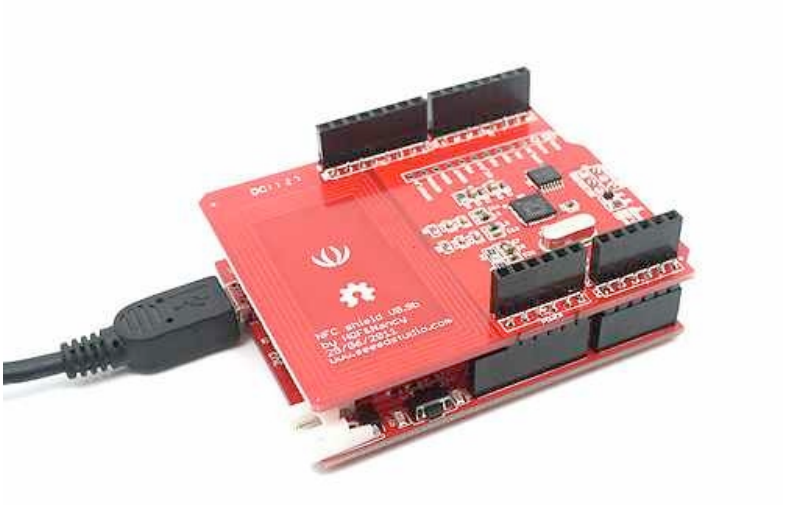
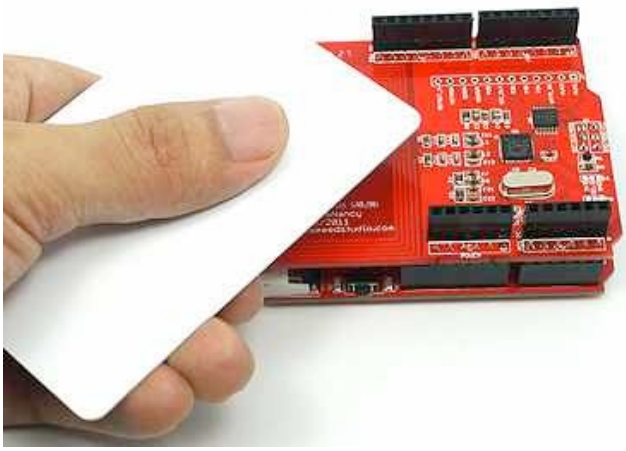
How to Use NFC Shield with Arduino and Demo Code?

I) Hardware Installation

1) Connect **NFC Shield** to **Arduino** as shown below.
2) Compile and upload the example sketch provided.



3) Hold the **MIFARE Card** near the antenna. The NFC Shield will read the passive id data.



4) Hold the **MIFARE Tag** near the antenna. The NFC Shield will read the passive id data

II) Programming

The PN532 software library for **NFC Shield** is derived from Adafruits PN532 Library.The original library provides API for reading Passive Target ID of Mifare Card/Tags. This is enough for card/tag identification purpose. We have added APIs for authentication, reading from and writing to Mifare Cards/Tags. The software library only provides low level functionality. Users have to implement NFC application layer(if required).

The PN532 software library should be inculded in the Arduino Include folder of the Arduino software program before using the following code example

Quick Start Demo

A simple sketch which reads the **Passive Target ID** from MIFARE cards and tags. **Passive Target ID**is an **unique**, **permanent** and **read-only** number programmed on to the MIFARE card by the manufacturer. This number is used to identify one card from another.

- Connect the NFC Shield to Seeeduino / Arduino as shown above.

- Include the PN532 software library in the include folder of the arduino program
- Compile and upload the program to Arduino.
- Bring a Mifare Card near the NFC Antenna as shown above.

```
#include <PN532.h>

/*
 * Corrected MISO/MOSI/SCK for Mega from Jonathan Hogg
(www.jonathanhogg.com)
 * SS is the same, due to NFC Shield schematic
 */
#define SS 10
#if defined(__AVR_ATmega1280__) || defined
(__AVR_ATmega2560__)
  #define MISO 50
  #define MOSI 51
  #define SCK 52
#else
  #define MISO 12
  #define MOSI 11
  #define SCK 13
#endif

PN532 nfc(SCK, MISO, MOSI, SS);

void setup(void) {
  Serial.begin(9600);

  nfc.begin();

  uint32_t versiondata = nfc.getFirmwareVersion();
  if (! versiondata) {
    Serial.print("Didn't find PN53x board");
    while (1); // halt
  }
  // Got ok data, print it out!
  Serial.print("Found chip PN5"); Serial.println
((versiondata>>24) & 0xFF, HEX);
```

```
  Serial.print("Firmware ver. "); Serial.print
((versiondata>>16) & 0xFF, DEC);
  Serial.print('.'); Serial.println((versiondata>>8) &
0xFF, DEC);
  Serial.print("Supports "); Serial.println(versiondata &
0xFF, HEX);

  // configure board to read RFID tags and cards
  nfc.SAMConfig();
}


void loop(void) {
  uint32_t id;
  // look for MiFare type cards
  id = nfc.readPassiveTargetID(PN532_MIFARE_ISO14443A);

  if (id != 0) {
    Serial.print("Read card #"); Serial.println(id);
  }
}
```

III) Application Programming Interfaces (API)

NFC is a secure technology (*Meaning*: *Communication between NFC reader/ writer and NFC card/tag happens in a encrypted and authenticated manner*). The security and other complex handshaking are handled by PN532 firmware provided by NXP.

