Near Field Communications (NFC)

https://goo.gl/QuZtgB

Capstone Project

Near Field Communications - NFC

A short-range high frequency (13.56MHz) wireless communication technology that enables the exchange of data between devices over about 10cm distance.

NFC Applications

NFC Tags

- Mifare Classic 1K (752 bytes), 4K (3440 bytes)
  - Low cost and very common (TnG etc.)
  - Not an NFC forum compliant tag and therefore not compatible with most latest Android phones
- NFC Forum Type 2 Tag
  - NFC forum compliant tag and therefore compatible with all Android phones with NFC capability
  - Mifare Ultralight (46 bytes)
  - NTAG203/NTAG213 (142 bytes)

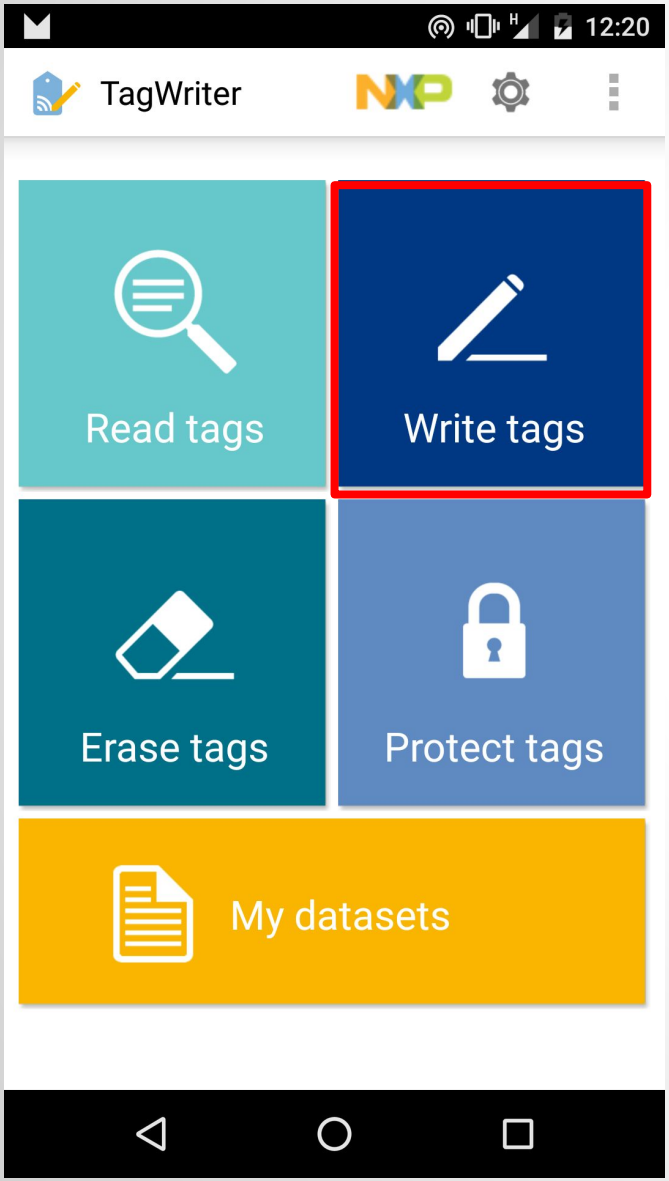
NFC Data Exchange Format (NDEF)

