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PN553/PN557 to PN7160 migration guidelines

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Application note

Document information

Information	Content
Keywords	PN553 NFC controller, PN557 NFC controller, PN7160 NFC controller, migration guidelines, Android, AOSP
Abstract	This application note describes the guidelines to migrate from NXP's PN553/PN557 NFC controllers to NXP's PN7160 NFC controller.



Revision history

Revision history

Revision number	Date	Description
1.0	20221007	Initial version

1 Introduction

1.1 Purpose

This document provides guidelines for the migration from PN553/PN557 NFC controller to PN7160 NFC controller. It intends to describe key differences and new features of PN7160 NFC controller, compared to PN553/PN557 NFC controller from both hardware and software perspective.

The software section describes step by step how to adapt Android Open Source Project sources built for PN553/PN557 NFC controller to migrate to PN7160 NFC controller.

1.2 Scope

PN7160 NFC controller is pin-to-pin compatible with PN553/PN557 NFC controller. This migration guide provides differentiation from PN553/PN557.

PN7160 and PN557 NFC Controllers are compliant with NCI version 2.0, while PN553 NFC Controller compliant with NCI version 1.0.

PN7160 NFC controller does not integrate Secure Element interfaces.

1.3 Audience

This document is intended for customers:

- who have developed their products based on PN553/PN557 NFC controller and have decided to migrate to the PN7160 NFC controller.
- who are familiar with PN553/PN557 NFC controller and want to start their new products based on PN7160 NFC controller.

2 High-level comparison between PN553/PN557 and PN7160

PN553/PN557 and PN7160 are NFC controllers designed for integration in mobile devices and devices compliant with NFC standards (NFC Forum, NCI). These products are designed for quick integration into a very wide range of systems and support all NFC Forum modes. The software package released by NXP Semiconductors includes drivers for Android and Linux, and supports RTOS and no OS applications.

PN553/PN557 NFC controller and PN7160 NFC controller are similar in terms of features. [Table 1](#) lists the main differences between these products:

Table 1. Features key differences

Feature	PN553/PN557 NFC controller	PN7160 NFC controller
Secure Element interfaces	HCI protocol interfaces according to ETSI/SCP standardization 2 Single Wire Protocol (SWP) interface according to ETSI/SCP standardization	No
NCI protocol interface	V1.0 for PN553 and 2.0 for PN557	V2.0
Apple Enhanced Contactless Polling	No	Specification: Version 2.0
Integrated power management unit	2 power regulators to supply UICC in class B and class C	UICC supply is not supported
Transmission modes and RF protocols	detailed comparison described in Table 2	

NFC FORUM NFC-IP and reader modes match for PN553/PN557 NFC controller and PN7160 NFC controller products.

Table 2. Card emulation protocol differences

Protocol	PN553/PN557 NFC controller	PN7160 NFC controller
T4T - ISO/IEC 14443 A	Yes	Yes
T4T - ISO/IEC 14443 B	Yes	Yes
MIFARE Classic 1K / 4K	Yes	No
MIFARE DESFire	Yes	No
T3T - Sony FeliCa	Yes	Yes

3 Hardware considerations

3.1 Pin-to-pin compatibility

The PN7160 NFC controller is pin-to-pin compatible with the PN553/PN557 NFC controller, and almost all peripherals are in accord in both devices. The main difference between these NFC Controllers is related to Secure Element interface connections and NFC_GPIO pins. All these pins listed in [Table 3](#) are internally connected in the PN7160 NFC controller and should be left open.

Table 3. Pins considerations.

Pin Name	Symbol PN553	Symbol PN7160	Comments
A2	NFC_GPIO_7	i.c.	To be left open.
A3	SIM_SWIO_1	i.c.	To be left open.
A4	VDD(SIM_PMU_1)	i.c.	To be left open.
A5	VDD(SIM_1)	i.c.	To be left open.
A6	SIM_SWIO_2	i.c.	To be left open.
A7	VDD(SIM_PMU_2)	i.c.	To be left open.
A8	VDD(SIM_2)	i.c.	To be left open.
B2	NFC_GPIO_1	i.c.	To be left open.
B3	SIM_IO_PULLDOWN_1	i.c.	To be left open.
B6	SIM_IO_PULLDOWN_2	i.c.	To be left open.
C2	NFC_GPIO_0	i.c.	To be left open.
F1	NFC_GPIO_6	i.c.	To be left open.
F2	NFC_GPIO_3	i.c.	To be left open.
F3	NFC_GPIO_2	i.c.	To be left open.
G1	VDD(GPIO)	i.c.	To be left open.
G2	NFC_GPIO_5	i.c.	To be left open.
H2	NFC_GPIO_4	i.c.	To be left open.

