Training Mobile Knowledge

PN7120

Best plug'n play full NFC solution

Easy integration into any OS environment

Public

MobileKnowledge

July 2015

Agenda

Session 8th July: PN7120 - Best plug'n play full NFC solution

- ▶ PN7120 & NXP NFC product families

- ▶ PN7120 use cases and target markets

- ▶ PN7120 comparison to NFC frontends and previous NFC controller solutions

- ▶ PN7120 product details

- ▶ PN7120 product support package

Session 15th July: NFC in Linux - How to get started with the PN7120S controller board

- ▶ NFC tools for Linux

- ▶ NXP solutions for Linux

- ▶ How to get started with Raspberry-Pi and PN710S

- ▶ How to integrate Linux libnfc-nci SW stack into a Linux system

Register here

NFC product families
Connected NFC tag, NFC frontend and NFC controller solutions

Connected NFC Tag solutions

A comprehensive portfolio of NFC Forum type 2 tags covering a broad range of use cases.

***Products**: NTAG21xF , NTAG I2C*

NFC frontend solutions

The lowest-cost and most flexible way to add NFC to a system.

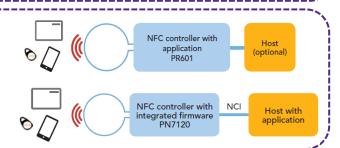***Products**: MFRC522, MFRC523, PN512, PN5180, CLRC663 family*

NFC controller solutions

Combination of NFC frontend with an advanced 32-bit microcontroller.
Options include integrated firmware or freely programmable microcontroller.

Products**: PR601, PN533, **PN7120

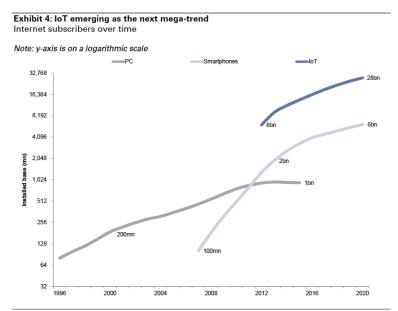# PN7120: *Best plug'n play full NFC solution*
Overview

- ► Full **NFC Forum-compliant** controller
- ► Support NFC card emulation, reader/writer and peer-to-peer modes
- ► Compatible with **ISO/IEC 14443-A&B**, **FeliCa** and **ISO/IEC 15693** cards
- ► **Integrated firmware** with **NCI** interface
- ► **Android** and **Linux** software drivers
- ► Low power operation mode

PN7120

Use cases and target markets

PN7120 accelerates NFC adoption in The Internet of Things (IoT)

The Internet of Things

Exhibit 4: IoT emerging as the next mega-trend
Internet subscribers over time

Note: y-axis is on a logarithmic scale

PC   Smartphones   IoT

28bn
6bn
6bn
2bn
1bn
200mn
100mn

Installed base (mn)

1996   2000   2004   2008   2012   2016   2020

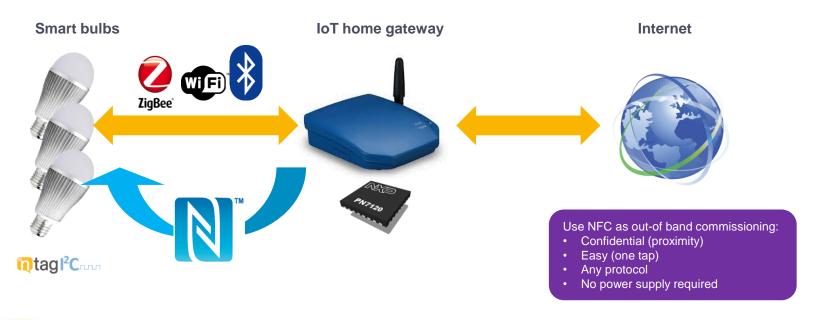*Source: IDC, Ericsson, Goldman Sachs Global Investment Research.*

PN7120 makes smart homes easier to manage
The smarter home – talking to the internet

