NXP PN7160 NCI Based NFC controllers Instructions

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Document information

Information	Content
Keywords	PN7160, PN7220, NCI, EMVCo, NFC Forum, Android, NFC
Abstract	This document describes how to port PN7160/PN7220 common middleware release to A ndroid 14.

This guide provides detailed instructions on how to integrate NXP NCI-based NFC controllers, PN7160 and PN7220, into an Android environment. The process involves installing the necessary kernel driver and configuration of MW (see [1]). For further information, refer to the product page for PN7160 [2] and PN7220 [3]. The Android Open Source Project (AOSP) has been updated to incorporate support for both PN7160 and PN7220 NFC controllers.

The PN7220 comes in two configurations: single-host and dual-host. The stack is generally the same for both. In dual-host mode, SMCU is added that means that all EMVCo related tasks are executed on SMCU. In singlehost EMVCo is executed in a dedicated EMVCo MW stack

Contents

Android MW stack

Figure 1 illustrates the architecture of the PN7220 Android NFC stack.

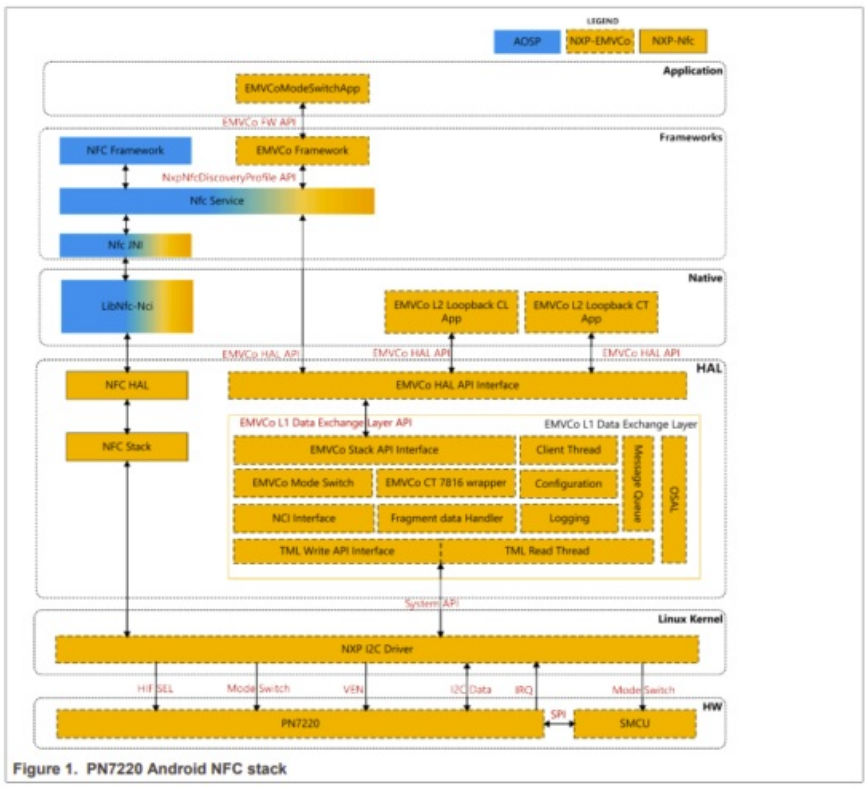

Figure 1. PN7220 Android NFC stack

- The NXP I2C Driver is a kernel module that allows access to the hardware resources of PN7220.
- The HAL module is an implementation of the NXP NFC controller-specific hardware abstraction layer.

- LibNfc-Nci is a native library that provides NFC functionality.
- NFC JNI acts as a bridge between Java and Native classes.
- The NFC and EMVCo Framework is a module of the application framework that allows access to NFC and EMVCo functionalities.

Figure 2 shows the architecture of the PN7160 Android NFC stack.