3.2 Packaging information

PN7160 NFC controller is available in two packaging configurations: VFBGA64 and HVQFN40, while PN553/PN557 NFC controller is only available in VFBGA64 package.

PN7160 and PN553/PN557 products are pin-to-pin compatible only for VFBGA64 package version [SOT1980-1](#).

For more information about package specifications, refer to PN7160 and PN553/PN557 data sheets.

3.3 NFC antenna matching

When replacing PN553/PN557 NFC controller with PN7160 NFC controller, no changes are required to the NFC antenna and its matching circuit. The same design is applicable.

4 Software considerations

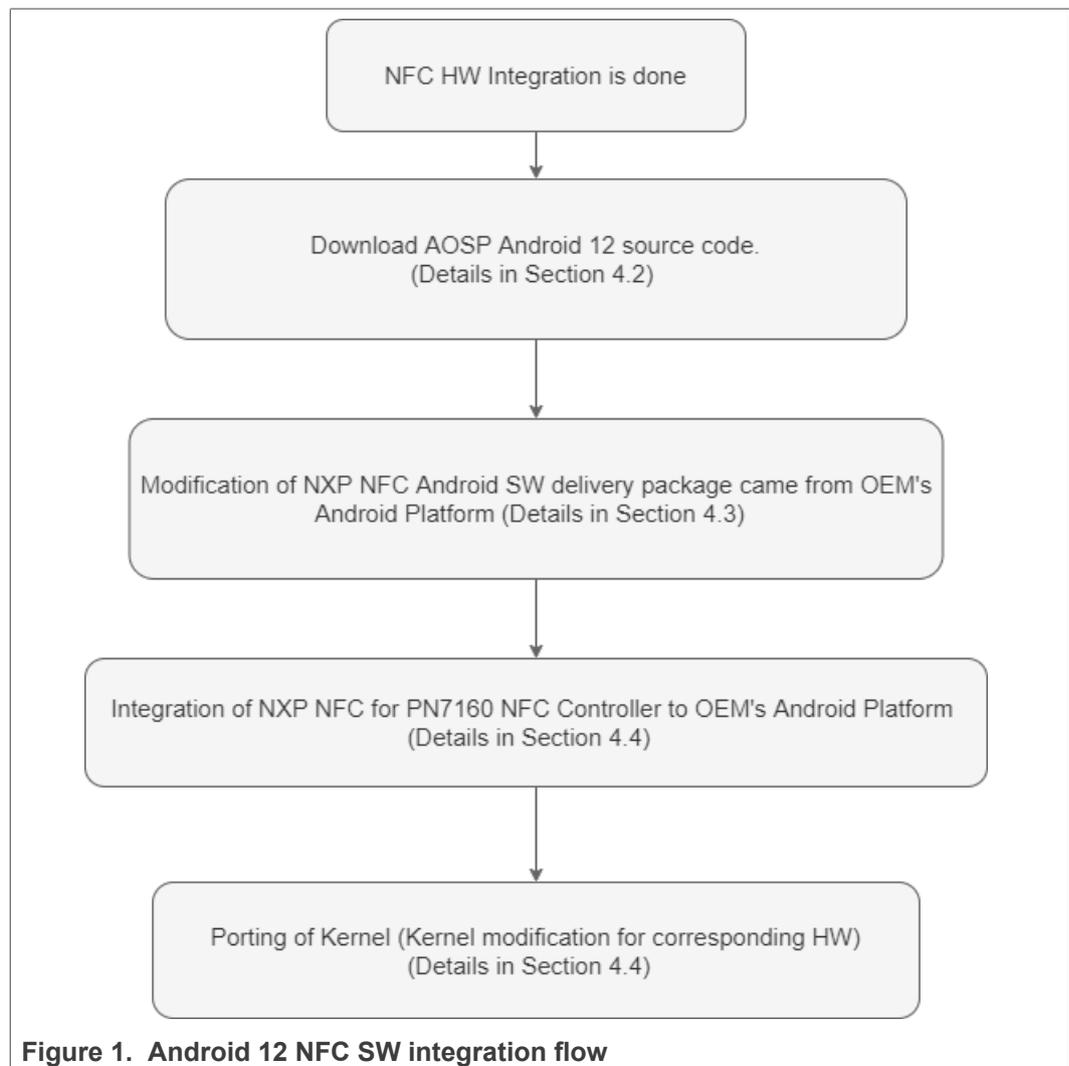
4.1 Android software overview

This chapter describes the architecture of Android 12 based on NXP's delivery package available at https://github.com/NXPnfcLinux/nxpnfc_android12 repository and explains all modifications that need to be done to migrate from PN553/PN557 NFC Controller to PN7160 NFC controller.