Smart Lighting

Wearables, healthcare, fitness

Smart Energy & sensors

Internet

IoT home gateway

Consumer electronics

Home appliances

Wi-FI, Bluetooth Zigbee

Smart home
NFC commissioning: easy, protocol agnostic and secure

► Tap the gateway with the nodes
  ▪ Smart Node with NFC tags (NTAG I2C)
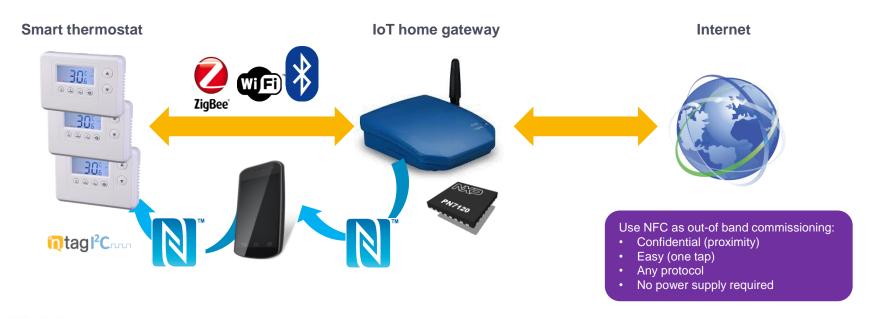 ▪ Smart Gateway with NFC reader (PN7120)

Smart bulbs

IoT home gateway

Internet

Use NFC as out-of band commissioning:
• Confidential (proximity)
• Easy (one tap)
• Any protocol
• No power supply required

Smart home
NFC commissioning: easy, protocol agnostic and secure

► Use the NFC phones as commissioning pilot
  - Smart node with NFC tags (NTAG I2C)
  - Smart Gateway (PN7120) with WiFi/BT connection to the phone

Smart thermostat

IoT home gateway

Internet

Use NFC as out-of band commissioning:
- Confidential (proximity)
- Easy (one tap)
- Any protocol
- No power supply required

PN7120 is the ideal solution for rapidly integrating NFC technology in any application

► Pairing
- Bluetooth, Wi-Fi, ZigBee
- Home automation commissioning

► Personalization
- Personalize your device, Parental control

► Payment
- Access VoD content from any provided.

► Logical access control
- Grant access only to authorized individuals

► User Interface
- Configure settings with smartphone
- Data transfer, product registration

► Maintenance
- Troubleshooting cloud assistance
- Firmware update

► Authentication
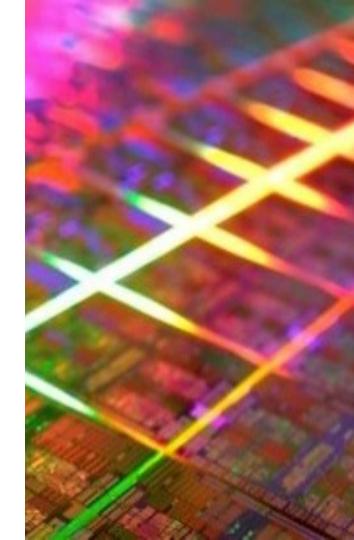- Originality check for ink cartridges, batteries, replacements

PN7120 NFC controller benefit
vs NFC front-end

► The NFC Controller embeds a CPU with dedicated code and data memories to have an embedded FW running.

► It allows us

- To avoid critical timing constraint on host as the critical timings are handled by the embedded FW
- To optimize power consumption since
  ❖ the NFC controller can go in low power mode on its own as soon as requested
  ❖ the host can be in sleep mode and be awakened by the controller only when entering RF-communication
- To drastically lighten the host interactions as some functionalities such as all the RF protocols are autonomously handled by the FW
- To ease the integration of the NFC Controller since the integrator does not need to know and care about the various RF protocols
- To decrease the footprint of the required code size on host (PN7120 FW code size is above 100kBytes)
- To easily integrate in main OS through standardized interface (NCI)

Positioning vs PN512 and PN532/3 protocol

	Embedded FW	NFC Tag reading	Card mode in host	Reader Writer	ISO 18092 Target	ISO 18092 Initiator	EMVCo PCD protocol	NFC Forum compliance
PN512		Reader Tag Type 1,2,3,4	ISO/IEC 14443-A	MIFARE, ISO/IEC 14443-A&B, FeliCa	Active & Passive	Active & Passive	Yes	Yes
PN532/3	Yes	Reader Tag Type 1,2,3,4	ISO/IEC 14443-A	MIFARE, ISO/IEC 14443-A&B, FeliCa	Active & Passive	Active & Passive		
PN7120	Yes	Reader Tag Type 1,2,3,4,5	ISO/IEC 14443-A&B	MIFARE,FeliCa ISO/IEC 14443-A&B, ISO/IEC15693	Active & Passive	Active & Passive	Yes	Yes