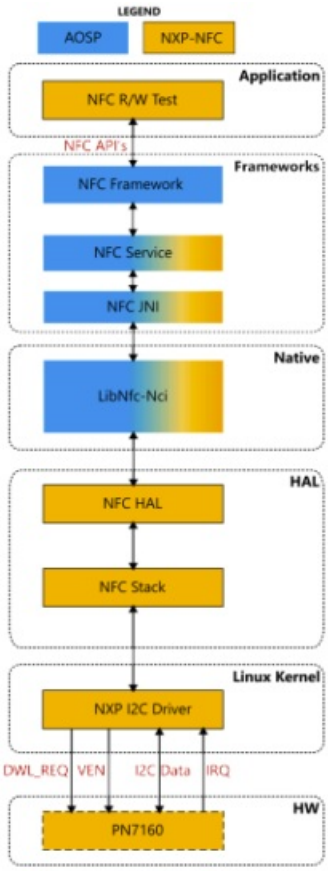

Figure 2. PN7160 Android MW stack

- The NXP I2C Driver is a kernel module that allows access to the hardware resources of PN7160.
- The HAL module is an implementation of the NXP NFC controller-specific hardware abstraction layer.
- LibNfc-nci is a native library that provides NFC functionality.
- NFC JNI acts as a bridge between Java and Native classes.
- The NFC is a module of the application framework that allows access to NFC functionalities.
- The MW source code is the same for PN7160 and PN7220, but there are a few limitations.

Table 1 shows unsupported features of each NFC controller.

Table 1. Unsupported features

NFC controller	Unsupported features
PN7160	• EMVCo MW stack • SMCU • CT feature
PN7220	• NFCEE_NDEF

Note: From Android 14 onwards P2P is also not supported on PN7160.

Kernel driver

To establish connection with the PN7220 or PN7160, the Android stack uses the nxpnfc kernel driver. It can be found in [4].

Driver details

PN7220 supports I2C physical interface, while PN7160 supports I2C or SPI physical interface. When installed into the kernel, the driver is exposed via the device node in /dev/nxpnfc.

Note: PN7160 and PN7220 use two different drivers, selection of the correct driver is required based on the chip type.

Getting the PN7160 driver source code

Copy the nfcandroid_platform_drivers/drivers/pn7160/nfc driver repository into the kernel directory, replacing the existing implementation. Refer to [4] for the kernel files.

$rm -rf drivers/nfc
$git clone “https://github.com/nxp-nfc-infra/nfcandroid_platform_drivers.git” -b br_ar_14_comm_infra_dev

This ends up with the folder drivers/nfc containing the following files:

- README.md: repository information
- Makefile: driver heading makefile
- Kconfig: driver configuration file
- License: driver licensing terms
- nfc subfolder containing:
    - commoc.c: generic driver implementation
    - common.h: generic driver interface definition
    - i2c_drv.c: i2c specific driver implementation
    - – i2c_drv.h: i2c specific driver interface definition
    - spi_drv.c: spi specific driver implementation
    - spi_drv.h: spi specific driver interface definition
    - Makefile: makefile that is included in the makefile of the driver

- Kbuild => build file
- Kconfig => driver configuration file

Getting the PN7220 driver source code

Copy the nfcandroid_platform_drivers/drivers/pn7220cs/nfc (single-host usecase) or nfcandroid_platform_ drivers/drivers/pn7220cms/nfc (dual-host usecase) into the kernel directory drivers/nfc, replacing the existing driver. Refer to [4] for the kernel files.

$rm -rf drivers/nfc$git clone “https://github.com/nxp-nfc-infra/nfcandroid_platform_drivers.git” -bbr_ar_14_comm_infra_dev

Following this command, the folder drivers/nfc contains the following files:

- README.md: repository information
- Makefile: driver heading makefile
- Kconfig: driver configuration file
- License: driver licensing terms
- nfc subfolder containing:
  - commoc.c: generic driver implementation
  - common.h: generic driver interface definition
  - i2c_drv.c: i2 c specific driver implementation
  - i2c_drv.h: i2 c specific driver interface definition
  - Makefile: makefile that is included in the makefile of the driver
  - Kbuild => build file
  - Kconfig => driver configuration file

Building the driver

The devicetree is responsible for adding the driver to the kernel and loading it on device boot.

