

# AN13303 SNxxx/PN557- NFC Host SW Integration Guideline

Rev-3.3 — 9/8/2023

Application Note

## Document information

| Info     | Content      |
|----------|--------------|
| Keywords | NFC, Android |

**Revision history**

| Rev | Date       | Description  |
|-----|------------|--|
| 1.0 | 2022-12-16 | Initial version for Android 14 NXP NFC Host SW Integration Guide |
| 2.0 | 2023-01-12 | Target Library list updated for NFC & SE AIDL based HAL service  |
| 2.1 | 2023-04-14 | Updated with DTA APK setup guide link.                           |
| 3.0 | 2023-04-24 | Review updates   |
| 3.1 | 2023-08-23 | Removed unused config options                                    |
| 3.2 | 2023-09-05 | Updated the keymint VTS/CTS and properties changes.              |
| 3.3 | 2023-09-08 | Updates for 14.0B.00   |

## 1. Introduction

NXP's NFC controller SNxxxT/U and PN557 are designed to work with Android open source. Fig. 1 for SN1xx , Fig. 2 for SN220 and Fig 3 for PN557 shows the NXP's development and validation platform setup with Hi-key board 960.

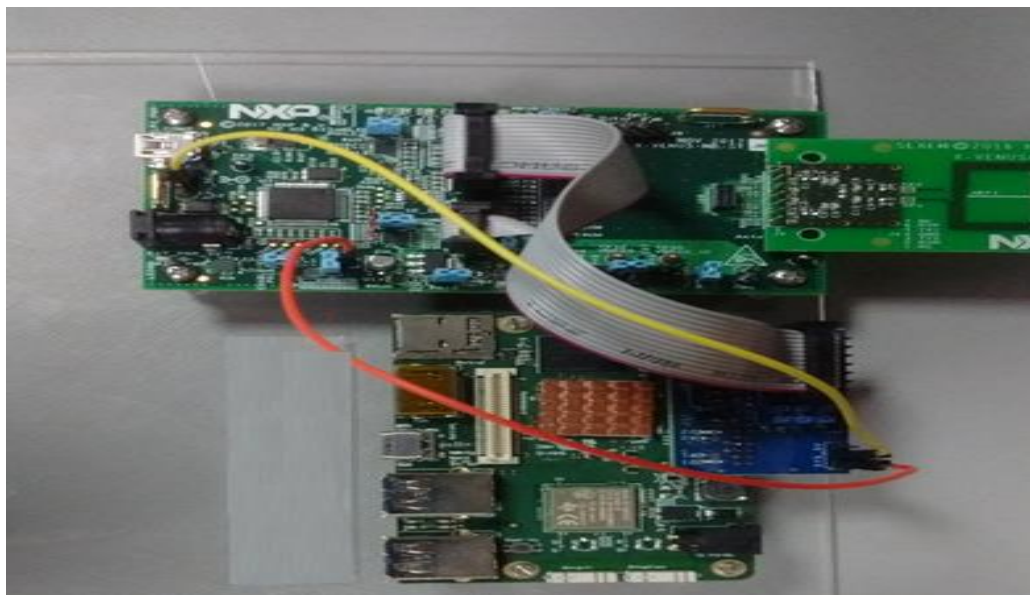


Figure 1: Hikey960 with SN1xx and Iguana Lite Board

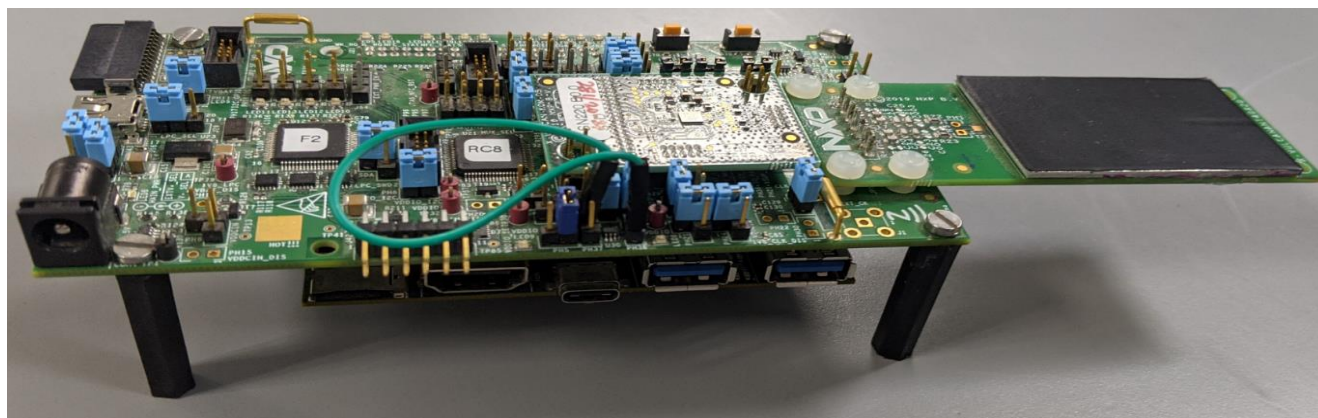


Figure 2: DB845C with SN220 and Komodo Board



Figure 3: Hikey960 along with PN557 Daughter sandwich board

## 2. Abbreviations

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|       |  |
|-------|--|
| NFC   | Near Field Communication                       |
| OEM   | Original Equipment Manufacturer                |
| HW    | Hardware                                       |
| IC    | Integrated Circuit                             |
| SWP   | Single Wire Protocol                           |
| GPIO  | General Purpose Input / Output                 |
| I2C   | Inter-Integrated Circuit                       |
| SPI   | Serial Peripheral Interface                    |
| SW    | Software                                       |
| SE    | Secure Element                                 |
| OMAPI | Open Mobile Application Programming Interface  |
| AOSP  | Android Open Source Project                    |
| HAL   | Hardware Abstraction Layer                     |
| eSE   | Embedded Secure Element                        |
| OS    | Operating System                               |
| SEMS  | Secure Element Management Service              |
| LS    | Loader Service                                 |
| GSMA  | GSM Association                                |
| GSM   | Global System for Mobile                       |
| NFCC  | NFC Controller                                 |
| SMB   | System Mail Box                                |
| HIDL  | HAL interface definition language              |
| UICC  | Universal Integrated Circuit Card              |
| ISO   | International Organization for Standardization |
| DH    | Device Host                                    |
| DTA   | Device Test Application                        |
| NA    | Not Applicable                                 |
| MPOS  | Mobile Point of Sale                           |
| TEE   | Trusted Execution Environment                  |

### 3. Scope

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This document provides guidelines for setting up NXP's new generation NFC/SE monolithic platform SN<sub>xxx</sub>T/U and NFC only PN557 in Android 14 build environment. It is a reference guideline for basic system integration. OEM integration may have variations based on actual system integration.

## 4. General steps for Android NFC integration

For the NFC software integration with Android, it is hereby assumed that NFC IC HW integration is done in a platform with following checks.

- Schematic reviewed with NXP
- HW IC interface like I2C/SPI, SWP (if used) working.
- Antenna designed and reviewed
- Antenna connection working
- GPIO connections checked

Fig. 4, shows the basic flow for Android NFC SW bring up. Following sections describe these steps in detail.