Card emulation — Card mode in host

Read & Write — Reader Writer

Peer-to-Peer — ISO 18092 Target / ISO 18092 Initiator

RF performances – power consumption - integration

Product	PN512	PN532/3	PN7120
Product features			
Reading distance up to [mm] (antenna dependent)	70 mm	70 mm	70 mm
Transmitter supply current, typ [mA]	60 mA	60 mA	60 mA
Host interface	SPI, I2C, RS232	SPI, I2C, RS232 / USB	I2C
Supply voltage host interface [V]	2,5 to 3,6 V	5 V	1,8 or 3,3 V
Main supply voltage [V]	2,5 to 3,6 V	5 V	2,3 to 5.5 V
Power-down mode current, typ [µA]	2 µA	10 µA	10,5 µA
Power-down mode with RF level detector on [µA]	25 µA	30 µA	20 µA
Low-power card detection mode [µA]	-	-	150 µA
Package	HVQFN40	HVQFN40	VFBGA49
Temperature range [ºC]	-25 to + 85 ºC	-25 to + 85 ºC	-30 to + 85 ºC
Security features			
MIFARE Classic security (CRYPTO1 HW)	Yes	Yes	Yes
Software support			
Host protocol	R/W registers	Proprietary	NCI 1.0
Host software	NFC reader lib	HAL, NFC Forum ref. implementation. PN533: USB PCSC driver	Android driver Linux driver
Recommended for integration			
	Real Time OS	PN532:all OS; PN533: PC/SC	Android and Linux OS ***

***Examples exist for Real Time OS integration support. NXP can give recommendation to connect the "OM5577/PN7120S NFC Controller Board"
***In case of Windows OS, the product is NPC100.

PN7120 positioning in NXP NFC portfolio
Product comparison

		Zero Power Access	Energy Harvesting	FW Embedded	NFC Tag	Output Power	Card in host mode	Reader & Writer		ISO 18092 Initiator	ISO 18092 Target
Connected Tags	NTAG F	Read& Write			Tag Type 2						
	NTAG I2C	Read& Write	10mA @ 2V		Tag Type 2						
NFC Frontends	PN512				Reader Tag Type 1,2,3,4	3.6V Output Stage	ISO/IEC 14443-A	ISO/IEC14443 FeliCa		Active& Passive	Active& Passive
	CLRC663				Reader Tag Type 1,2,3,4	5V Output Stage		ISO/IEC14443 FeliCa	ISO/IEC15693	Passive	
	PN5180				Reader Tag Type 1,2,3,4,5	5.5V Output Stage	ISO/IEC 14443-A	ISO/IEC14443 FeliCa	ISO/IEC15693	Active& Passive	Active& Passive
NFC Controllers	PN532 PN533			Yes	Reader Tag Type 1,2,3,4	3.6V Output Stage	ISO/IEC 14443-A	ISO/IEC14443 FeliCa		Active& Passive	Active& Passive
	PN7120			Yes	Reader Tag Type 1,2,3,4,5	3.3V Output Stage	ISO/IEC 14443-A&B	ISO/IEC14443 FeliCa	ISO/IEC15693	Active& Passive	Active& Passive
							Card emulation	**Read & Write**		**Peer-to-Peer**	

PN7120
Product details

PN7120

Customer Benefits

- ▸ Low PCB footprint
- ▸ Low power consumption
- ▸ EMVCo 2.3.1a PCD analog and digital
- ▸ NFC Forum Device Requirements v1.3
- ▸ Full SW stack available for integration within Linux and Android 4.4.x and 5.x

Features

Ease of integration

- ▸ Direct connection to 5.5V device battery
- ▸ Flexible clock supply concept
- ▸ Supports both 1.8 and 3V connections to host controller
- ▸ Buffered output drivers to connect an antenna with minimum number of external components

Flexibility in use case supports

- ▸ Fully configurable polling loop with low power modes for automated device discovery
- ▸ Autonomous mode when host is shut down (host can be in a deep sleep mode and be awakened via IRQ pin by PN7120 when entering RF field)

RF communication modes

Reader/Writer modes

- ▸ NFC Forum tags Type 1, 2, 3, 4 and 5
- ▸ ISO/IEC 14443 Type A & B, R/W up to 848 Kbps
- ▸ ISO/IEC 15693 Tags (ICODE)
- ▸ FeliCa tags up to 424 Kbps
- ▸ MIFARE 1K/4K
- ▸ MIFARE DESFire
- ▸ Kovio ink printed tags

Card modes

- ▸ ISO/IEC 14443-A and B card emulation via host

P2P modes

- ▸ Active and passive initiator and target according to ISO/IEC 18092 at all data rates (106 kbps to 424 kbps)