After upgrading the devicetree specification, the platform-related devicetree must be rebuilt. NXP recommends using kernel version 5.10 as it provides comprehensive validation.

To build the driver, the following steps must be performed:

1. Get the kernel driver
2. Get the source code for the driver
3. Modify the devicetree definition, which is unique to the device in use.
4. Build the driver:

a. Through the menuconfig procedure, add the target driver into the build.

After rebuilding the completed kernel, the driver will be included in the kernel image. All new kernel images must be copied into the AOSP build.

AOSP adaptation

NXP adds modifications to the AOSP code. This means that the AOSP code is used as a foundation, but extended for NXP-specific features. [5] is the current AOSP tag used by NXP. After obtaining the AOSP build, the existing AOSP code must be replaced, and a number of patches must be applied.

Note: A different version of the AOSP code can be used, but additional modifications must be performed.

AOSP build

Get AOSP source code.

$ repo init -u https://android.googlesource.com/platform/manifest -b android-14.0.0_r2 $ repo sync

Note: The repo tool must be installed on the system. Refer to [6] for instructions.

Build source code.

$cd Android_AROOT
$source build/envsetup.sh
$lunch select_target #target is DH we want to use for example: evk_8mn-userdebug
$make -j

Copy all NXP repositories into the target location.

Table 2. Branche for specific Android version

Android version	Branch
Android 14	br_ar_14_comm_infra_dev

Note: While cloning, it is important to select the correct branch.

Table 3. Clone repositories

AOSP Repos	NXP GitHub Repos
"$ANDROID_ROOT"/packages/ apps/Nfc	https://github.com/nxp-nfc-infra/nxp_nci_hal_nfc/tree/br_ar_14_comm_infra_dev
"$ANDROID_ROOT"/system/ nfc	https://github.com/nxp-nfc-infra/nxp_nci_hal_libnfc-nci/tree/br_ar_14_comm_infra_dev
"$ANDROID_ROOT"/hardware/ nxp/nfc	https://github.com/nxp-nfc-infra/nfcandroid_nfc_hidlimpl/tree/br_ar_14_comm_infra_dev
"$ANDROID_ROOT"/vendor/ nxp/ frameworks	https://github.com/nxp-nfc-infra/nfcandroid_frameworks/tree/br_ar_14_comm_infra_dev
"$ANDROID_ROOT"/hardware/ nxp/emvco	https://github.com/nxp-nfc-infra/nfcandroid_emvco_aidlimpl/tree/ br_ar_14_comm_infra_dev
"$ANDROID_ROOT"	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/ br_ar_14_comm_infra_dev

Table 4. Clone repositories for test applications and TDA support

Folder in GitHub	AOSP Repos	NXP GitHub	IC Supported
test_apps/SMCU_Switch	“$ANDROID_ROOT”/ packages/apps/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7220
test_apps/EMVCoMode SwitchApp	“$ANDROID_ROOT”/ packages/apps/Nfc/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7220
test_apps/Cockpit	“$ANDROID_ROOT”/ hardware/nxp/nfc/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7220
test_apps/SelfTest	“$ANDROID_ROOT”/ hardware/nxp/nfc/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7220
test_apps/SelfTest_pn7160	“$ANDROID_ROOT”/ hardware/nxp/nfc/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7160
test_apps/load_unload	“$ANDROID_ROOT”/ hardware/nxp/nfc/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7220
test_apps/SelfTestAidl	“$ANDROID_ROOT”/ hardware/nxp/nfc/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_test_apps	PN7220
nfc_tda	“$ANDROID_ROOT”/system/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_comm_libs	PN7220

emvco_tda	“$ANDROID_ROOT”/ hardware/nxp/emvco/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_comm_libs	PN7220
emvco_tda_test	“$ANDROID_ROOT”/ hardware/nxp/emvco/	https://github.com/ nxp-nfc-infra/ nfcandroid_infra_comm_libs	PN7220
NfcTdaTestApp	“$ANDROID_ROOT”/ packages/apps/Nfc/	https://github.com/ nxp-nfc-infra/nfcandroid_infra_comm_libs	PN7220