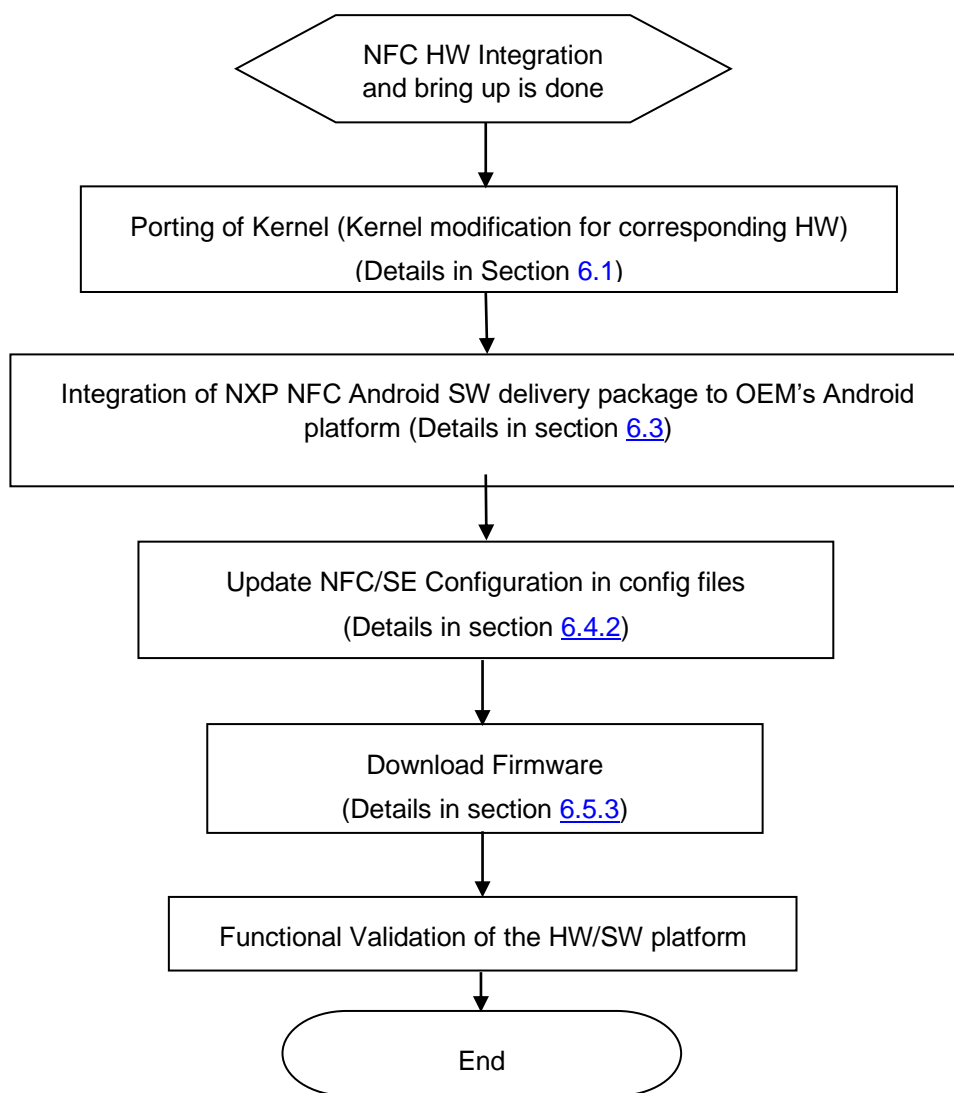


Figure 4: Android NFC SW bring up flow

## 5. Architecture Overview

Fig. 5, describes the architecture of Android 14 based NXP delivery package.

OMAPI implementation is part of the AOSP from Android P version onwards and NXP does not make any modification in Android OMAPI service layer.

**Note: SEHal, WeaverHal, KeyMint Hal, AuthSecret HAL and SPIDriver are not applicable and shall not be integrated for NFC only product PN557.**

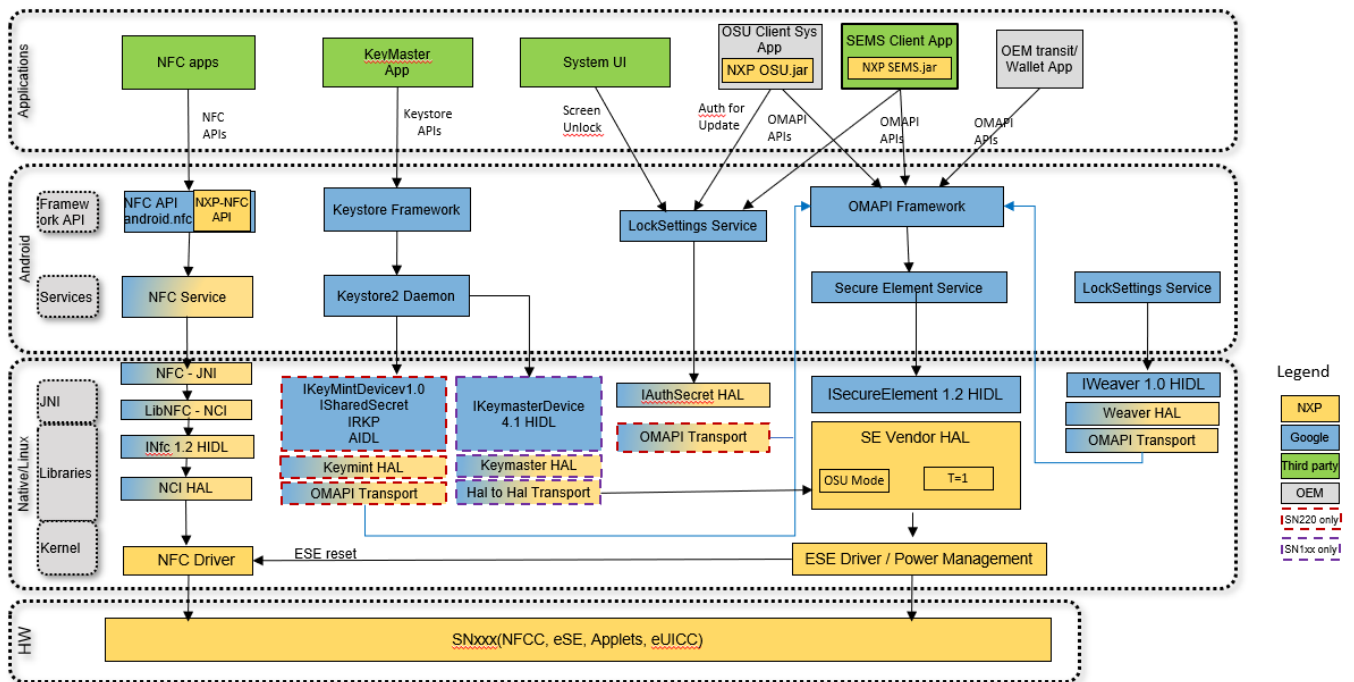


Figure 5: Secure NFC MW architecture



## 6. Setup of Android NFC

### 6.1 Android Kernel driver setup for NXP-NFCC and eSE

#### 6.1.1 SNxxx

The db845c platform kernel can be downloaded by the below command:

```
repo init -u https://android.googlesource.com/kernel/common
repo sync -j8
```

Additional information regarding db845 kernel:

git branch: 5.10

git commit: ea897dd10d35334b86d85e4cf23169d550220921

Steps to perform in platform's kernel root directory to integrate NXP specific I2C and SPI drivers for accessing NFCC and eSE.