Interfaces

- ▸ I2C up to 3,4MBaud/s
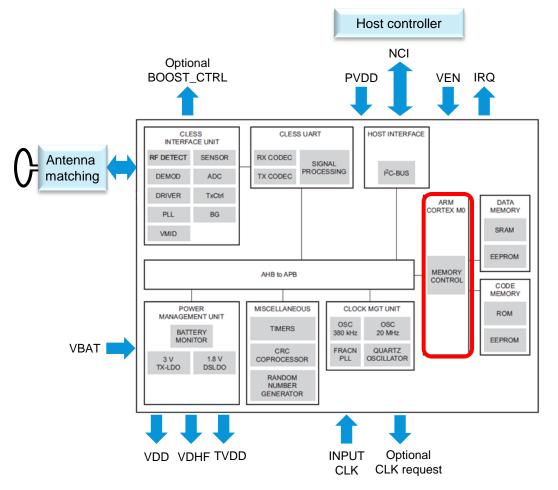- ▸ NFC Forum NCI 1.0 compliant protocol
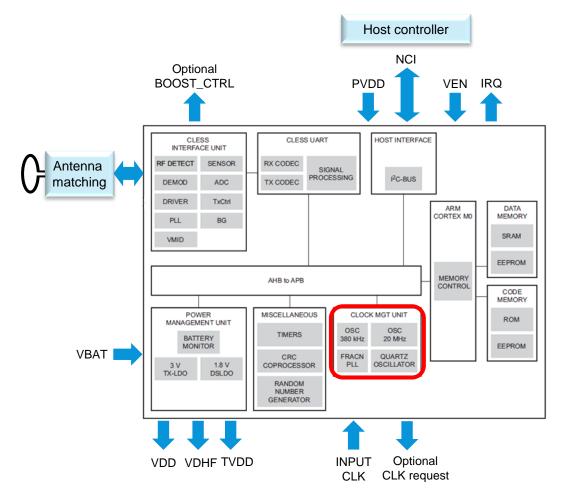
Package

- ▸ VFBGA49

PN7120
Block diagram

► ARM Cortex-M0 for integrated firmware

► Host interface
  ▪ Link with host controller (NCI over I2C)

► Clock interface
  ▪ Clock source required when generating the RF field

► Power interface
  ▪ Interface to power management unit (direct battery supply supported)

► Antenna interface
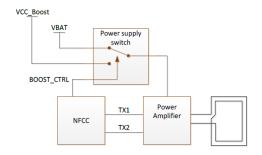 ▪ Link to an NFC antenna in order to enable communication with a remote contactless device

18

PN7120
Clock management unit

► Use of crystal oscillator

- A 27.12 MHz crystal can be used as input clock for PN7120

- When using a crystal, frequency accuracy and drive level must be carefully selected according to the specs.

► Use of system clock

- Input clock frequency must be one of the following values: 13MHz, 19.2MHz, 24MHz, 26MHz, 38.4MHz or 52MHz.

- Based on this input clock signal, the PN7120 integer PLL generates the required 27.12MHz internal clock for field generation.

► Clock request mechanism:

- In order to optimize the device power consumption, the input clock could be provided by the system only when it is actually needed by the chip.

PN7120
Optional booster control

► An external booster can add to the hardware design to achieve better communication distance and RF performance.

► The PN7120 offers a control of the booster circuitry to optimize the overall power consumption
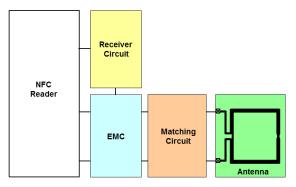
  ▪ This is done via the PN7120 BOOST_CTRL pin

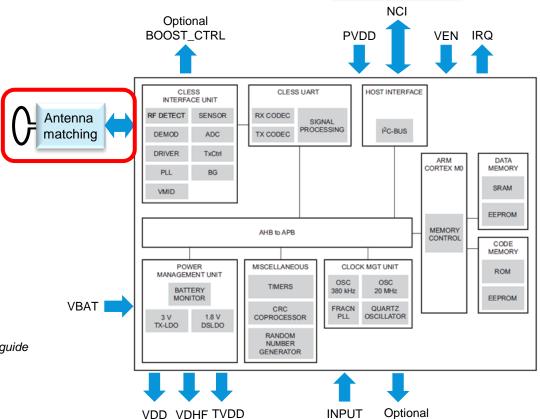*More info: AN11565 Hardware Design guide*

PN7120
Antenna matching block

▶ The PN7120 is intended to be connected to an external coil antenna through a specific matching/tuning network