Apply patches

Table 5. Apply patches

Location to apply	Patch to apply	Location of the patch
"$ANDROID_ROOT"/build/ bazel/	*AROOT_build_bazel. patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/build/ make/	*AROOT_build_make. patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/build/ soong/	*AROOT_build_soong. patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/ frameworks/base/	*AROOT_frameworks_ base.patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/ frameworks/native/	*AROOT_frameworks_ native.patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/ system/logging/	*AROOT_system_loggi ng. patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/ packages/modules/ Bluethooth/	*AROOT_packages_ modules_Bluethooth. patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/
"$ANDROID_ROOT"/ framework/proto_logging/	*AROOT_framework_ proto_logging.patch*	https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/build_pf_patches/

Note: Check the output after applying the patch, if any issue was observed during the patching.

Add FW libraries. Refer to [8] for FW.

Note: Not mandatory. FW can always be updated.

For PN7160:

$git clone https://github.com/NXP/nfc-NXPNFCC_FW.git
$cp -r nfc-NXPNFCC_FW/InfraFW/pn7220/64-bit/libpn7160_fw.so AROOT/vendor/nxp/7160/firmware/lib64/libpn7160_fw.so
$cp -r nfc-NXPNFCC_FW/InfraFW/pn7220/32-bit/libpn7160_fw.so AROOT/vendor/nxp/7160/firmware/lib/libpn7160_fw.so

For PN7220:

$git clone https://github.com/NXP/nfc-NXPNFCC_FW.git
$cp -r nfc-NXPNFCC_FW/InfraFW/pn7220/64-bit/libpn7220_64bit.so AROOT/vendor/nxp/pn7220/firmware/lib64/libpn72xx_fw.so

Adding NFC to the build

In the device.mk makefile (for example, device/brand/platform/device.mk), include specific makefiles:

$(call inherit-product, vendor/nxp/nfc/device-nfc.mk)

In the BoardConfig.mk makefile (for example, device/brand/platform/BoardConfig.mk), include a specific makefile:

-include vendor/nxp/nfc/BoardConfigNfc.mk

Adding the DTA application

$git clone https://github.com/NXPNFCProject/NXPAndroidDTA.git $patch -p1 nfc-dta.patch #located in https://github.com/nxp-nfc-infra/nfcandroid_platform_reference/tree/br_ar_14_comm_infra_dev/build_cfg/ build_mw_patches/db845c $ cp -r nfc-dta /system/nfc-dta $/system/nfc-dta/$ mm -j

Build AOSP with changes:

$cd framework/base
$mm
$cd ../..
$cd vendor/nxp/frameworks
$mm #after this one, com.nxp.emvco.jar and com.nxp.nfc.jar should be inside out/target/product/xxxx/system/framwework/
$cd ../../..
$cd hardware/nxp/nfc
$mm
$cd ../../..
$make -j

Now, flash the device with new Android images.

Android NFC Apps and Lib on targets

After the build, the created libraries must be installed on the target device. Section 4.2 specifies the project location, the corresponding library, and the target device location where to be installed.

Note: EMVCo binaries are applicable only with PN7220.