1. Download NFC I2C & SPI drivers from below git hub location:  
[https://github.com/NXPnfcProject/NXPnfc\\_I2CDriver/tree/br\\_android\\_ncihalx\\_comm\\_14](https://github.com/NXPnfcProject/NXPnfc_I2CDriver/tree/br_android_ncihalx_comm_14)  
[https://github.com/NXPnfcProject/NXPese\\_SPIDriver/tree/br\\_android\\_ncihalx\\_comm\\_14](https://github.com/NXPnfcProject/NXPese_SPIDriver/tree/br_android_ncihalx_comm_14)
2. Create nxp folder inside common/drivers/
3. Copy nfc from NXPnfc\_I2CDriver and keep inside common/driver/nxp
4. Copy ese from NXPnfc\_SPIDriver to common/driver/nxp
5. Include the driver Makefile folder path in the higher level Makefile in hierarchy
6. Include the Kconfig source to the higher level Kconfig in hierarchy
7. Add the DTS changes required in your platform DTS file

```
clock-frequency = <1000000>;
sn-i2c@28 {
    compatible = "nxp,sn-nci";
    reg = <0x28>;
    nxp,sn-irq = <&gpio26 0 0>;
    nxp,sn-ven-rstn = <&gpio26 1 0>;
    nxp,sn-dwl-req = <&gpio26 2 0>;
};
p61@0 {
    compatible = "nxp,p61";
    reg = <0>;
    nxp,p61-irq = <&gpio2 3 0>;
    nxp,p61-rst = <&gpio2 5 0>;
    nxp,trusted-se = <&gpio26 4 0>;
    spi-max-frequency = <20000000>;
    nxp,nfcc = "2-0028";    };
```

8. Set the kernel configuration to build driver as static or dynamic in the platform config file
  - a. Static Linking with kernel image  
CONFIG\_NXP\_NFC\_I2C=y  
CONFIG\_NXP\_ESE\_P73=y
  - b. Dynamic as module(.ko)  
CONFIG\_NXP\_NFC\_I2C=m  
CONFIG\_NXP\_ESE\_P73=m
9. Compile the kernel using corresponding cross compiler and copy the generated Image.gz-dtb file to the ANDROID\_ROOT/device/vendor/platform-kernel

*Note: It is recommended to apply the patches manually.*

*Steps 2-6 are only required for building driver in-tree during building kernel.*

*Max frequency supported can be adjusted in dts as in step 7.*

*Ex. For SNxxx based platforms:*

*For I2c: clock-frequency = <3400000>*

*For SPI: spi-max-frequency = <25000000>*

### 6.1.2 PN557

The db845c platform kernel can be downloaded by the below command:

```
repo init -u https://android.googlesource.com/kernel/common  
repo sync -j8
```

Additional information regarding db845 kernel:

git branch: 5.10

git commit: ea897dd10d35334b86d85e4cf23169d550220921

Steps to perform in platform's kernel root directory to integrate NXP specific I2C driver for accessing NFCC

1. Download NFC I2C driver from below git hub location:  
[https://github.com/NXPnfcProject/NXPnfc\\_I2CDriver](https://github.com/NXPnfcProject/NXPnfc_I2CDriver)
2. Create nxp folder inside kernel/driver/
3. Copy nfc from NXPnfc\_I2CDriver and keep inside kernel/driver/nxp
4. Include the driver Makefile folder path in the higher level Makefile in hierarchy
5. Include the Kconfig source to the higher level Kconfig in hierarchy
6. Add the DTS changes required in your platform DTS file

```
ldo11: LDO11 { /* Low Speed Connector */
    regulator-name = "VOUT11_1V8_2V95";
    regulator-min-microvolt = <1825000>;
    regulator-always-on;
    regulator-enable-ramp-delay = <240>;
};
clock-frequency = <1000000>;
sn-i2c@28 {
    compatible = "nxp,sn-nci";
    reg = <0x28>;
    nxp,sn-irq = <&gpio26 0 0>;
    nxp,sn-ven-rstn = <&gpio26 1 0>;
    nxp,sn-dwl-req = <&gpio26 2 0>;
};
```

7. Set the kernel configuration to build driver as dynamic in the platform config file  
CONFIG\_NXP\_NFC\_I2C=m
8. Compile the kernel using corresponding cross compiler and copy the generated Image.gz-dtb file to the ANDROID\_ROOT/device/vendor/platform-kernel

## 6.2 Setup of Android NFC for DB845C

### 6.2.1 Downloading Android source code

Use following command to get source code for Android-<x>.<y>:

```
repo init -u https://android.googlesource.com/platform/manifest -b android-<x>.<y>
repo sync -f
```

*Note: x & y represents Android major & minor versions*

For detailed steps to download Android source code refer Android website:

<http://source.android.com/source/downloading.html>

### 6.2.2 Building the source code

Use android build instructions from Android website for building android OS image:

<http://source.android.com/source/building.html>

Build name for RB3 development board is **DB845C**. For device specific build (e.g. RB3), additional steps as described in link below needs to be followed.

<https://source.android.com/setup/build/running>

Information about the public APIs supported by Android NFC are available on following links:

<http://developer.android.com/reference/android/nfc/package-summary.html>

<http://developer.android.com/reference/android/nfc/tech/package-summary.html>

### 6.2.3 Building driver out of kernel tree(for arm64 arch)

Following are the steps to build the NFCC and ESE driver out-of-tree with the ACK, validated with the launch kernel android13-5.10 for A14.

1. Follow the steps mentioned in 6.1 for kernel sync & NXP NFC/SE driver integration.
2. Run below command for kernel out of tree compilation according to target platform. command mentioned in a. is for hikey960 & command mentioned in a. is for db845c.

a. BUILD\_NUMBER= BUILD\_CONFIG=common/build.config.hikey960 ./build/build.sh -j\$(nproc)

b. BUILD\_NUMBER= BUILD\_CONFIG=common/build.config.db845c ./build/build.sh -j\$(nproc)

SKIP\_MRPROPER=1 SKIP\_CP\_KERNEL\_HDR=1 are optional parameters to optimize the kernel build time during incremental build.

3. Build binaries will be available in KROOT/out/android13-5.10/dist folder. Create Image.gz-dtb by concatenate Image.gz & dtb file.

**Example:** cat Image.gz hi3660-hikey960.dtb > Image.gz-dtb

4. Copy the generated ko files & Image.gz-dtb to the android build environment for example "device/linaro/hikey-kernel/hikey960/5.10/" for hikey960.

