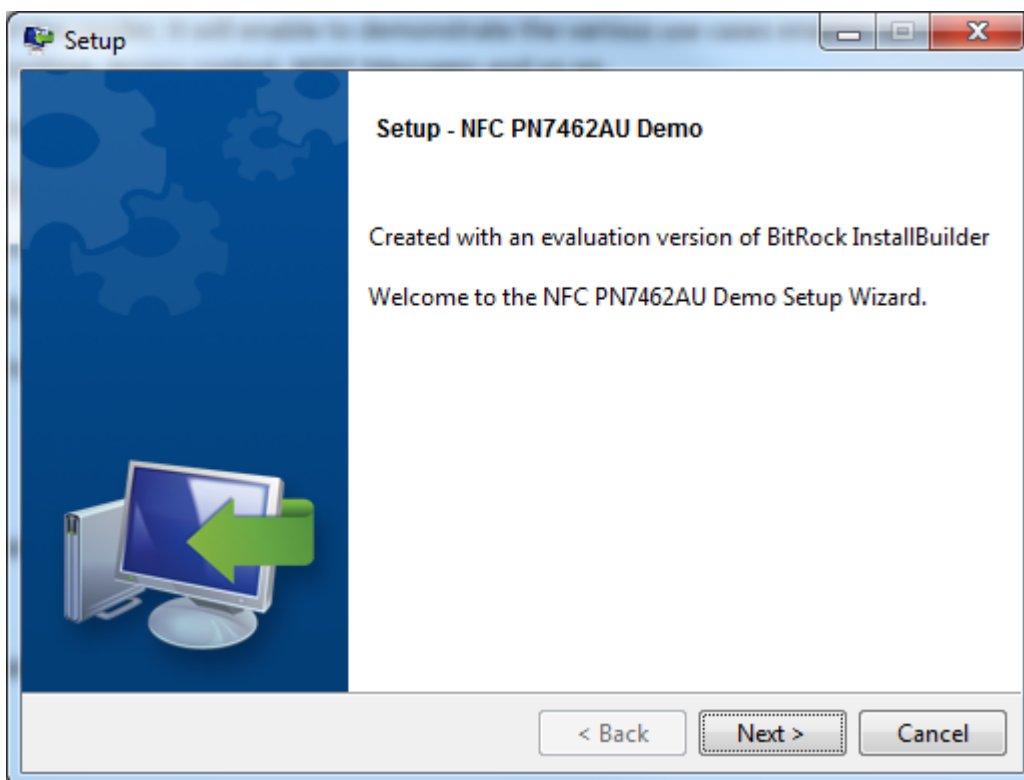
#### Installation:

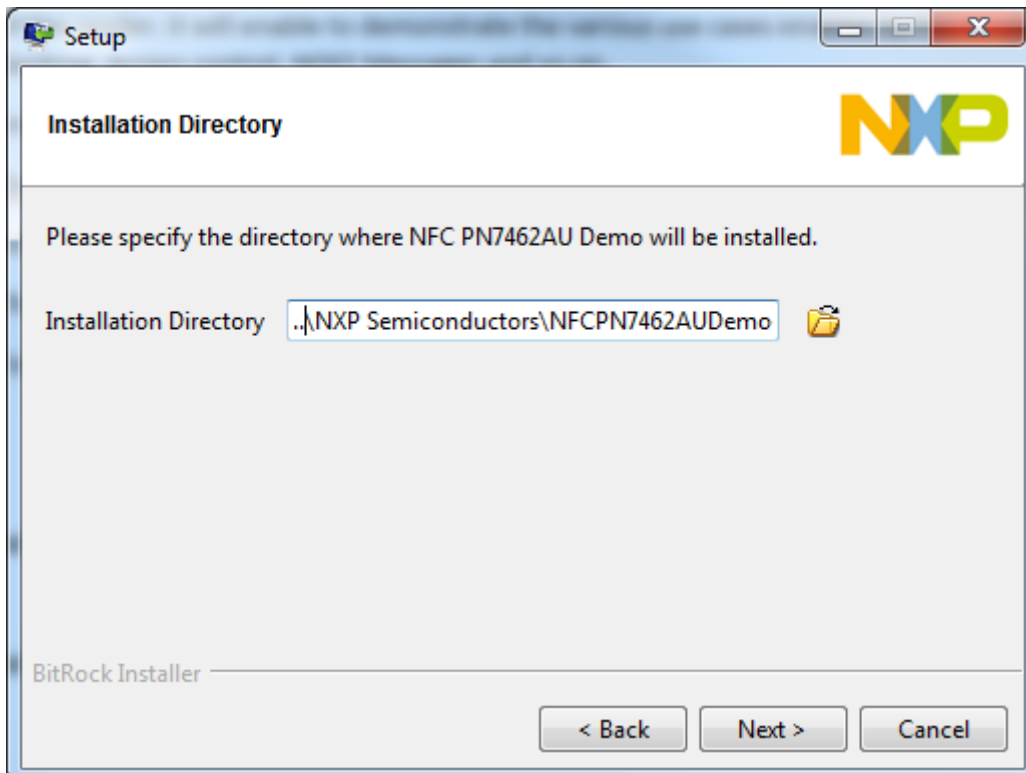
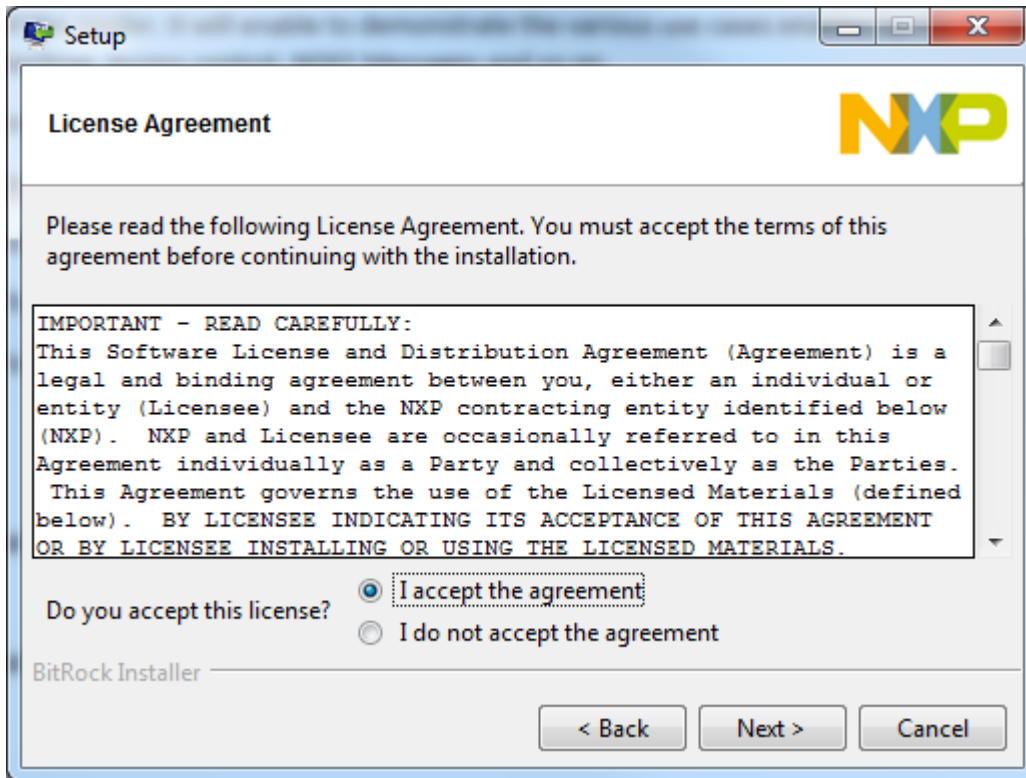
Download the Software from the link below:

<http://www.nxp.com/NFCcube>

The name of the PC Software is NFC PN7462AU Demo – Vx.x.x

Follow the steps from the wizard you see below:

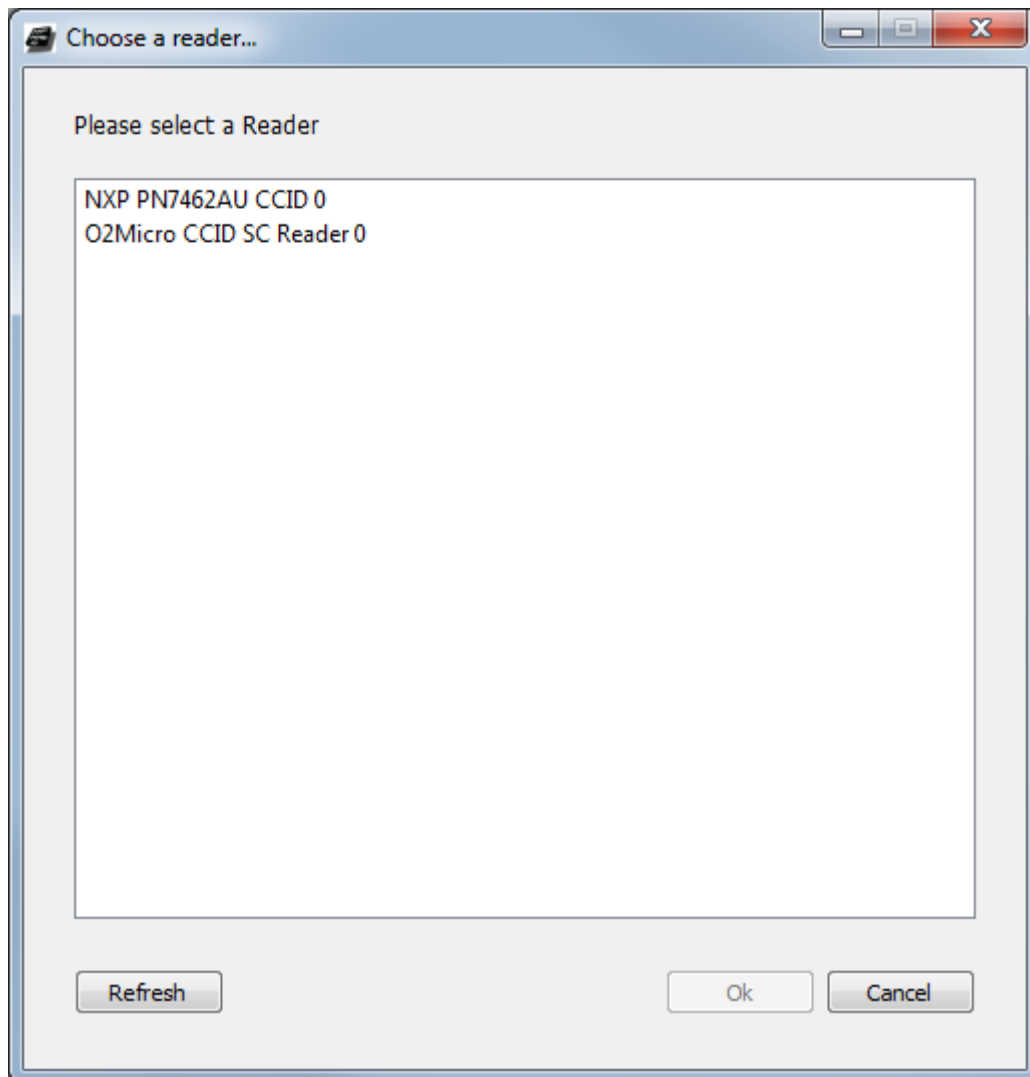




Using the Software:

Go to the installation folder and do a double click on the \*.exe file.

Now the Software will be started. Now you will see a little window to choose one of the connected readers.



NXP PN7462AU CCID 0 is the right one. Choose it and you can use the Software. Now tap a card to the cube and enjoy.

Functionality:

- Supported cards: Mifare family, Type B, Felica
- NDEF support: VCards, Url's, Text, Bluetooth, WLAN
- Application support: Mood cards, ACCESS cards, Passport, Activision gaming tags, Color cards (NDEF Message: RGB:XXXXXX)
- NTAG I<sup>2</sup>C and NTAG I<sup>2</sup>C *plus*

## Disclaimer

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The NFC Cube and all related software and documentation are provided exclusively for demonstration. The NFC Cube is not intended for sales. It is not CE or Fcc certified.

**Hardware** The NFC Cube is developed for demonstration purpose only. It is not a reference design, the PCB files and schematics cannot be shared. For hardware reference the PNEV7462EV board schematics should be used.

**Software:** The NFC Cube software and the android application are developed for demonstration only and the source code cannot be shared. Please refer to the PSP (Product Support Package) for examples on how to use the various interfaces.

## Document History

Version	Comment	Date
1	Initial Version	13/05/2016
1.1	Add introduction – editorial modifications	14/05/2016
1.2	Change Engagement to NFC Cube	20/05/2016
1.3	Review – typo and phrasing corrections	20/05/2016
1.4	Disclaimer addition	23/05/2016
1.5	Integration of Sophie’s comment,, add a link to NTAG I2C plus board, replace all cube by NFC Cube, and “present” by “Tap”	23/05/2016
1.6	Typo correction, update the Mobile App address in “google play”	20/06/2016
1.7	Update according to FW3.3 – support of contact cards, support of DESFire T4T for the access demonstration, support of T4T and T5T as NFC cards	17/11/2016
1.8	Update according to FW3.9 – support Tamper Tag, pure PC/SC mode and display of temperature	23/11/2017