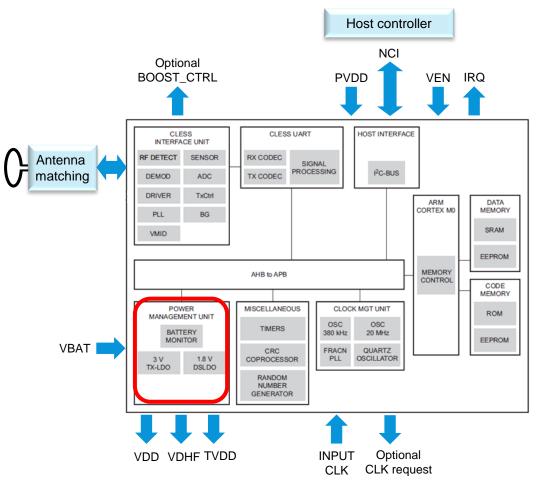*More info: AN11564 PN7120 Antenna and tuning design guide*

PN7120
Power management unit

► Highly efficient integrated power management unit (PMU) allows direct supply from a battery.
  ▪ It is able to operate with a wide voltage input range from 5.5V down to 2.75V

► PN7120 is designed in order to enable different power states:
  ▪ **Monitor**: The system is in power off since it is supplied with voltage below its programmable critical level
  ▪ **Hard power down**: The system is in power off to have minimum power consumption
  ▪ **Standby**: The system is kept supplied to enable configured wake-up sources which allow us to switch to Active state
  ▪ **Active**: The system is on power on and PN7120 internal blocks are supplied.

► At application level, the PN7120 continuously switches between different states to optimize current consumption.

PN7120
Low power discovery mode

► Average power consumption depends on:
- Polling modes enabled by host controller
- Listen mode duration (standby current)
- Antenna system used by the application (RF impedance)

► PN7120 implements two additional modes of Low Power Polling:
- Low power tag detector
  - Replaces each regular polling cycle by an RF pulse (few µs)
  - It uses an enhanced HW reception path in order to reliably detect the insertion of a tag within the field.
  - NXP provides a proprietary extension to the NCI driver in order to enable and configure this mode
- Hybrid mode
  - Introduces a regular polling cycle after a defined amount of LPCD pulses if a tag is still not detected

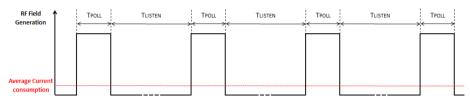*More info: AN11562 PN7120 Low Power mode configuration*
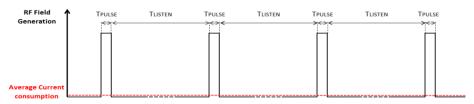

Fig 1. Regular polling loop

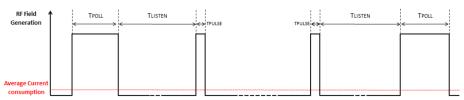*Fig 2. Low power card detector loop*

Fig 3. Hybrid polling loop

PN7120
NCI interface

► The NCI specification defines a standard interface within an NFC device between an NFC controller and the device's main application processor.

► The NCI interface provides manufacturers with a standard interface they can use for whatever kind of NFC-enabled device they build

More info: UM10819 - PN7120 User Manual

NFC Forum Controller Interface (NCI)

NFC Forum
A global, special interest group (SIG)

► The mission of the NFC Forum is to advance the use of NFC technology by:
  - Developing standards-based specifications that ensure interoperability among devices and services
  - Encouraging the development of products using NFC Forum specifications
  - Educating the market globally about NFC technology
  - Ensuring that products claiming NFC capabilities comply with NFC Forum specifications
  - Promoting the NFC Forum N-Mark

► NFC Forum approved 21 specifications spanning:
  - Data exchange formats
  - Tag types
  - Record type definition
  - Device interface controller → NCI
  - Protocols
  - Reference applications
  - Personal Health Device Communications

NFC controller interface (NCI)
NFC Forum TS-NCI-1.1

► Aim of the NCI specification:
- Defines an interface within the NFC device between an NFC Controller and the device's main application processor (DH)
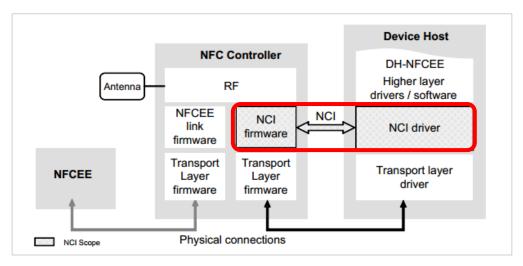
► How it does this:
- NCI offers users a logical interface that can be used with different physical transports, such as UART, SPI or I2C.

► Implementation:
- Requires software implementation in both NFC Controller and device main application processor (linked with device running OS).

► Scope:
- NCI scope is limited to the interface between the Device Host (DH) and the NFC controller (NFCC)

http://nfc-forum.org/our-work/specifications-and-application-documents/specifications/nfc-forum-technical-specifications/

NFC controller interface (NCI)
NXP NCI extension

▶ NCI interface as defined by the NFC Forum does not give access to the entire functionality set.