## 6.3 Android NXP NFC SW Delivery Package

### 6.3.1 Android NXP NFC Package Description

| Project/Repository      | Repository Link   | Branch                     |
|-------------------------|---|----------------------------|
| NFC_NCIHAL_base         | <a href="https://github.com/NXPnFCProject/NFC_NCIHAL_base">https://github.com/NXPnFCProject/NFC_NCIHAL_base</a>                 | br_android_ncihalx_comm_14 |
| NFC_NCIHAL_Nfc          | <a href="https://github.com/NXPnFCProject/NFC_NCIHAL_Nfc">https://github.com/NXPnFCProject/NFC_NCIHAL_Nfc</a>                   | br_android_ncihalx_comm_14 |
| NFC_NCIHAL_libnfc-nci   | <a href="https://github.com/NXPnFCProject/NFC_NCIHAL_libnfc-nci">https://github.com/NXPnFCProject/NFC_NCIHAL_libnfc-nci</a>     | br_android_ncihalx_comm_14 |
| nfcandroid_nfc_hidlimpl | <a href="https://github.com/NXPnFCProject/nfcandroid_nfc_hidlimpl">https://github.com/NXPnFCProject/nfcandroid_nfc_hidlimpl</a> | br_android_ncihalx_comm_14 |

|                            |   |                            |
|----------------------------|---|----------------------------|
| nfcandroid_se_hidimpl      | <a href="https://github.com/NXPnfcProject/nfcandroid_se_hidimpl">https://github.com/NXPnfcProject/nfcandroid_se_hidimpl</a>           | br_android_ncihalx_comm_14 |
| nfcandroid_secureelement   | <a href="https://github.com/NXPnfcProject/nfcandroid_secureelement">https://github.com/NXPnfcProject/nfcandroid_secureelement</a>     | br_android_ncihalx_comm_14 |
| nfcandroid_weaver_hidimpl  | <a href="https://github.com/NXPnfcProject/nfcandroid_weaver_hidimpl">https://github.com/NXPnfcProject/nfcandroid_weaver_hidimpl</a>   | br_android_ncihalx_comm_14 |
| nfcandroid_keymint_hidimpl | <a href="https://github.com/NXPnfcProject/nfcandroid_keymint_hidimpl">https://github.com/NXPnfcProject/nfcandroid_keymint_hidimpl</a> | br_android_ncihalx_comm_14 |
| nfcandroid_nxp_ese_clients | <a href="https://github.com/NXPnfcProject/nfcandroid_nxp_ese_clients">https://github.com/NXPnfcProject/nfcandroid_nxp_ese_clients</a> | br_android_ncihalx_comm_14 |
| NXPnfc_Reference           | <a href="https://github.com/NXPnfcProject/NXPnfc_Reference">https://github.com/NXPnfcProject/NXPnfc_Reference</a>                     | br_android_ncihalx_comm_14 |
| NXPnfc_I2CDriver           | <a href="https://github.com/NXPnfcProject/NXPnfc_I2CDriver">https://github.com/NXPnfcProject/NXPnfc_I2CDriver</a>                     | br_android_ncihalx_comm_14 |
| NXPese_SPIDriver           | <a href="https://github.com/NXPnfcProject/NXPese_SPIDriver">https://github.com/NXPnfcProject/NXPese_SPIDriver</a>                     | br_android_ncihalx_comm_14 |
| NFC_NCIHAL_docs            | <a href="https://github.com/NXPnfcProject/NFC_NCIHAL_docs">https://github.com/NXPnfcProject/NFC_NCIHAL_docs</a>                       | br_android_ncihalx_comm_14 |
| nfc-NXPnfc_FW              | <a href="https://github.com/NXP/nfc-NXPnfc_FW">https://github.com/NXP/nfc-NXPnfc_FW</a>   | master                     |
| NXPAndroidDTA              | <a href="https://github.com/NXPnfcProject/NXPAndroidDTA">https://github.com/NXPnfcProject/NXPAndroidDTA</a>                           | master                     |
| nfcandroid_frameworks      | <a href="https://github.com/NXPnfcProject/nfcandroid_frameworks.git">https://github.com/NXPnfcProject/nfcandroid_frameworks.git</a>   | br_android_ncihalx_comm_14 |

Table 1: Android NXP NFC Package Description

### 6.3.2 Integration of NXP NFC Modules for SNxxx & PN557

Modify/Add AOSP directories in-place with NXP GitHub sources as per the following table:

| Module                                       | NXP GitHub sources                     | Integration Path                                     | Description  | Applicable Chip type |
|--|--|--|--|----------------------|
| NFC Interface and Public APIs                | NFC_NCIHAL_base /core/java/android/nfc | \$ANDROID_ROOT/frameworks/base/core/java/android/nfc | NFC Interfaces & Public APIs for Google AOSP   | SNxxx & PN557        |
| NFC JNI and JAVA implementation of NCI stack | NFC_NCIHAL_Nfc/nci                     | \$ANDROID_ROOT/packages/apps/Nfc/nci                 | Includes Java files and JNI for NCI NFC stack. It is modified minimally to adapt new features provided by NXP. | SNxxx & PN557        |
|  | NFC_NCIHAL_Nfc                         | \$ANDROID_ROOT/packages/apps/Nfc                     | It is a derived module originally from AOSP. It is modified minimally to adapt new features provided by NXP.   | SNxxx & PN557        |

|                                       |  |  |  |               |
|---------------------------------------|--|--|--|---------------|
| NCI based NFC stack implementation    | <i>NFC_NCIHAL_libnfc-nci</i>           | \$ANDROID_ROOT/system/nfc                        | NCI based NFC stack.<br>It is a derived module originally from AOSP (Android Open Source Project). It is modified to adapt new features provided by NXP  | SNxxx & PN557 |
| HAL implementation for NFC            | nfcandroid_nfc_hidlimpl                | \$ANDROID_ROOT/hardware/nxp/nfc                  | Hardware abstraction layer for NXP specific controllers. This directory includes the configuration files also as below.<br>1.libnfc-nci.conf (to be pushed to vendor/etc on target)<br>2.libnfc-nxp-sn100x_example.conf (to be pushed to vendor/etc on target as libnfc-nxp.conf.<br>3.libnfc-nxp_RF-sn100x_example.conf(to be pushed to /vendor/ on target)<br>NOTE: these configuration files are example files. Contact NXP support engineer for creating exact file for your platform. | SNxxx & PN557 |
| HAL implementation for Secure Element | nfcandroid_se_hidlimpl                 | \$ANDROID_ROOT/hardware/nxp/secure_element       | Hardware abstraction layer implementation for Secure Element.  | SNxxx         |
| HAL implementation for Weaver         | nfcandroid_weaver_hidlimpl             | \$ANDROID_ROOT/hardware/nxp/weaver               | Hardware abstraction layer implementation for Weaver.  | SNxxx         |
| HAL implementation for keymint        | nfcandroid_keymint_hidlimpl            | \$ANDROID_ROOT/hardware/nxp/keymint              | Hardware abstraction layer implementation for Keymint  | SNxxx         |
| HAL implementation for authsecret     | nfcandroid_keymint_hidlimpl/authsecret | \$ANDROID_ROOT/hardware/nxp/keymint/authsecret   | Hardware abstraction layer implementation for authsecret   | SNxxx         |
| SE Service                            | nfcandroid_secureelement               | \$ANDROID_ROOT/packages/apps/SecureElement       | AOSP Secure Element Service  | SNxxx         |
| eSe Client Library                    | nfcandroid_nxp_ese_clients             | \$ANDROID_ROOT/hardware/nxp/secure_element_extns | NXP eSE client library implementation  | SNxxx         |
| Vendor APIs                           | nfcandroid_frameworks                  | \$ANDROID_ROOT/vendor/nxp/frameworks             | NXP vendor framework APIs for NXP extension interfaces, SEMS & GSMA interfaces.  | SNxxx & PN557 |
| NFC I2C Driver                        | NXPNFC_I2CDriver/nfc                   | \$KERNEL_ROOT/drivers/nxp/nfc                    | NFCC I2C Interface   | SNxxx & PN557 |
| NFC SPI Driver                        | NXPESE_SPIDriver/ese                   | \$KERNEL_ROOT/drivers/nxp/ese                    | NFCC SPI Interface   | SNxxx         |
| Nxp Nfc Documentation                 | NFC_NCIHAL_docs                        | NA   | NXP framework Java Docs  | SNxxx & PN557 |
| NFCC                                  | nfc-NXPNFCC_FW                         | \$ANDROID_ROOT/system/ve                         | NFCC FW binary   | SNxxx &       |

|          |  |   |   |               |
|----------|--|---|---|---------------|
| Firmware |  | ndor/lib64                                |   | PN557         |
| DTA      | NXPAndroidDTA                            | \$ANDROID_ROOT/system/nfc-dta/            | Device Test Application (DTA) used for NFC Forum testing. | SNxxx & PN557 |
| SePolicy | NXPNFC_Reference/<br>/nxp/SNxxx/sepolicy | \$ANDROID_ROOT//vendor/nxp/SNxxx/sepolicy | SE Policy updates for NFC and SE service                  | SNxxx & PN557 |