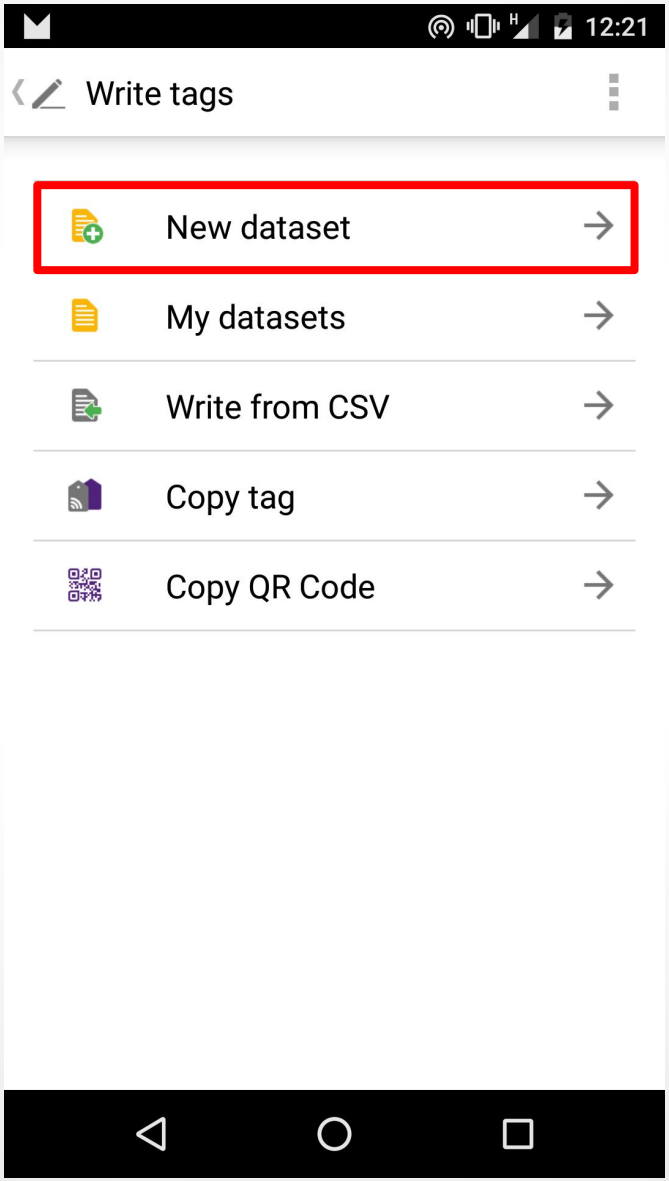
- NFC data usually encoded in NDEF format
- A lightweight, binary message format that can be used to encapsulate one or more application-defined payloads of arbitrary type and size
- Each NDEF message consists of one or more NDEF records

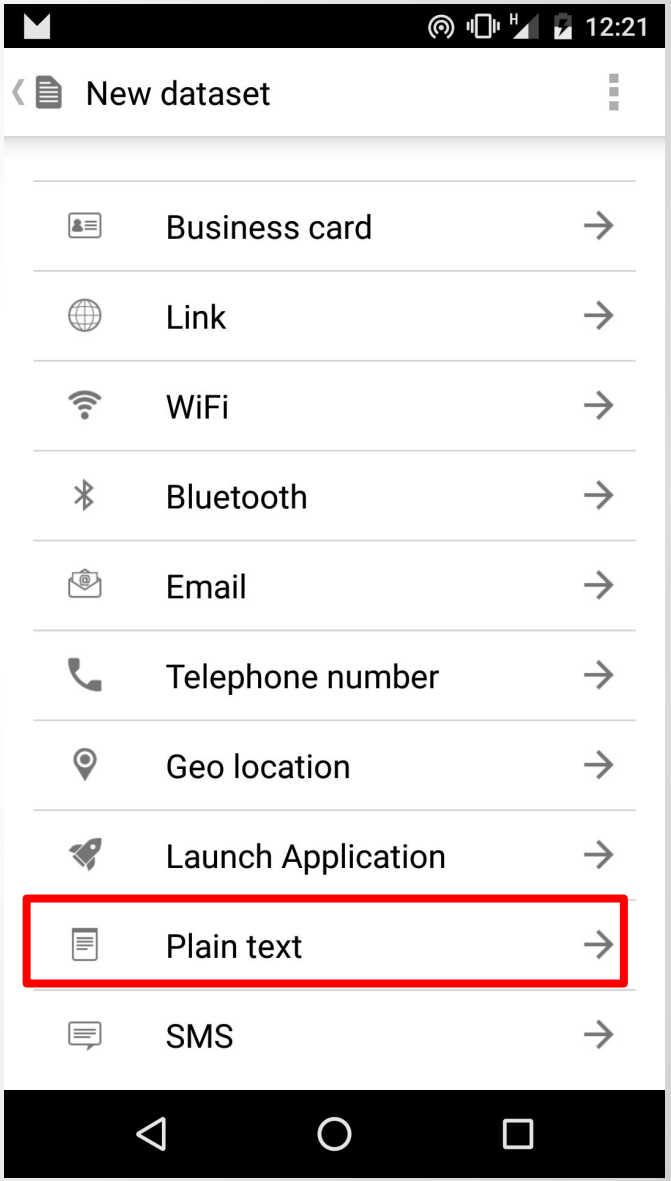
Writing Data to NFC Tags

- Using the Android App **NFC TagWriter by NXP** downloaded from https://play.google.com/store/apps/details?id=com.nxp.nfc.tagwriter