This document takes as a reference Android AOSP version 12.0.0_r9, porting to other Android version may require minor adaptation of API.

OEM integration may have variations based on actual system integration.

[Figure 1](#) shows the basic flow for Android NFC SW Porting. Find details of each block in following sections.



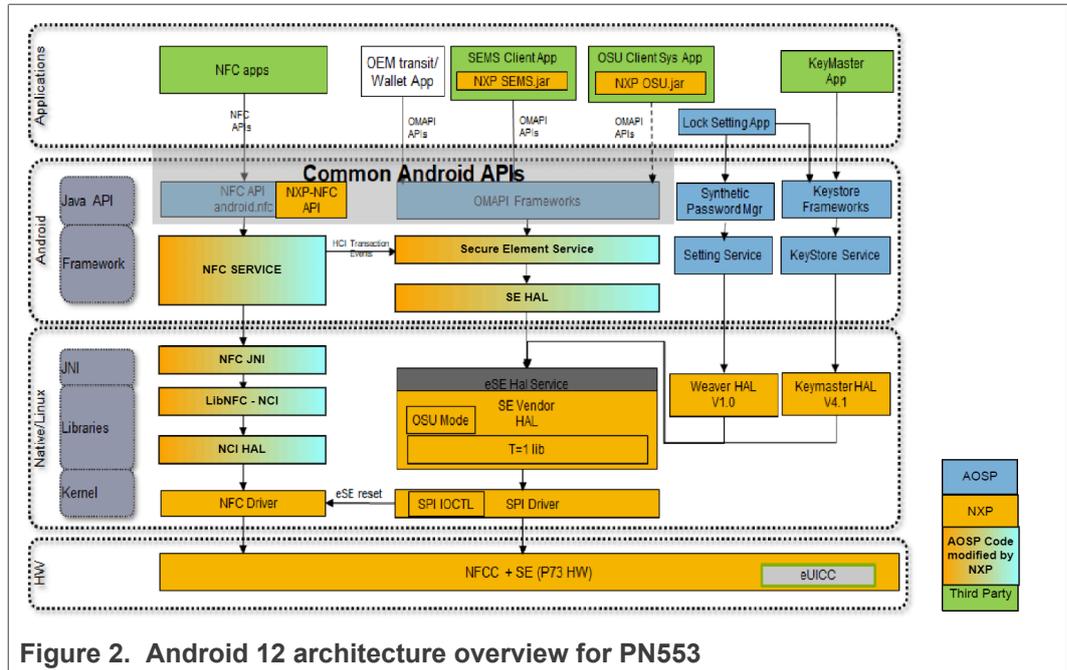


Figure 2. Android 12 architecture overview for PN553

Figure 2 shows all AOSP modules that were modified to adapt AOSP to PN553 NFC controller. But now, to migrate to PN7160 NFC controller many of these modules must be rolled back to AOSP original version or removed as is the case for the Secure element-related modules.

To roll back these modules, it is necessary to download Android Source Code from Google repository. See Section 4.2.

Note: For PN557 NFC controller SEHal, WeaverHal, KeyMasterHal and SPIDriver are not integrated for NFC. All modifications related to these modules can be ignored.

4.1.1 Android stack comparison for PN553/PN557 NFC controller and PN7160 NFC controller

These are the software key differences between PN553/PN557 NFC controller and PN7160 NFC controller:

- PN553/PN557 NFC controller uses customized NFC and NCI libraries from NXP while PN7160 NFC controller uses AOSP native libraries.
- PN553/PN557 NFC controller uses NXP Framework for Secure Element, PN7160 NFC controller does not integrate SE.

4.2 Downloading Android source code

Use following instructions from Android website:

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

Use following command to get source code for respective branch android-12.0.0_r9:

repo init -u <https://android.goglesource.com/platform/manifest> -b android-12.0.0_r9

repo sync -f

More information about android build instructions from Android website for building Android OS image:

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

4.3 Modifications of NXP Android stack

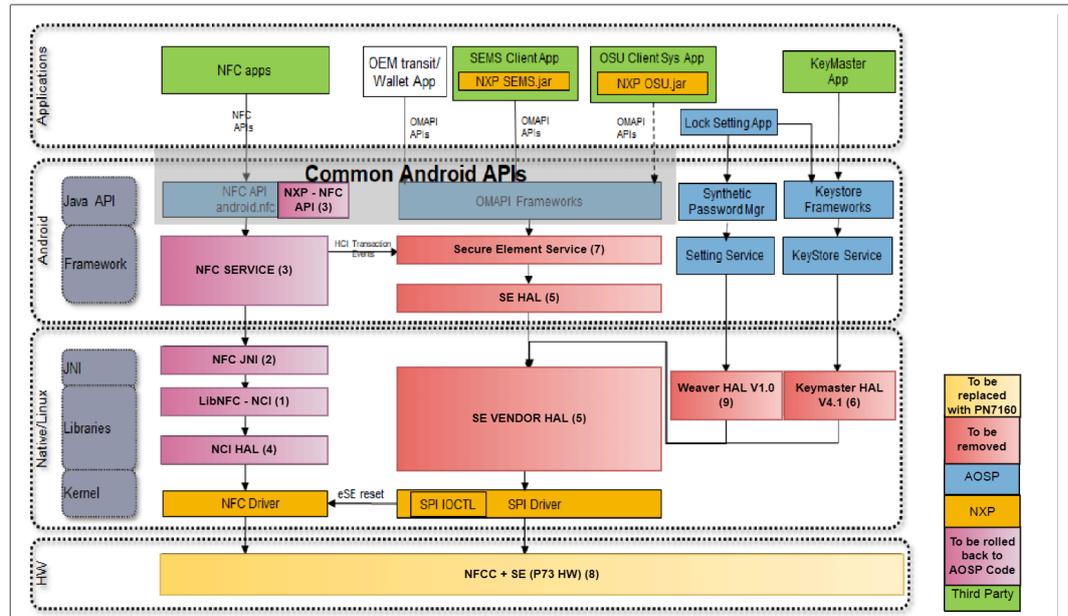


Figure 3. Android modules involved in PN7160 NFC controller porting

Figure 3 shows Android stack with modules that must be modified/removed to clear all dependencies to PN553/PN557 NFC controller and prepare the code for PN7160 NFC controller integration.

Modify/Add your \$ANDROID ROOT directories as is shown in the following table:

Table 4. NXP NFC Integration

ID	Module	Integration Path	Action description
1	NCI-based NFC stack implementation	\$ANDROID ROOT/system/nfc	Replace existing integration folder's content with original AOSP/system/nfc content
2	NFC JNI and JAVA implementation on NCI stack	\$ANDROID ROOT/packages/apps/Nfc/nci	Replace folder's content with original AOSP/packages/apps/Nfc/nci

Table 4. NXP NFC Integration...continued

ID	Module	Integration Path	Action description
3	NFC Interface and Public APIs	\$ANDROID ROOT/frameworks/ base/core/java/android/nfc \$ANDROID ROOT/frameworks/ base/core/java/android/se	Replace "nfc" folder 's content with AOSP/frameworks/base/core/java/android/nfc content and remove \$ANDROID ROOT/frameworks/base/core/java/android/se folder
4	HAL implementation for NFC	\$ANDROID ROOT/hardware/nxp/ nfc	This directory includes the configuration files. Replace <i>libnfc-n ci.conf</i> and <i>libnfc-nxp.conf</i> files with specific configuration files for PN7160 NFC controller. For more information, please see the document mentioned in Section 4.4
5	HAL implementation for Secure Element	\$ANDROID ROOT/hardware/nxp/ secure_element	Remove this folder and its content as secure element is not supported by PN7160 NFC controller
6	HAL implementation for Secure Element	\$ANDROID ROOT/hardware/nxp/ keymaster	Remove this folder and its content as secure element is not supported by PN7160 NFC controller
7	SE Service	\$ANDROID ROOT/packages/apps/ SecureElement	Remove this folder and its content as secure element is not supported by PN7160 NFC controller
8	eSe Client Library	\$ANDROID ROOT/hardware/nxp/ secure_element_extns	Remove this folder and its content as secure element is not supported by PN7160 NFC controller
9	HAL implementation for Weaver	\$ANDROID ROOT/hardware/nxp/ weaver	Remove this folder and its content as weaver is not supported by PN7160 NFC controller
10	Vendor APIs	\$ANDROID ROOT/vendor/nxp/ frameworks	Remove this folder and its content

4.4 Integration of PN7160 NXP NCI-based NFC controller

To complete the integration of PN7160 NFC controller into your AOSP, refer to:

- <https://www.nxp.com/docs/en/application-note/AN13189.pdf>

4.5 Kernel porting - driver details

PN553/PN557 NFC controller implements two different drivers for I2C and SPI interfaces, where the second one is used for Secure Element communication. For PN7160 NFC controller, SPI interface can be used as a main connection depending on device and platform configuration.

In any case, for PN7160 NFC controller, it is necessary to configure and include the targeted driver (I2C or SPI version) to the build. For the complete guide about how to build kernel drivers, see the document mentioned in [Section 4.4](#).

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