Table 2 : Android NXP NFC Integration

### 6.3.3 Android NFC Apps and Lib on Target

| Projects                             | Compiled Files   | Location in target device  |
|--------------------------------------|--|--|
| NFCNCIHAL_base/core/java/android/nfc | Will be part of framework.jar  | /system/framework  |
| NFC_NCIHAL_Nfc                       | lib/<br>NfcNci.apk<br>oat/<br>libnfc_nci_jni.so  | /system/app/NfcNci<br><br>/system/lib64/                           |
| nfcandroid_secureelement             | oat/<br>SecureElement.apk  | /sytem/app/SecureElement   |
| NFC_NCIHAL_libnfc-nci                | libnfc_nci.so  | /system/lib64  |
| nfcandroid_nfc_hidlimpl              | nfc_nci_nxp_snxxx.so<br>android.hardware.nfc-service.nxp   | /vendor/lib64<br>/vendor/bin/hw/                                   |
| nfcandroid_nfc_hidlimpl/extns        | vendor.nxp.nxpnfc_aidl-V1-ndk.so   | /vendor/lib64  |
| nfcandroid_se_hidlimpl               | ese_spi_nxp_snxxx.so<br>android.hardware.secure_element-service.nxp  | /vendor/lib64<br>/vendor/bin/hw/                                   |
| nfcandroid_keymint_hidlimpl          | libjc_keymint.nxp.so<br>libjc_keymint_transport.nxp.so<br>android.hardware.security.keymint-service.strongbox.nxp<br>android.hardware.authsecret-service.nxp | /vendor/lib64<br>/vendor/lib64<br>/vendor/bin/hw<br>/vendor/bin/hw |
| nfcandroid_weaver_hidlimpl           | ese_weaver.so<br>android.hardware.weaver-service.nxp   | /vendor/lib64<br>/vendor/bin/hw                                    |
| nfcandroid_nxp_ese_clients           | se_extn_client.so  | /vendor/lib64  |
| Nfcandroid_frameworks                | com.nxp.nfc.jar<br>com.nxp.sems.jar<br>com.nxp.osu.jar   | /system/framework<br>/product/framework<br>/product/framework      |

Table 3 : Android NXP NFC Apps &amp; Library Info on Target

## 6.3.4 Android Platform Modifications

### 6.3.4.1 Android platform specific patches

Follow Step 1 to enable the following:

- Enable NFC, host card emulation and HCE-Felica features.
  - Provide permission to i2c(nxp-nci) and spi(p73) driver for NFC Hal and SE Hal
  - Assign object type for i2c(nxp-nci) and spi(p73) devices for providing se policy permissions
  - Android SE Policy changes (these changes help in defining types, classes, permissions and rules for Nfc, SE, Strongbox & Weaver Hal service)
1. Integrate all required sepolicy. Reference SE policy changes are available in below link  
[https://github.com/NXPnfcProject/NXPnfc\\_Reference/tree/br\\_android\\_ncihalx\\_comm\\_14/nxp/SNxxx/sepolicy](https://github.com/NXPnfcProject/NXPnfc_Reference/tree/br_android_ncihalx_comm_14/nxp/SNxxx/sepolicy)

Make sure to add corresponding HAL SEPolicy dirs to device makefile. Example as below

```
BOARD_SEPOLICY_DIRS += vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy \
```

```
vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy/authsecret \
```

```
vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy/keymint \
```

```
vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy/nfc \
```

```
vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy/se \
```

```
vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy/weaver
```

### 6.3.4.2 Android Source Build

To perform a full build, execute the following command from android root directory:

- `cd $ANDROID_ROOT/`
- `make api-stubs-docs-non-updatable-update-current-api`
- `make system-api-stubs-docs-non-updatable-update-current-api`
- `make -j$(nproc)`



6.4 Host SW Source Package Compilation

6.4.1 Compilation Flags

|                |                       |
|----------------|-----------------------|
| NXP_EXTNS=TRUE | Enable NXP extensions |
|----------------|-----------------------|

Table 4: Compilation Flags

6.4.2 Configuration Files

Host specific configuration are available in the below path and all the configs are self-explanatory and some of the configs are listed below

SN110 Config path:

[https://github.com/NXPNFCProject/nfcandroid\\_nfc\\_hidlimpl/tree/br\\_android\\_ncihalx\\_comm\\_14/snxxx/halimpl/conf/SN1xx/sn110/gen-config-files](https://github.com/NXPNFCProject/nfcandroid_nfc_hidlimpl/tree/br_android_ncihalx_comm_14/snxxx/halimpl/conf/SN1xx/sn110/gen-config-files)

SN100 config path:

[https://github.com/NXPNFCProject/nfcandroid\\_nfc\\_hidlimpl/tree/br\\_android\\_ncihalx\\_comm\\_14/snxxx/halimpl/conf/SN1xx/sn100/gen-config-files](https://github.com/NXPNFCProject/nfcandroid_nfc_hidlimpl/tree/br_android_ncihalx_comm_14/snxxx/halimpl/conf/SN1xx/sn100/gen-config-files)

SN220 Config path:

[https://github.com/NXPNFCProject/nfcandroid\\_nfc\\_hidlimpl/tree/br\\_android\\_ncihalx\\_comm\\_14/snxxx/halimpl/conf/SN220/gen-config-files](https://github.com/NXPNFCProject/nfcandroid_nfc_hidlimpl/tree/br_android_ncihalx_comm_14/snxxx/halimpl/conf/SN220/gen-config-files)

PN557 Config path:

[https://github.com/NXPNFCProject/nfcandroid\\_nfc\\_hidlimpl/tree/br\\_android\\_ncihalx\\_comm\\_14/snxxx/halimpl/conf/PN557/gen-config-files](https://github.com/NXPNFCProject/nfcandroid_nfc_hidlimpl/tree/br_android_ncihalx_comm_14/snxxx/halimpl/conf/PN557/gen-config-files)

## 6.5 Feature Integration guideline

### 6.5.1 OMAPI Secure Element terminal configuration

Assignment of terminal number to each SE interface (SPI) is based on system configuration in **libnfc-nxp-SN100/SN110/SN220-example.conf**. These terminals are mapped to OMAPI framework SEService readers list. This section is not applicable for PN557.