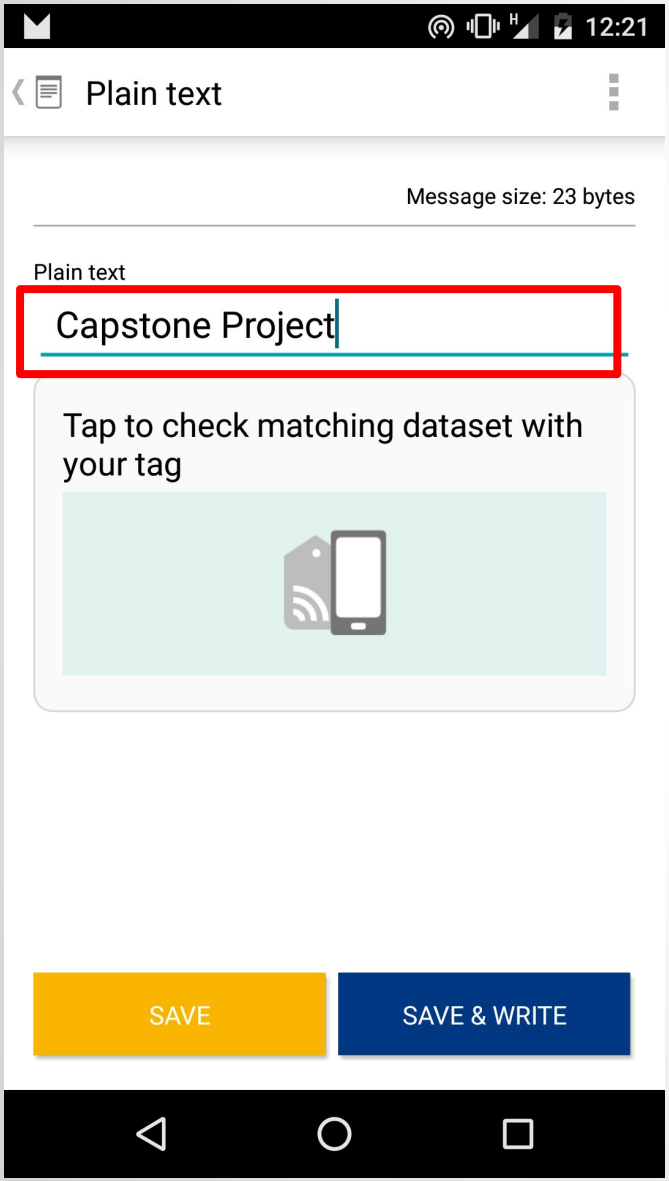
Writing Data to NFC Tags

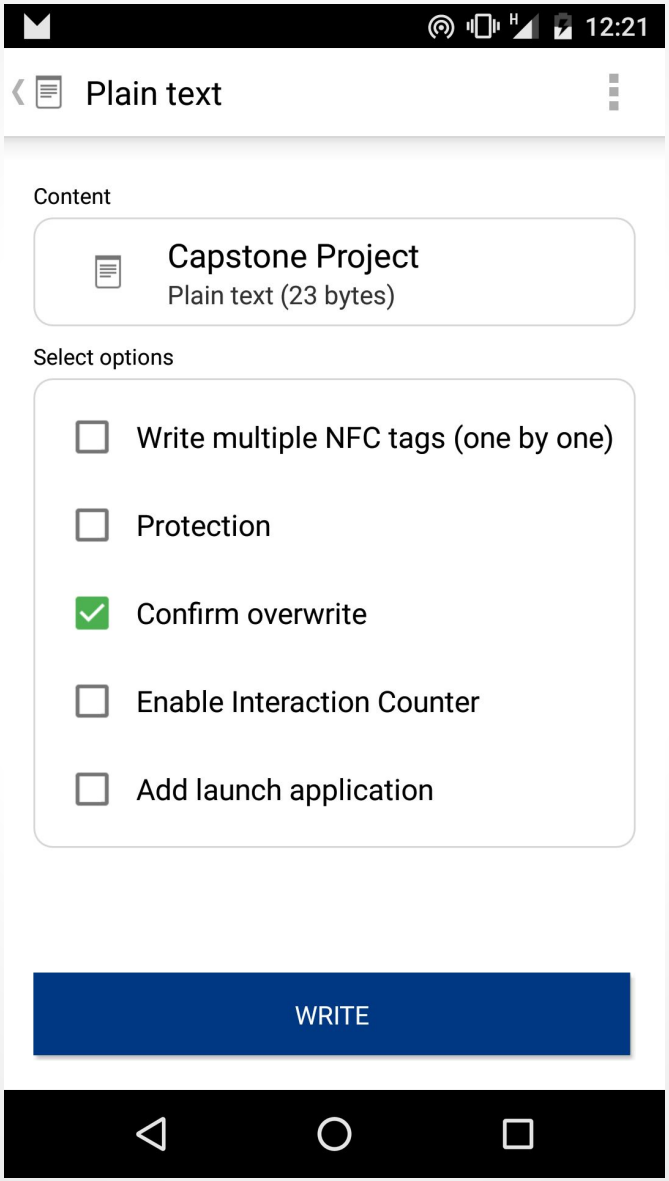


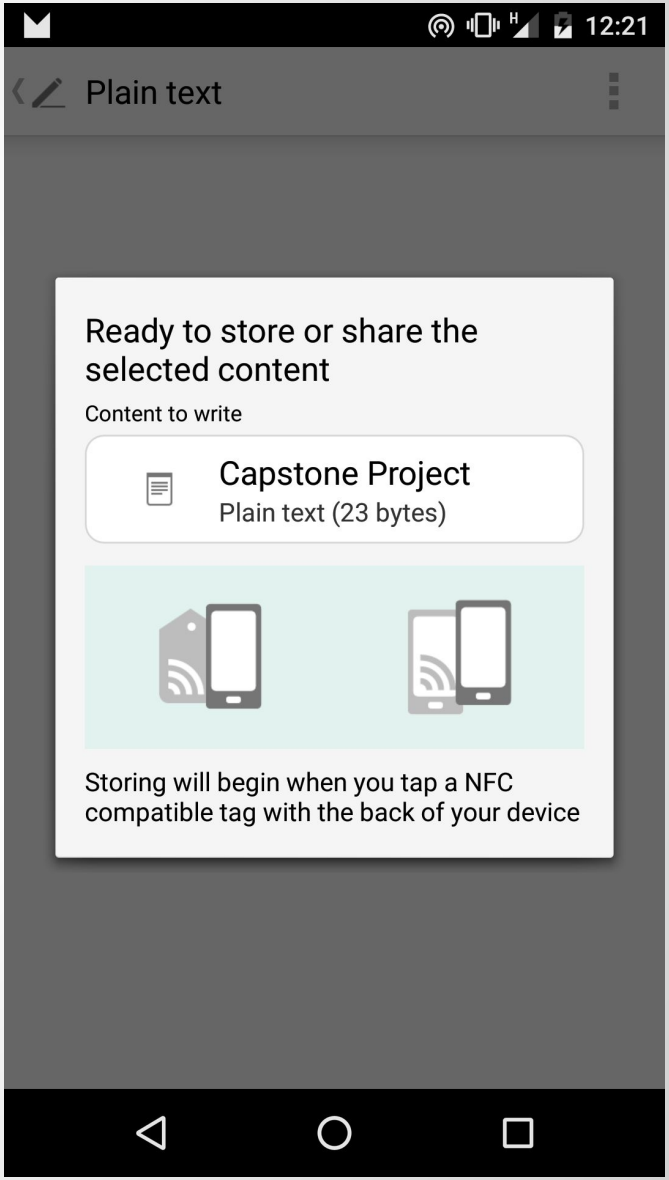




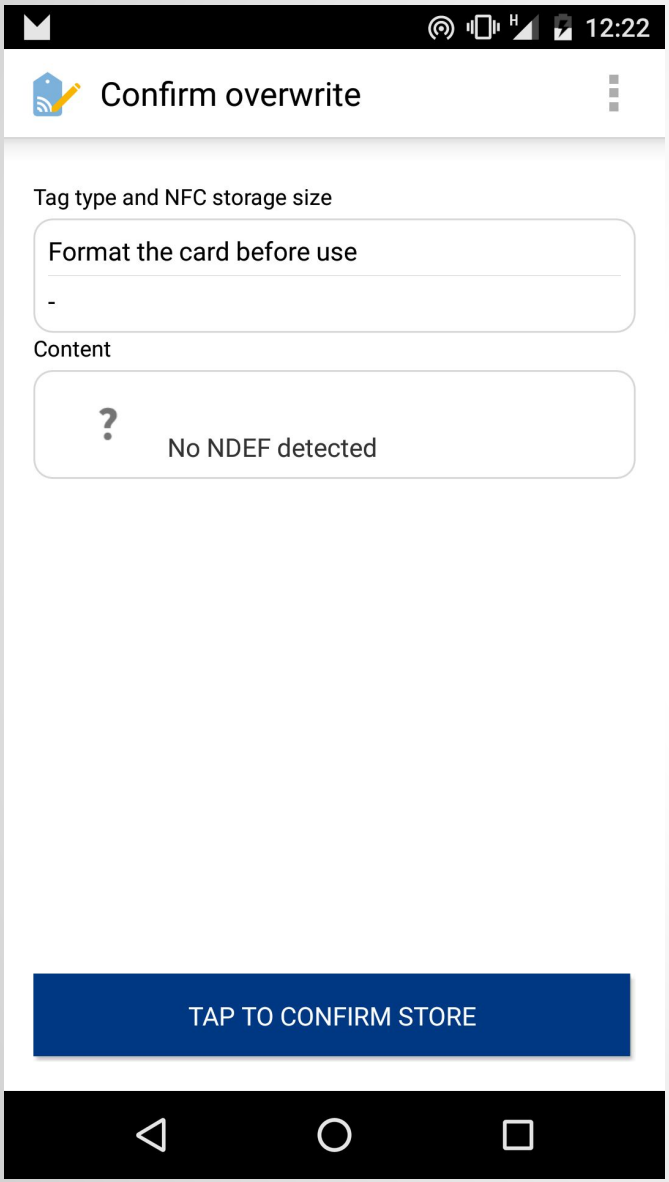
Writing Data to NFC Tags

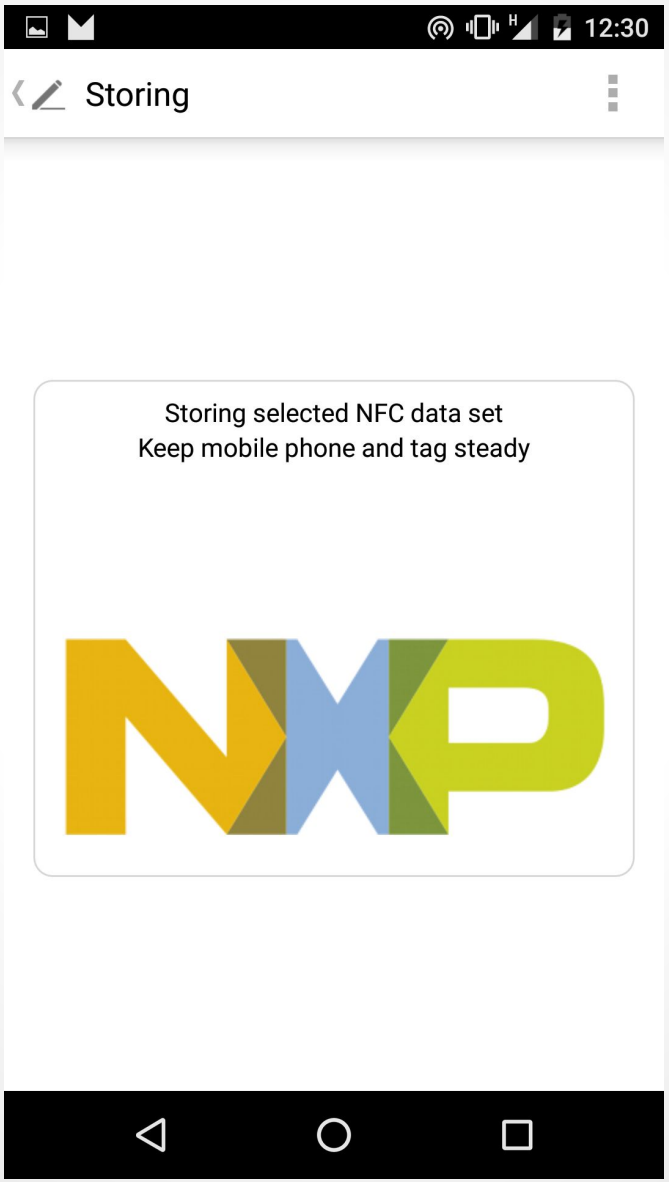


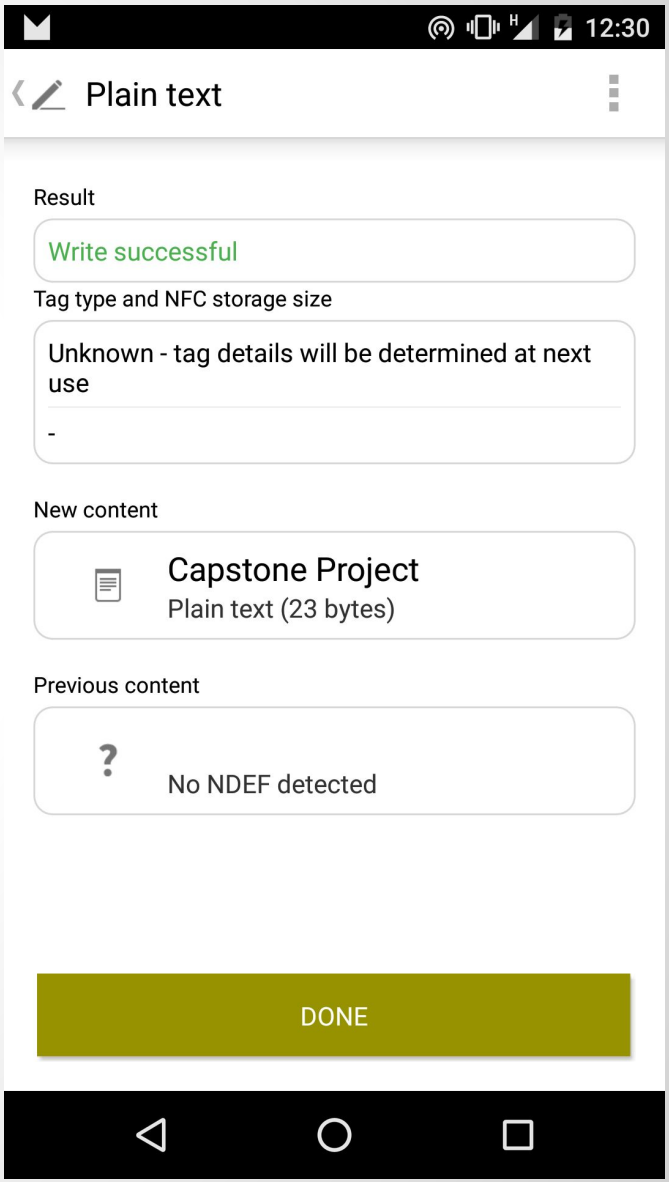




Writing Data to NFC Tags



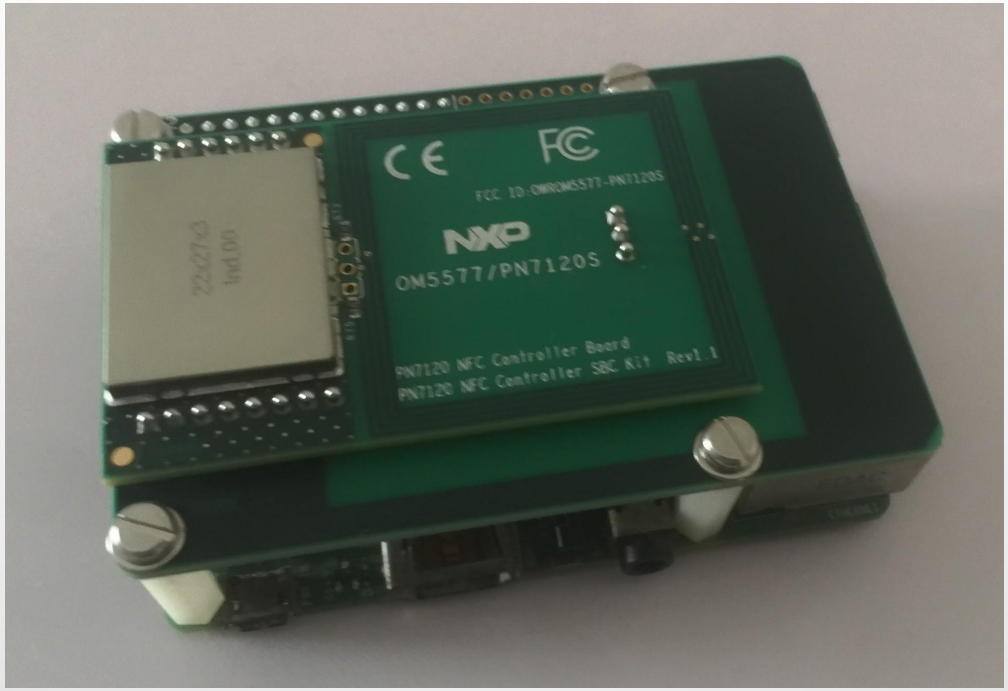




NFC
on Raspberry Pi