Table 6. Compiled files with device target

Project location	Compiled Files	Comments	Location in target device

“$ANDROID_ROOT”/ packages/apps/Nfc	*NfcNci.odex NfcNci.vdex lib/NfcNci.apk oat/libnfc_nci_jni.so*		*/system/app/NfcNci/ oat/arm64/ /system/app/NfcNci/ oat/arm64/ /system/app/NfcNci/ /system/lib64/*
“$ANDROID_ROOT”/ system/nfc	*libnfc_nci.so*		*/system/lib64/*
“$ANDROID_ROOT”/ system/nfc_tda”	*nfc_tda.so*	Applicable only for CT feature.	*/system/lib64/*
“$ANDROID_ROOT”/ hardware/nxp/nfc	*nfc_nci_nxp_pn72xx.so **android.hardware.nfc_72xx@1.2-service** **android.hardware.nfc_72xx@1.2-service.rc** **android.hardware.nfc@1.0.so** **android.hardware.nfc@1.1.so** **android.hardware.nfc@1.2.so** **vendor.nxp.nxpnfc@2.0.so** **vendor.nxp.nxpnfc@1.0.so***		*/vendor/lib64 /vendor/bin/hw/ /vendor/etc/init /system/lib64/ /system/lib64/ /system/lib64/ /vendor/lib64/ /vendor/lib64/*
“$ANDROID_ROOT/ hardware/interfaces/nfc”	*android.hardware.nfc-V1-ndk.so **android.hardware.nfc@1.0.so** **android.hardware.nfc@1.1.so** **android.hardware.nfc@1.2.so** **android.hardware.nfc@1.0.so** **android.hardware.nfc@1.1.so** **android.hardware.nfc@1.2.so***		*/system\/ib64/ /system/lib64/ /system/lib64/ /system/lib64/ /vendor/lib64/ /vendor/lib64/ /vendor/lib64/*
“$ANDROID_ROOT”/ vendor/nxp/frameworks	*com.nxp.emvco.jar (PN7220) com.nxp.nfc.jar*		*/system/framework /system/framework*

“$ANDROID_ROOT”/ *hardware/nxp/emvco*	*emvco_poller.so (PN7220) vendor.nxp.emvco-V1-ndk.so vendor.nxp.emvco-V2-ndk.so vendor.nxp.emvco-V2-ndk.so vendor.nxp.emvco-service vendor.nxp.emvco-service.rc*		*/vendor/lib64/* */system/lib64/* */system/lib64/* */vendor/lib64/* */vendor/bin/hw/* */vendor/etc/init/*
“$ANDROID_ROOT/ *hardware/nxp/emvco_tda”*	*emvco_tda.so*	Applicable only for CT feature.	*/vendor/lib64/*

Block mapping

Mapping the block name from Section 1 to target location in AOSP code.

Table 7. Patch location in NFC Stack

Block name	Location in AOSP code
NFC HAL and EMVCo HAL	*hardware/interfaces/*
NFC Stack	*hardware/nxp/nfc/*
EMVCo L1 Data Exchange Layer = EMVCo Stack	*hardware/nxp/emvco/*
LibNfc-Nci	*system/nfc/*
NFC JNI	*packages/apps/nfc/*
NFC Service	*packages/apps/nfc/*
NFC Framework	*frameworks/base/*
EMVCo Framework	*vendor/nxp/frameworks/*

EMVCo AP

PN7220 MW stack extends AOSP code with EMVCo MW stack. This section describes the EMVCo APIs.

Note: APIs can be called only when using PN7220 IC. If calling it with PN7160 IC, the API does not work. EMVCo Profile Discovery. Those APIs can be used with contact and contactless profiles.

registerEMVCoEventListener()

- ndk::ScopedAStatus registerEMVCoEventListener (const std::shared_ptr< INxpEmvcoClientCallback > & in_clientCallback, bool * in_aidl_return)
- **Description:** Register EMVCo callback function to receive the events from a listener device
- **Note:** This function is must to ball before invoking any other api.