Terminal Naming should start from eSE1 and continue in ascending order

(This is as per OMAPI SE service implementation)

Only terminal which are mapped in configuration file are reflected as readers available in SE service.

For Example: -

Order below is just an example

NXP\_SPI\_SE\_TERMINAL\_NUM="eSE1" -> eSE domain accessed via SPI interface

Additionally, from Android 11 onwards it is mandatory to enable terminals as per the system configuration in vendor/etc/vintf/manifest/secure\_element-service-nxp.xml.xml

Based on number of terminals getting enabled in config file corresponding number of terminal instances need to be updated in manifest.xml as shown below

```
<manifest version="1.0" type="device">
  <hal format="aidl">
    <name>android.hardware.secure_element</name>
    <version>1</version>
    <fqname>ISecureElement/eSE1</fqname>
  </hal>
</manifest>
```

### 6.5.2 NFC DTA Setup

#### 6.5.2.1 NFC DTA Source

Information of NXPAndroidDTA Project repositories in the GitHub are as below:

NFC DTA source can be downloaded from the below link:

<https://github.com/NXPnfcProject/NXPAndroidDTA>

Copy NFC DTA source to /system/nfc-dta/ folder

#### 6.5.2.2 Build NFC DTA

After building DTA, it generates 64-bit DTA binaries. To install DTA on the android device, ensure that adb is installed on the system and USB cable is connected between the system and the android device.

### 6.5.2.3 NFC DTA Binaries

1. The generated binary files should be pushed to the target devices as per the below table.

| Project          | Compiled Files   | Location in target device  |
|------------------|--|--|
| /system/nfc-dta/ | libdta.so<br>libosal.so<br>libdta_jni.so<br>libmwif.so | /system/lib64  |
| /system/nfc-dta/ | NxpDTA.apk   | /system/app/NxpDTA<br>(Create folder "NxpDTA" under /system/app in target device ) |

**Table 5: DTA specific binaries**

After updating the required files, the "NXP Device Test Application" appears in the main menu.

Setting to be done before running DTA APK are as below

1. Switch off the default NFC service option in Settings.  
Settings->Connected Devices >NFC as OFF (Un-ticked) and reboot the device (using 'adb reboot').
2. Set Screen time out settings or Stay Awake option should be ticked.  
Screen time out should be updated in the IUT settings to avoid the DTA RF signal loss. Because once the device goes to sleep mode immediately RF will be stopped from device, to avoid this device screen timeout should be increased to 30 minutes or device should be powered. The following path can be used for updating the screen timeout setting.  
Main menu -> Settings -> Developer Options -> Stay Awake.  
Settings -> Display -> Sleep -> select 30 minutes.

Refer DTA setup guide( [link](#) ) for the usage of DTA application.

### 6.5.3 Firmware Download

NXP provides precompiled firmware for ARM platforms. NXP also can provide firmware as .c file and it can be compiled as .so file with the platform compiler. Firmware resides at location /system/vendor/lib64/ on the android target system.

Firmware can be updated when NXP releases an updated version. Steps to update are as follows:

1. Compile the firmware to .so file using the file received in .C file format. If firmware is in .so format then this step can be skipped.
2. Push the firmware file to
  - a. /system/vendor/lib64/libsn100u\_fw.so for SN1xx
  - b. /system/vendor/lib64/libsn220u\_fw.so for SN22x
  - c. /system/vendor/lib64/libpn557\_fw.so for PN557on target.

3. Reboot the device or disable and enable NFC service. New firmware will be downloaded during the NFC service boot up
4. Firmware file can be downloaded from below location  
[https://github.com/NXP/nfc-NXPNFCC\\_FW/tree/master/sn1xx](https://github.com/NXP/nfc-NXPNFCC_FW/tree/master/sn1xx)  
[https://github.com/NXP/nfc-NXPNFCC\\_FW/tree/master/sn220](https://github.com/NXP/nfc-NXPNFCC_FW/tree/master/sn220)  
[https://github.com/NXP/nfc-NXPNFCC\\_FW/tree/master/pn557](https://github.com/NXP/nfc-NXPNFCC_FW/tree/master/pn557)

*Note 1: Firmware download can take up around 10 seconds including host delay.*

*Note 2: It is strongly recommended not to modify the original firmware download logic of Android NFC.*

*Note 3: It is recommended that Firmware is always upgraded and not downgraded. If firmware version is required to be downgraded, then please consult NXP.*

## 6.6 Android one specific

Android one compliant stack is where only vendor partition(HAL source), config files are from NXP remaining layers(Framework, NFC service, JNI and libnfc source) i.e. system partition is default AOSP source. Following section contains list of changes needed for Android-one specific configuration.

This section is not applicable for PN557

### 6.6.1 Card emulation through Off-host in Android-one platform

To achieve card emulation functionality through off-host(eSE/UICC) on Android one stack below changes are needed in libnfc-nxp config file which is different from regular config options

Default AOSP implementation only supports below config options related to routing table management

- 1) DEFAULT\_ISODEP\_ROUTE(libnfc-nci.conf)
- 2) DEFAULT\_SYS\_CODE\_ROUTE(libnfc-nxp.conf)
- 3) DEFAULT\_OFFHOST\_ROUTE(libnfc-nxp.conf)

|       | Value       |         |
|-------|-------------|---------|
| Route | Android One | Regular |
| eSE   | 0xC0        | 0x01    |
| UICC1 | 0x80        | 0x02    |
| UICC2 | 0x81        | 0x03    |

Table 6: NFCEE route Ids

Hence the platforms which are willing to use Card emulation functionality through off-host locations shall update config file with values indicated above

## 6.7 Enable SecureElement OMAPI AIDL interface to Vendor Services

To enable communication from KeyMint/Weaver HAL to SecureElement OMAPI AIDL service, following settings Required in the build environment

1. Add overlay in the device configuration folders as below (Example is given as per Dragon board)  
Create new folder **device/linaro/dragonboard/overlay/packages/apps/SecureElement/res/value**

Create new file "config.xml" with following content:

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
  <!-- To enable vendor stable service, set this to true and
       make sure its vntf manifest entry is also configured. -->
  <bool name="secure_element_vntf_enabled">true</bool>
</resources>
```

config.xml file should be present in the  
"device/linaro/dragonboard/overlay/packages/apps/SecureElement/res/value"

2. Add following line in <ANDORID\_ROOT>/vendor/nxp/SNxxx/BoardConfigNfc.mk  
PRODUCT\_MANIFEST\_FILES += packages/apps/SecureElement/secure\_element-service.xml

## 6.8 Strongbox, Weaver & AuthSecret Hal Integration

NXP Secure Element enables tamper-resistant key storage for Android Apps using StrongBox. StrongBox is an implementation of the Keymint HAL that resides in a hardware security module.

Weaver provides secure storage of secret value (device PIN/Password) that may only be read if the corresponding key has been presented.

This section is not applicable for PN557

### 6.8.1 Weaver Hal Integration

NXP Weaver applet shall be preinstalled on eSE, please contact NXP CAS for further support.

Below steps shall be followed to enable Weaver Hal in Android.

- Download Weaver Hal source from NXP git hub
  - [https://github.com/NXPnfcProject/nfcandroid\\_weaver\\_hidlimpl](https://github.com/NXPnfcProject/nfcandroid_weaver_hidlimpl)
- Integrate Weaver Hal to AOSP Code (br\_android\_ncihalx\_comm\_14)
  - cp -rf nfcandroid\_weaver\_hidlimpl/weaver AOSP/hardware/nxp/weaver
  - Copy below folder if keymint hal is not integrated, please skip if keymint hal is integrated

- `cp -rf nfcandroid_keymint_hidlimpl/keymint/transport/ AOSP/hardware/nxp/weaver`
  - Update include path in `AOSP/hardware/nxp/weaver/libese_weaver/Android.bp`
- Required sepolicy rules for Weaver HAL in link below
  - [https://github.com/NXPnfcProject/NXPnfc\\_Reference/tree/br\\_android\\_ncihalx\\_comm\\_14/nxp/SNxxx/sepolicy/weaver](https://github.com/NXPnfcProject/NXPnfc_Reference/tree/br_android_ncihalx_comm_14/nxp/SNxxx/sepolicy/weaver)
- Add Below permission in “`AOSP/vendor/nxp/SNxxx/sepolicy/file_context`”
  - “`(vendor|system/vendor)/bin/hw/android\hardware\weaver-service\nxp`  
`u:object_r:hal_weaver_default_exec:s0`”
- Add Weaver HAL Service Pkg in “`AOSP/vendor/nxp/SNxxx/Device.mk`”
  - `PRODUCT_PACKAGES += android.hardware.weaver-service.nxp`
  - `BOARD_SEPOLICY_DIRS += vendor/$(NXP_VENDOR_DIR)/SNxxx/sepolicy/weaver`
- Minimal FW logic shall be enabled in NFC Hal(only required for SN110), Please make sure below configs are set
  - Android makefile: `-DNXP_NFC_RECOVERY=TRUE`
  - Libnfc-nxp config file option
    - # Enable or Disable the minimal FW recovery support.
    - # This logic will get enabled on early NFC hal boot.
    - # Disable NFCC RECOVERY support      `0x00`
    - # Enable NFCC RECOVERY support      `0x01`
    - `NXP_NFCC_RECOVERY_SUPPORT=0x01`
  - NFC hal shall be configured as early hal, SE policy changes shall be adopted in SE and NFC hal  
[https://github.com/NXPnfcProject/NXPnfc\\_Reference/tree/br\\_android\\_ncihalx\\_comm\\_14/nxp/SNxxx/sepolicy](https://github.com/NXPnfcProject/NXPnfc_Reference/tree/br_android_ncihalx_comm_14/nxp/SNxxx/sepolicy)

### 6.8.2 Strongbox Hal(Keymint) Integration

Android Keymint Hal supportd Android Hardware backed Keystore. **Keymint both Hal are available in GitHub, but are mutually exclusive.** Only one service should be integrated in system. Also corresponding NXP Keymint applet shall be preinstalled on eSE. Please contact NXP CAS for info on which Hardware backed keystore is supported for specific chip types.

Keymint uses OMAPI Transport layer. Hence ARA rules need to be updated for keymint HAL to access eSE via OMAPI. Please contact NXP CAS for ARA applet and ARA rules support.

- Get Keymint HAL source from below location
  - [https://github.com/NXPnfcProject/nfcandroid\\_keymint\\_hidlimpl/tree/br\\_android\\_ncihalx\\_comm\\_14](https://github.com/NXPnfcProject/nfcandroid_keymint_hidlimpl/tree/br_android_ncihalx_comm_14)
- `cp -rf nfcandroid_keymint_hidlimpl/keymint AOSP/hardware/nxp/JavacardKeymaster`
  - Enable compilation of strongbox HAL source by adding `android.hardware.security.keymint-service.strongbox` in board config file (`vendor/nxp/SNxxx/device-nfc.mk`)

- PRODUCT\_PACKAGES + android.hardware.security.keymint-service.strongbox
- Required sepolicy changes as below in vendor/nxp/SNxxx/sepolicy/file\_contexts
  - #StrongBox Keymint HAL
  - + /vendor/bin/hw/android.hardware.security.keymint-service.strongbox
  - u:object\_r:hal\_keymint\_strongbox\_exec:s0
- vendor/nxp/SNxxx/sepolicy/hal\_keymint\_strongbox.te shall have changes available in below link
  - [https://github.com/NXPnfcProject/NXPnfc\\_Reference/blob/br\\_android\\_ncihalx\\_com\\_m\\_14/nxp/SNxxx/sepolicy/hal\\_keymint\\_strongbox.te](https://github.com/NXPnfcProject/NXPnfc_Reference/blob/br_android_ncihalx_com_m_14/nxp/SNxxx/sepolicy/hal_keymint_strongbox.te)
- vendor/nxp/SNxxx/config.fs shall have changes available in below link & config.fs file should be added as TARGET\_FS\_CONFIG\_GEN (e.g., TARGET\_FS\_CONFIG\_GEN += vendor/nxp/SNxxx/config.fs) in BoardConfigNfc.mk
  - [https://github.com/NXPnfcProject/NXPnfc\\_Reference/blob/br\\_android\\_ncihalx\\_com\\_m\\_14/nxp/SNxxx/config.fs](https://github.com/NXPnfcProject/NXPnfc_Reference/blob/br_android_ncihalx_com_m_14/nxp/SNxxx/config.fs)
- Please make sure below binaries are present on device:
  - SB HAL binary: /vendor/bin/hw/android.hardware.security.keymint-service.strongbox
  - SB HAL init rc: /vendor/etc/init/android.hardware.security.keymint-service.strongbox.rc
  - Manifest: /vendor/etc/vintf/manifest/android.hardware.security.keymint-service.strongbox.xml
  - Manifest: /vendor/etc/vintf/manifest/android.hardware.security.sharedsecret-service.strongbox.xml
  - uuid mapping xml file : vendor/etc/hal\_uuid\_map\_config.xml

#### Changes required for Keymint VTS, CTS and RKPD test case execution:

- Enable Keystore attest key feature
  - PRODUCT\_COPY\_FILES += \
 frameworks/native/data/etc/android.hardware.keystore.app\_attest\_key.xml:system/etc/permissions/
 android.hardware.keystore.app\_attest\_key.xml
- For RKP functionality
  - PRODUCT\_PRODUCT\_PROPERTIES +=
 remote\_provisioning.hostname=remoteprovisioning.googleapis.com
  - PRODUCT\_PRODUCT\_PROPERTIES += remote\_provisioning.enable\_rkpd=true
  - PRODUCT\_PRODUCT\_PROPERTIES += remote\_provisioning.strongbox.rkp\_only=true
- Setting ro.vendor.build.security\_patch for Keymint 3.0 VTS Test cases



- `VENDOR_SECURITY_PATCH = $(PLATFORM_SECURITY_PATCH)`