Adding NFC Capability to Raspberry Pi

- **PN7120 NFC Controller Board,** A fully NFC compliant expansion board for the Raspberry Pi based on the NXP PN7120 NFC Controller
- Plugged into the GPIO pins via Raspberry Pi Interface Board



Using PN7120 NFC Controller Board

- Documentation at

https://www.nxp.com/docs/en/user-guide/UM10878.pdf

- Software for the board is included in the OM5577 Raspberry Pi Linux demo image

https://www.nxp.com/lgfiles/updates/NFC/OM5577-PN7120S_Rpi_Linux_demo_v1.3.zip

- Run the basic example to detect NFC tag and read NDEF data

~/linux_libnfc-nci/nfcDemoApp poll

Using Python module Pexpect

- Pexpect is a Python module for spawning child applications, controlling them and responding to expected patterns in the output

```
import pexpect
p = pexpect.spawn('/home/pi/linux_libnfc-nci/
                          nfcDemoApp poll', timeout=None)
for line in p:
    If "Text :" in line:
        print line.strip()
p.close()
```

NFC
on Android

Android NFC Modes

- **Reader Mode**
  - read NFC tags (since API Level 9)
  - write NFC tags (since API Level 10)
- P2P Mode
  - 2 devices exchange data (since API Level 10)
- Card Emulation
  - Host-based Card Emulation (since API Level 19)