▶ NXP extends NCI interface with a proprietary extension.

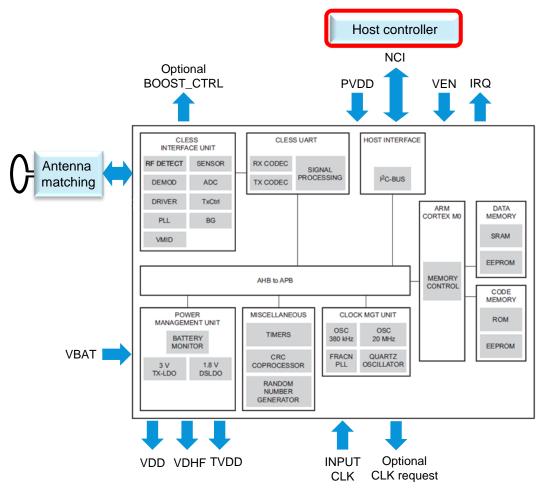| Features	NCI	PN7120- NCI
RF Discovery activity (NFC Forum, EMVCo)	🟡	🟢
Reader/Writer ISO-DEP for NFC-A & NFC-B, T1T, T2T, T3T, T4T	🟢	🟢
Reader/Writer MIFARE Classic, MIFARE Plus, ISO15693, Kovio	🔴	🟢
Card Emulation ISO-DEP for NFC-A & NFC-B	🟢	🟢
P2P passive (Initiator & Target)	🟢	🟢
P2P active (Initiator & Target)	🔴	🟢
RF bit rates for Listen mode & Poll mode: 106 Kbps (NFC-A & NFC-B), 212 Kbps (NFC-F), 424 Kbps (NFC-F)	🟢	🟢
RF bit rates for Listen mode & Poll mode in technology NFC-A & NFC-B: 212 Kbps, 424 Kbps, 848 Kbps	🔴	🟢
Configuration: Power management, RF settings, clocking schemes	🔴	🟢
Others: Presence check	🔴	🟢

🟢 Covered   🟡 Partially covered   🔴 Not covered

PN7120
Host controller integration

► NCI stack is available in Android and Linux systems.

► Additionally, NXP provides software extensions to make use of the full PN7120 capabilities.

Software integration
Linux OS
Android OS
RTOS or without OS platforms

NFC in Linux
Way forward to implement your stack

► **Option 1**: Use Linux open source stack
  - The stack will be maintained by the community
  - NXP will not provide support. No more contribution from NXP to the stack in kernel.org.
    - ❖ For its NCI interface based products NXP participated in improvements of this Kernel based stack (v1.2.0 being up streamed into kernel.org)

► **Option 2:** Use Linux libnfc-nci stack from NXP (recommended)
  - NXP's SW product "Linux libnfc-nci stack" is derived from our available and proven Android stack
  - From June 2015 onwards NXP will provide and maintain the NFC driver in user mode and will be distributed through GitHub:
    - ❖ https://github.com/NXPNFCLinux/linux_libnfc-nci
  - Install PN5xx_I2C kernel driver (without dependencies to kernel version)
  - Install Linux libnfc-nci stack (full user mode)
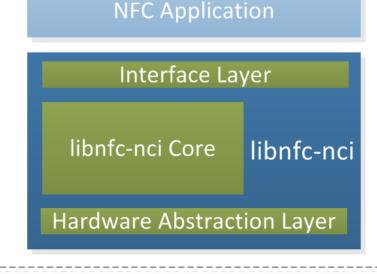 - Port existing application on the Linux libnfc-nci stack (similar to neardal)

![NXP logo] Training Mobile Knowledge

PN7120 SW integration in Linux OS
Linux libnfc-nci stack: Architecture overview

► **Interface Layer:** exposes the library API

► **Core Layer:** implements NFC features (NCI, NDEF, Tag operations..)