- **For testing deleteAllKeys during factory reset**
  - `PRODUCT_PRODUCT_PROPERTIES +=`  
`ro.crypto.metadata_init_delete_all_keys.enabled=true`
- **For Device Id Attestation Testcases**

These changes are just for reference only and properties values might vary based on the OEM device configurations.

  - `PRODUCT_COPY_FILES += \`  
`frameworks/native/data/etc/android.software.device_id_attestation.xml:$(TARGET_COPY_OUT_VENDOR)/etc/permissions/android.software.device_id_attestation.xml`
  - `PRODUCT_COPY_FILES += \`  
`frameworks/native/data/etc/android.software.managed_users.xml:`  
`system/etc/permissions/android.software.managed_users.xml`
  - `PRODUCT_PRODUCT_PROPERTIES +=`  
`ro.product.device_for_attestation=$(TARGET_PRODUCT)`
  - `PRODUCT_PRODUCT_PROPERTIES +=` `ro.product.product_for_attestation=unknown`
  - `PRODUCT_PRODUCT_PROPERTIES +=`  
`ro.product.manufacturer_for_attestation=unknown`
  - `PRODUCT_PRODUCT_PROPERTIES +=` `ro.product.vendor.name=unknown`
  - `PRODUCT_PRODUCT_PROPERTIES +=` `ro.product.name=unknown`
  - `PRODUCT_MODEL_FOR_ATTESTATION := $(TARGET_PRODUCT)`
  - `PRODUCT_BRAND_FOR_ATTESTATION := Android`

| SI<br>No | Package/tool     | Location in AOSP                            | Description    | Steps to Execute  |
|----------|------------------|---|----------------|---|
|          | rkpdapp.apk      | packages/modules/RemoteKeyProvisioning/app/ | RKP service    | This always runs in background on boot complete.  |
|          | RkpdAppIntegrati | packages/modules/RemoteKeyProvisioning/app/ | RKP end to end | <ul style="list-style-type: none"> <li>• <code>adb install -t RkpdAppIntegrationTests.apk</code></li> </ul> |

|  |                             |  |  |  |
|--|-----------------------------|--|--|--|
|  | onTests.apk                 | tests/e2e  | tests  | <ul style="list-style-type: none"> <li>adb shell am instrument -w com.android.rkpdapp.e2etest/androidx.test.runner.AndroidJUnitRunner</li> </ul>   |
|  | RkpdAppUnitTests.apk        | packages/modules/RemoteKeyProvisioning/app/tests/unit    | RKP unit test  | <ul style="list-style-type: none"> <li>adb install -t RkpdAppUnitTests.apk</li> <li>adb shell am instrument -w com.android.rkpdapp.unittest/androidx.test.runner.AndroidJUnitRunner</li> </ul> |
|  | RkpdAppStressTests.apk      | packages/modules/RemoteKeyProvisioning/app/tests/ stress | RKP stress test  | <ul style="list-style-type: none"> <li>adb install -t RkpdAppStressTests.apk</li> <li>adb shell am instrument -w com.android.rkpdapp.stress/androidx.test.runner.AndroidJUnitRunner</li> </ul> |
|  | rkp_factory_extraction_tool | system/security/provisioner/                             | Extract the RKP CSR in factory to share with Google. This shall be done prior to any test. | <ul style="list-style-type: none"> <li>adb push rkp_factory_extraction_tool /vendor/bin/</li> <li>adb shell /vendor/bin/rkp_factory_extraction_tool</li> </ul>                                 |

### 6.8.3 AuthSecret Hal Integration

NXP IAR applet shall be preinstalled on eSE, please contact NXP CAS for further support.

Below steps shall be followed to enable AuthSecret Hal in Android.

- Download KeyMint Hal source from NXP git hub
  - [https://github.com/NXPnfcProject/nfcandroid\\_keymint\\_hidlimpl/tree/br\\_android\\_ncihalx\\_comm\\_14](https://github.com/NXPnfcProject/nfcandroid_keymint_hidlimpl/tree/br_android_ncihalx_comm_14)
- Integrate Weaver Hal to AOSP Code (br\_android\_ncihalx\_comm\_14)
  - cp -rf nfcandroid\_keymint\_hidlimpl/ authsecret AOSP/hardware/nxp/authsecret
- Copy below folder if keymint hal is not integrated, please skip if keymint hal is integrated
  - cp -rf nfcandroid\_keymint\_hidlimpl/transport/ AOSP/hardware/nxp/authsecret
  - Update include path in AOSP/hardware/nxp/authsecret/Android.bp
- Required sepolicy rules for AuthSecret HAL in link below
  - [https://github.com/NXPnfcProject/NXPnfc\\_Reference/tree/br\\_android\\_ncihalx\\_comm\\_14/nxp/SNxxx/sepolicy/hal\\_authsecret\\_default.te](https://github.com/NXPnfcProject/NXPnfc_Reference/tree/br_android_ncihalx_comm_14/nxp/SNxxx/sepolicy/hal_authsecret_default.te)
  - [https://github.com/NXPnfcProject/NXPnfc\\_Reference/tree/br\\_android\\_ncihalx\\_comm\\_14/nxp/SNxxx/sepolicy/secure\\_element.te](https://github.com/NXPnfcProject/NXPnfc_Reference/tree/br_android_ncihalx_comm_14/nxp/SNxxx/sepolicy/secure_element.te)
- Add Below permission in "AOSP/vendor/nxp/SNxxx/sepolicy/file\_context"

- “/vendor/bin/hw/android.hardware.authsecret-service.nxp  
u:object\_r:hal\_authsecret\_default\_exec:s0”
- Add AuthSecret HAL Service Pkg in “AOSP/vendor/nxp/SNxxx/Device.mk”
  - PRODUCT\_PACKAGES += android.hardware.authsecret-service.nxp
- BOARD\_SEPOLICY\_DIRS += vendor/\$(NXP\_VENDOR\_DIR)/SNxxx/sepolicy
- vendor/nxp/SNxxx/config.fs shall have changes available in below link & config.fs file should be added as TARGET\_FS\_CONFIG\_GEN (e.g., TARGET\_FS\_CONFIG\_GEN += vendor/nxp/SNxxx/config.fs) in BoardConfigNfc.mk
  - [https://github.com/NXPnfcProject/NXPnfc\\_Reference/blob/br\\_android\\_ncihalx\\_comm\\_14/nxp/SNxxx/config.fs](https://github.com/NXPnfcProject/NXPnfc_Reference/blob/br_android_ncihalx_comm_14/nxp/SNxxx/config.fs)
- Make sure uuid mapping xml file (vendor/etc/hal\_uuid\_map\_config.xml) UUID mapping for AuthSecret HAL service UID.

## 6.9 Enable ULPDET feature (Optional)

To enable ULPDET feature please add following property to the “libnfc-nxp.conf”

**NXP\_DEFAULT\_ULPDET\_MODE=1**

**Note:** This feature is supported only on SN220 chipset. This is not applicable for SN1xx & PN557.

## 6.10 Power Tracker feature (Optional)

- 1) To enable Power feature please add following property to the “libnfc-nxp.conf”  
**NXP\_SYSTEM\_POWER\_TRACE\_POLL\_DURATION\_SEC=30**
- 2) By Default power tracker specific libraries build as part of NFC HAL compilation
- 3) During full build add command line argument POWER\_TRACKER\_FEATURE=true to enable power tracker service.

Example: make TARGET\_NXP\_NFC\_HW=SN220 POWER\_TRACKER\_FEATURE=true

For more information related to Power tracker integration & test steps please refer below link.

Link:

[https://github.com/NXPnfcProject/nfcandroid\\_nfc\\_hidlimpl/blob/br\\_android\\_ncihalx\\_comm\\_14/snxxx/halimpl/power-tracker/README.txt](https://github.com/NXPnfcProject/nfcandroid_nfc_hidlimpl/blob/br_android_ncihalx_comm_14/snxxx/halimpl/power-tracker/README.txt)

**Note:** This feature is supported only on SN220 chipset. This is not applicable for SN1xx & PN557.

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