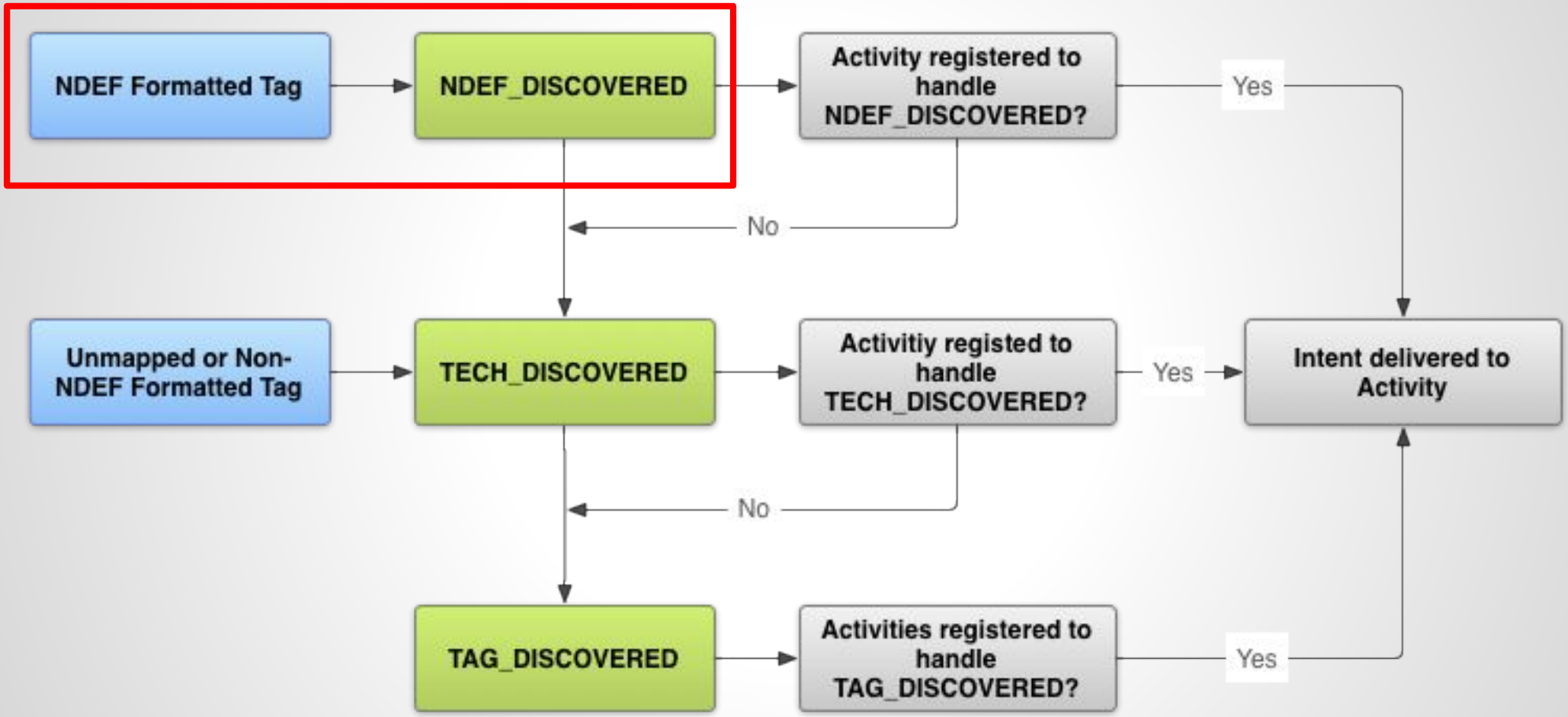
NFC Adapter

- Represents the local NFC adapter
- Using NFC requires permission in Android Manifest
  “android.permission.NFC”
- Get the default NFC adapter for an Android device with

```
NfcAdapter nfc = NfcAdapter.getDefaultAdapter(this);
```

- getDefaultAdapter() returns **null** if NFC is not supported
- nfc.**isEnabled()** returns **false** if NFC is not enabled

Android NFC Tag Dispatch System



Android NFC Tag Dispatch System

- NFC Foreground Dispatch
  - The Activity will read NDEF data when it is active in the foreground
  - Enable by calling **enableForegroundDispatch()**
- NFC Background Dispatch
  - The Activity will read NDEF data even when Activity is not yet launched or running in the background
  - Enable by adding an Intent Filter in Android Manifest

NFC Foreground Dispatch

- In onResume(), listen to the intent NfcAdapter.*ACTION_NDEF_DISCOVERED*

```
PendingIntent pi = PendingIntent.getActivity(this, 0,
    new Intent(this, getClass()), 0);
IntentFilter filter = new IntentFilter(NfcAdapter.
  ACTION_NDEF_DISCOVERED);
filter.addCategory(Intent.CATEGORY_DEFAULT);
filter.addDataType("text/plain");
IntentFilter[] filters = {filter};
nfc.enableForegroundDispatch(this, pi, filters, null);
```

NFC Foreground Dispatch

- In onPause(), stop listening to the NDEF Discovered intent

```
nfc.disableForegroundDispatch(this);
```

NFC Foreground Dispatch

- To prevent MainActivity to be launched again with NFC Foreground Dispatch, change MainActivity launch mode to **Single Instance**

```
<activity
        android:name=".MainActivity"
        android:launchMode="singleInstance">