- **Parameters:**
  - [in] *in_clientCallback: has EMVCo client HAL callback
  - [in] *in_aidl_return: indicates register status in return to caller
- **Returns**
  - boolean returns true, if success and returns false, if failed to register

get Current Discovery Mode ()

- **ndk::ScopedAStatus getCurrentDiscoveryMode(::aidl::vendor::nxp::emvco::NxpDiscoveryMode * _aidl_return)**
- **Description:** returns the current active profile type.
- **Returns**
  - NxpDiscoveryMode – NFC/EMVCo/Unknown

onNfcStateChange()

- ndk::ScopedAStatus onNfcStateChange(NxpNfcState in_nfcState)
- **Description:** updated NFC state to EMVCo HAL.
- **Parameters:**
  - [in] in_nfcState: specifies the NFC state
- **Returns:**
  - void

registerNFCStateChangeCallback()

- ndk::ScopedAStatus registerNFCStateChangeCallback (const std::shared_ptr< ::aidl::vendor::nxp::emvco::INxpNfcStateChangeRequestCallback > & in_nfcStateChangeRequestCallback, bool * _aidl_return
- **Description:** Register an NFC callback function to receive the events from a listener device.
- **Note:** This function is must call before invoking any other api.
- **Parameters:**
  - [in] in_nfcStateChangeCallback: INxpNfcStateChangeRequestCallback the event callback function to be passed by the caller. It should implement to turn ON/OFF NFC based on the request received.
- Returns: boolean returns true, if success and returns false, if failed to register.

setByteConfig()

ndk::ScopedAStatus setByteConfig (::aidl::vendor::nxp::emvco::NxpConfigType
in_type,
int32_t in_length,
int8_t in_value,
::aidl::vendor::nxp::emvco::NxpEmvcoStatus * _aidl_return

setEMVCoMode()

ndk::ScopedAStatus setEMVCoMode (int8_t in_disc_mask,

bool in_isStartEMVCo)

- **Description:** Starts the EMVCo mode with the Device-Controller. Once the Application Data Channel is established, the Application may send start the EMVCo mode with the Device-Controller.
- **Parameters:**
  - [in] in_disc_mask EMVCo: polling technologies are configured through this parameter
  - [in]in_isStartEMVCo: specifies to start or stop the EMVCo mode
- **Returns:**
  - void

setLed()

ndk::ScopedAStatus setLed (::aidl::vendor::nxp::emvco::NxpLedControl
in_ledControl,
::aidl::vendor::nxp::emvco::NxpEmvcoStatus * emvco_status)

For Contact EMVCo, the following APIs can be used on top of the previous ones.

closeTDA()

ndk::ScopedAStatus closeTDA (int8_t in_tdaID, bool in_standBy)

- **Description:** Closes the smart card connected over TDA
- **Parameters:**
  - [in] tdaID: id of the tda slot to be closed
- **Exceptions:**
  - EMVCO_STATUS_INVALID_PARAMETER, if provided tdaID is in-valid
  - EMVCO_STATUS_FEATURE_NOT_SUPPORTED when the contact card feature is not supported.
- **Returns:**
  - void

discoverTDA()

ndk::ScopedAStatus discoverTDA
(std::vector<::aidl::vendor::nxp::emvco::NxpEmvcoTDAInfo > * emvcoTDAInfo)

Description: discoverTDA provides all the details of smart card connected over TDA

- **Parameters:**
  - [in]*in_clientCallback: provides EMVCo state and TDA state as callback
- **Exceptions:**
  - EMVCO_STATUS_FEATURE_NOT_SUPPORTED when the contact card feature is not supported.
- **Returns:**
  - NxpEmvcoTDAInfo[] returns all the smart card connected over TDA. valid emvcoTDAInfo is received only when the status is EMVCO_STATUS_OK

openTDA()

ndk::ScopedAStatus openTDA (int8_t in_tdaID, bool in_standBy, int8_t * out_connID)

Description: opens the smart card connected over TDA

- **Parameters:**
  - [in]tdaID: tda id of the smart card received through discoverTDA
- **Exceptions:**
  - EMVCO_STATUS_INVALID_PARAMETER, if provided tdaID is in-valid
  - EMVCO_STATUS_FEATURE_NOT_SUPPORTED when the contact card feature is not supported.
- **Returns:**
  - byte returns the connection id of the smart card. valid connection id received only when status is EMVCO_STATUS_OK

registerEMVCoCTListener()

ndk::ScopedAStatus registerEMVCoCTListener (const std::shared_ptr<::aidl::vendor::nxp::emvco::INxpEmvcoTDACallback > & in_in_clientCallback, bool * _aidl_return)