The APIs make use of the commands to invoke the interfaces provided by PN532 firmware via SPI. All these commands are documented in PN532 User Manual. The following APIs are provided by PN532 Library.

PN532(uint8_t cs, uint8_t clk, uint8_t mosi, uint8_t miso)

An object of PN532() is created with this. The digital pins of Arduino used as SPI (in AtMega328P or Mega) is specified as parameters.

Usage:

```
#define SCK 13
#define MOSI 11
#define SS 10
#define MISO 12

PN532 nfc(SCK, MISO, MOSI, SS);
```

begin()

begin() method has to be called to initialize the driver.

Usage:

```
nfc.begin();
```

boolean SAMConfig(void)

This API invokes the **SAMConfiguration** command of PN532 and sets it to **Normal Mode**. **SAM**stands for Security Access Module (i.e the PN532 system). PN532 system can work in **Normal**mode, **Virtual Card** mode, **Wired Card** mode and **Dual Card** mode.

Usage:

```
nfc.SAMConfig(); // Call this before any read/write operation
```

uint32_t readPassiveTargetID(uint8_t cardbaudrate)

This method reads the Passive Target ID and returns it as a 32-bit number. At the moment only reading MIFARE ISO14443A cards/tags are supported. Hence use **PN532_MIFARE_ISO14443A** as parameter. *Returns* 32 bit card number

Usage:

```
uint32_t cid;
// look for MiFare type cards/tags
cid = nfc.readPassiveTargetID(PN532_MIFARE_ISO14443A);
```

uint32_t authenticateBlock(uint8_t cardnumber, uint32_t cid, uint8_t blockaddress ,uint8_t authtype, uint8_t * keys)

This method is used to authenticate a memory block with key before read/write operation. *Returns***true** when successful.

- **cardnumber** can be 1 or 2
- **cid** is 32-bit Card ID
- **blockaddress** is block number (any number between 0 - 63 for MIFARE card)
- **authtype** is which key is to be used for authentication (either **KEY_A** or **KEY_B**)
- **keys** points to the byte-array holding 6 keys.

Usage:

```
uint8_t keys[]= {0xFF,0xFF,0xFF,0xFF,0xFF,0xFF};  // default key
of a fresh card
nfc.authenticateBlock(1, id ,3,KEY_A,keys); ////authenticate
block 3, id is 32-bit passive target id.
```

uint32_t readMemoryBlock(uint8_t cardnumber,uint8_t blockaddress, uint8_t * block)

This method reads a memory block after authentication with the key. *Returns* **true** when successful.

- **cardnumber** can be 1 or 2

- **blockaddress** is block number (any number between 0 - 63 for MIFARE card) to read. Each block is 16bytes long in case of MIFARE Standard card.
- **block** points to buffer(byte-array)to hold 16 bytes of block-data.

Usage:

```
uint8_t block[16];
nfc.readMemoryBlock(1,3,block); //Read can be performed only
when authentication was successful.
```

uint32_t writeMemoryBlock(uint8_t cardnumber,uint8_t blockaddress, uint8_t * block)

This method writes data to a memory block after authentication with the key. *Returns* **true** when successful.

- **cardnumber** can be 1 or 2
- **blockaddress** is block number (any number between 0 - 63 for MIFARE card) to write. Each block is 16bytes long in case of MIFARE Standard card.
- **block** points to buffer(byte-array) which holds 16 bytes of block-data to write.

Usage:

```
uint8_t writeBuffer[16];
    for(uint8_t ii=0;ii<16;ii++)
     {
       writeBuffer[ii]=ii; //Fill buffer with 0,1,2....F
     }
nfc.writeMemoryBlock(1,0x08,writeBuffer); //Write writeBuffer[]
to block address 0x08. Read can be performed only when
authentication was successful.
```

readAllMemoryBlocks.pde

Compile and upload **readAllMemoryBlocks.pde** example provided with the library. This sketch reads the complete memory of a MIFARE Standard card using default authentication keys. The output gives typical memory layout of fresh MIFARE Standard card.

Blocks are classified as **Manufacturer Block**(read-only), **Data Block** (user/ application writable area), and **Sector Trailer**(authentication and access bits for that sector)

Output