        …
</activity>
```

NFC Background Dispatch

- Add NDEF Discovered Intent Filter to MainActivity to enable NFC Background Dispatch

```
<intent-filter>
    <action android:name=
            "android.nfc.action.NDEF_DISCOVERED" />
    <category android:name=
            "android.intent.category.DEFAULT" />
    <data android:mimeType="text/plain" />
</intent-filter>
```

Reading NDEF Data

- Obtain the NDEF Data from the **NDEF Discovered Intent** in
  - onNewIntent(Intent **intent**)
    - via Foreground Dispatch
    - via Background Dispatch when Activity is running in background
  - getIntent() in onCreate()
    - via Background Dispatch when Activity is not launched

Reading NDEF Data

- Obtain the NDEF Message from **NDEF Discovered Intent**

```
Parcelable[] messages =
                intent.getParcelableArrayExtra(
                  NfcAdapter.EXTRA_NDEF_MESSAGES);
for(int i = 0;i < messages.length;i++) {
    NdefMessage message
                        = (NdefMessage) messages[i];
}
```

Reading NDEF Data

- Obtain the NDEF records from NDEF Message

```
NdefRecord[] records = message.getRecords();
for (int j = 0; j < records.length; j++) {
        NdefRecord record = records[j];
        ......
}
```

Reading NDEF Data

- Obtain the text from NDEF Record Type T (urn:nfc:wkt:T → Text)

```
NdefRecord record = records[j];
if(new String(record.getType()).equals("T")) {
    byte[] original = record.getPayload();
    byte[] value = Arrays.copyOfRange(original, 3,
                                      original.length);
    String payload = new String(value);
}
```

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Thank you