- **Description:** registers the EMVCoCT callback to the EMVCo stack
- **Parameters:**
  - [in]*in_in_clientCallback: provides EMVCo state and TDA state as callback
- **Returns:**
  - void

transceive()

ndk::ScopedAStatus transceive (const std::vector< uint8_t > & in_cmd_data, std::vector< uint8_t > * out_rsp_data)

- **Description:** sends application data with the Device-Controller and receives response data from the controller
- **Note:** connection id of the TDA should be added as part of the NCI header.
- **Parameters:**
  - [in]in_cmd_data: Application command data buffer
- **Exceptions:**
  - EMVCO_STATUS_INVALID_PARAMETER, if provided connection id is in-valid
  - EMVCO_STATUS_FEATURE_NOT_SUPPORTED when the contact card feature is not supported.
- **Returns:**
  - Response APDU received from controller. valid Response APDU received only when status is EMVCO_STATUS_OK

For EMVCo contactless, the following APIs can be called:

registerEMVCoEventListener()

ndk::ScopedAStatus registerEMVCoEventListener (const std::shared_ptr< INxpEmvcoClientCallback > & in_clientCallback, bool * _aidl_return)

- **Description:** Register an EMVCo callback function to receive the events from a listener device.
- **Note:** This function is must call before invoking any other api.
- **Parameters:**
  - [in]*in_clientCallback: has EMVCo client HAL callback
  - [in]*in_aidl_return: indicates register status in return to caller
- **Returns:**
  - boolean returns true, if success and returns false, if failed to register

setEMVCoMode()

ndk::ScopedAStatus setEMVCoMode (int8_t in_config, bool in_isStartEMVCo)

- **Description:** Starts the EMVCo mode with the Device-Controller. Once the Application Data Channel is established, the Application may send start the EMVCo mode with the Device-Controller.
- **Parameters:**
  - [in]in_config: EMVCo polling technologies are configured through this parameter
  - [in]in_isStartEMVCo: specifies to start or stop the EMVCo mode
- **Returns:**
  - void

StopRFDisovery()

ndk::ScopedAStatus stopRFDisovery
(::aidl::vendor::nxp::emvco::NxpDeactivationType in_deactivationType,
::aidl::vendor::nxp::emvco::NxpEmvcoStatus * emvco_status)

- **Description:** stops the RF field and moves in to the specified deactivation state.
- **Parameters:**
  - [in]in_deactivationType: specifies the state to be in after RF deactivation
- **Returns:**
  - NxpEmvcoStatus returns EMVCO_STATUS_OK if command processed successfully and returns EMVCO_STATUS_FAILED, if command is not processed due to in-valid state. EMVCo mode should be ON to call this API

transceive()

ndk::ScopedAStatus transceive (const std::vector< uint8_t > & in_data, int32_t * _aidl_return)

- **Description:** send application data with the Device-Controller.
- **Note:** In case if send data is failed, the Application shall again invoke open() before invoking this API.
- **Parameters:**
  - (in]in_data: Application data buffer

- **Returns:**
  - NxpEmvcoStatus indicating execution status

Configuration files PN7160

For PN7160, there are two different configuration files.

1. libnfc-nci.conf
2. libnfc-nxp.conf

Note: Configuration files provided by NXP are examples related to the NFC controller demo board. These files must be adopted according to the targeted integration.

Configuration files must be placed in the target location (see Table 8).

Table 8. Locations of configuration files

Name of configuration file	Location in device
libnfc-nci.conf	*system/etc*
libnfc-nxp.conf	*vendor/etc*

To get more informations on the configuration files, see [9].

Configuration files PN7220

For PN7220, there are five different configuration files.