► **Hardware abstraction layer**: provides connection to the kernel driver as well as basic functionalities like self-test or FW update

► List of features supported by Linux libnfc-nci stack:
   ▪ NDEF tag support
   ▪ MIFARE classic tag support
   ▪ P2P, LLCP, SNEP
   ▪ WiFi & Bluetooth handover
   ▪ Raw tag command support
   ▪ Propietary NCI command support
   ▪ Host Card Emulation

NFC Application

Interface Layer

libnfc-nci Core   libnfc-nci

Hardware Abstraction Layer

User space
- -
Kernel space

PN5xx I2C Driver

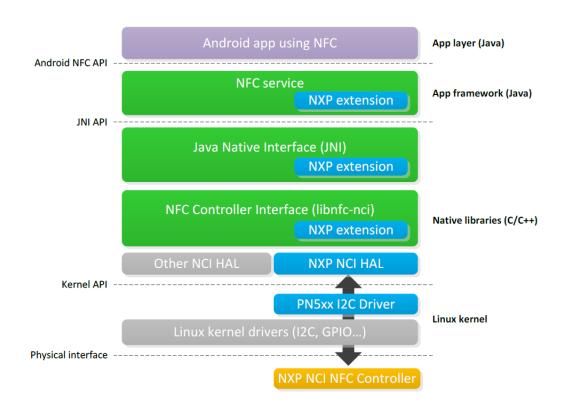- -
Hardware

NXP NCI NFC Controller

PN7120 SW integration in Android
Android NFC stack

► **NFC service:** API within the Android framework that provides access to the NFC functionality.

► **JNI**: Glue code between Java classes and Native classes (written in C/ C++)

► **NXP NCI HAL**: NXP hardware specific implementation supporting full capabilities

► **Linux Kernel**: Implements the hardware drivers and speaks to the underlying NFC controller.

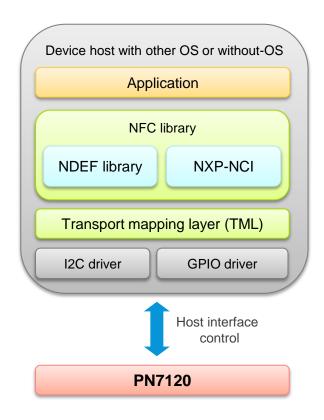# PN7120 SW integration in RTOS or without OS systems
e.g.: LPCXpresso platform

▶ PN7120 NCI based NXP NFC Controller can be integrated to an embedded system with no OS resources in order to provide NFC capability

▶ There is a project example based on LPCXpresso platform, running on NXP LPC122x or LPC11xx MCUs driving the NFC controller
  ▪ This example can easily be ported in a system with RTOS support.

Architecture overview:

▶ *NXP-NCI:* High level NFC API for the connection and configuration of the NFC controller

▶ *NDEF library:* Submodule handling NDEF functionality for R/W, P2P and CE modes.

▶ *TML*: Brings HW abstraction to the NFC library

▶ *I2C driver*: Handler for the I2C communication with the NFC controller

▶ *GPIO driver*: handler for the NFC controller VEN (Hard reset) and IRQ (interface interrupt) pins.

Easy porting to other platforms:

▶ *NFC Library* and *TML* layers can be reused

▶ Only *I2C driver* (3 functions) and *GPIO driver* (4 functions) need to be adapted to each system

PN7120

Product support package

PN7120
Support material

Doc ID	Doc Name	Description
939775017621	PN7120 Leaflet	Full NFC Forum-compliant controller with integrated FW and NCI interface
PN7120	PN7120 Product Data Sheet	Describes the functionality and electrical specification of the PN7120 NFC controller
AN11700	PN7120 Product Quick Start Guide	Describes the PN7120 documentation to be used to start working with PN7120
UM10819	PN7120 User Manual	Describes the PN7120 interfaces, modes of operation and possible configurations.
AN11565	PN7120 Hardware Design Guide	Provides an overview on how to integrate the PN7120 NFC controller from hardware perspective
AN11564	PN7120 Antenna and tuning Design Guide	Provides guidelines regarding the way to design and tune an NFC antenna for the PN7120
AN11562	PN7120 Low Power mode configuration	Provides guidance on how PN7120 can be configured in order to reduce current consumption by using low power poll mode
AN11658	NXP-NCI NullOS integration example	Intended to provide a description of the NXP-NCI demo project demonstrating simple integration of NXP-NCI based NFC Controller without any OS support required.
SW324110	NXP-NCI LPCXPresso example project	
AN11697	PN7120 Linux SW stack integration guidelines	Provides guidelines for the integration of NXP's PN7120 NFC controller to a generic GNU/Linux platform from SW perspective
AN11690	NXP-NCI Android porting guidelines	Describes how to add support for a NXP NCI NFC chip to an Android based system.