1. libemvco-nxp.conf
2. libnfc-nci.conf
3. libnfc-nxp.conf
4. libnfc-nxp-eeprom.conf
5. libnfc-nxp-rfExt.conf

Note: Configuration files provided by NXP are examples related to the NFC controller demo board. These files must be adopted according to the targeted integration

Configuration files need to be placed in the target location (see Table 9).

Table 9. Locations of configuration files

Name of configuration file	Location in device
libemvco-nxp.conf	*vendor/etc*
libnfc-nci.conf	*system/etc*
libnfc-nxp.conf	*vendor/etc*
libnfc-nxp-eeprom.conf	*vendor/etc*
libnfc-nxprfExt.conf	*vendor/etc*

To get more informations on the configuration files, see [9].

DTA application

To allow NFC Forum certification testing, a device test application is provided. It is composed of several components in the different Android layers, which must be built and included in the Android image.

To push the DTA application, the following steps must be executed:

1. **Copy all DTA files to one location**
   $cp -rf “out/target/product/hikey960/system/lib64/libosal.so” /DTA-PN7220
   $cp -rf “out/target/product/hikey960/system/lib64/libmwif.so” /DTA-PN7220
   $cp -rf “out/target/product/hikey960/system/lib64/libdta.so” /DTA-PN7220
   $cp -rf “out/target/product/hikey960/system/lib64/libdta_jni.so” /DTA-PN7220
   $cp -rf “out/target/product/hikey960/system/app/NxpDTA/NxpDTA.apk” /DTAPN7220
2. **Push the binaries to the device as bellow**
   adb shell mkdir /system/app/NxpDTA/
   adb push libosal.so /system/lib64/
   adb push libdta.so /system/lib64/
   adb push libdta_jni.so /system/lib64/
   adb push libmwif.so /system/lib64/
   adb push NxpDTA.apk /system/app/NxpDTA/

After flashing the target, the DTA application should then be present in the list of installed applications. Refer to [7] for a detailed description of how to use the application.

Abbreviations

Table 10. Abbreviations

Acronym	Description
APDU	application protocol data unit
AOSP	Android Open Source Project
DH	device host
HAL	hardware abstraction layer
FW	firmware
I2C	Inter-Integrated Circuit
LPCD	lower powered card detection
NCI	NFC controller interface
NFC	near-field communication
MW	middleware
PLL	phase-locked loop
P2P	peer to peer
RF	radio frequency
SDA	serial data
SMCU	secure microcontroller
SW	software

References

1. GitHub repository – PN7160 and PN7220 Common MW: (**link**)
2. Web page – PN7160 – NFC Plug and Play Controller with Integrated Firmware and NCI Interface (**link**)
3. Web page – PN7220 – EMV L1 Compliant NFC Controller with NCI Interface Supporting EMV and NFC Forum Applications (**link**)
4. GitHub repository – PN7160 and PN7220 kernel driver: (**link**)
5. Resources – AOSP r2 tag (**link**)
6. Resources – Source control tools (**link**)
7. User guide – UG10068 – PN7220 – Quick start guide (**link**)
8. GitHub repository – PN7160 and PN7220 FW location: (**link**)
9. Application note – AN14431 – PN7160/PN7220 configuration files (**link**)

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Revision history

Table 11. Revision history

Document ID	Release date	Description
AN14430 v.1.0	03 September 2024	• Initial version

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Documents / Resources

	NXP PN7160 NCI Based NFC controllers [pdf] Instructions PN7160, PN7220, PN7160 NCI Based NFC controllers, PN7160, NCI Based NFC controllers, Based NFC controllers, NFC controllers, controllers

References

- Today I Learned for programmers - Tiloid
- platform/manifest - Git at Google
- GitHub: Let’s build from here · GitHub
- nxp-nfc-infra · GitHub
- GitHub - nxp-nfc-infra/nfcandroid_platform_drivers: DB845C and Hikey board and linux I2C client drivers and patches
- GitHub - nxp-nfc-infra/nfcandroid_platform_reference: DB845C and linux Kernal patches
- GitHub - NXPNFCProject/NXPAndroidDTA: NXPAndroidDTA
- User Manual