Product website PN7120: www.nxp.com/products/identification_and_security/nfc_and_reader_ics/nfc_controller_solutions/PN7120A0EV.html

PN7120 controller SBC Kit
OM5577/PN7120S

► Demoboard for the PN7120 NFC controller

► Designed to work with Raspberry-Pi or BeagleBone
  ▪ Can be adapted to other systems

► Drivers available for Linux and Android

► Linux images available for Raspberry-Pi and BeagleBone
  ▪ They come with the full libnfc-nci NFC stack installed
  ▪ They integrate the PN7120 drivers
  ▪ They include demo software

* Board available at NXP distributors

Demoboard website PN7120S/OM5577: www.nxp.com/demoboard/OM5577.html

Package ID	Package details
OT334610	Hardware design files for OM5577/PN7120S

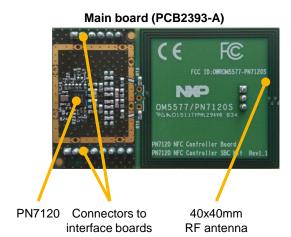| Software	
OM5577_Rbi	Demonstration image for quick start in Raspberry Pi Linux environment
OM5577_BBB_Linux	Demonstration image for quick start in BeagleBone Linux environment
OM5577_BBB_Kitkat	Demonstration image for quick start in BeagleBone Android environment

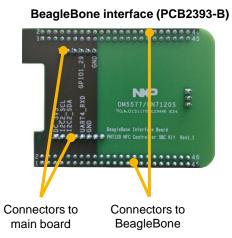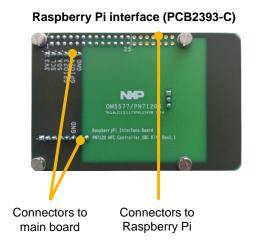| Documentation	
UM10878	PN7120 NFC Controller SBC Kit user manual
AN11646	PN7120 NFC Controller SBC Kit quick start guide
PN7120_SBC_Kit	PN7120 NFC Controller SBC Kit OM5577/PN7120S (leaflet)

PN7120 controller SBC Kit
OM5577/PN7120S

► PN7120 controller SBC kit is a high performance fully NFC compliant expansion board for both Raspberry Pi and BeagleBone.

► The kit is composed of three PCBs:

Main board (PCB2393-A)

PN7120   Connectors to interface boards   40x40mm RF antenna

BeagleBone interface (PCB2393-B)

Connectors to main board   Connectors to BeagleBone

Raspberry Pi interface (PCB2393-C)

Connectors to main board   Connectors to Raspberry Pi

Getting started with the OM5577/PN7120S board and Raspberry-Pi
What you will need

Raspberry-Pi

**PN7120
controller board**

**Raspberry-Pi
interface board**

**SD card
(at least 4GB)**

Power supply

HDMI screen

**USB mouse
and keyboard**

**Internet
connection**

Getting started with the OM5577/PN7120S board and BeagleBone Black
What you will need

BeagleBone Black

**PN7120
controller board**

**BeagleBone
interface board**

**microSD card
(at least 8GB for Android on BBB)**

**5V DC
Power supply**

**HDMI screen
+
MicroHDMI to HDMI cable**

**USB hub, USB
mouse and
keyboard**

**Internet
connection**

Getting started with the OM5577/PN7120S board
Hands-on

Hands-on using PN7120S
controller board + Raspberry-Pi

15th June

► Overview of the Linux libnfc-nci SW stack

► How to get started with Raspberry-Pi and PN7120S

► How to integrate Linux libnfc-nci SW stack into a Linux system

Wrap up

PN7120
Key points

► Highly integrated and full NFC Forum controller solution

► Multiple target markets:
- TVs, set-top boxes. Home automation, home appliances, wearable, printers, IP phones, gaming consoles, healthcare, wireless routers, etc.

► Multiple use cases:
- Pairing, Personalization, User Interface, Maintenance, Logical access control, etc

► RF protocols:
- R/W: ISO/IEC14443 Type A/B, ISO/IEC15693, FeliCa
- P2P: ISO/IEC18092 (Active and Passive)
- CE: ISO/IEC14443 Type A/B

► Ease of integration:
- Pre-loaded FW, NCI interface, Linux and android drivers

► Low bill of materials :
- Direct connection to application host, BGA package

► Low-power operation mode

► Demokit and support information available

Further information

► NFC Everywhere
http://www.nxp.com/nfc

► NFC Everywhere support page
http://www.nxp.com/techzones/nfc-zone/community.html

► From here check out the community for FAQs of post your question into the discussion forum for NFC Readers

► PN7120 product support information
http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics/nfc_controller_solutions/PN7120A0EV.html

Check our FAQ and community
nxp.com/nfc
for latest posts on PN7120

MobileKnowledge
Thank you for your attention

► We are a global competence team of hardware and software technical experts in all areas related to contactless technologies and applications.

► Our services include:
  - Application and system Design Engineering support
  - Project Management
  - Technological Consulting
  - Advanced Technical Training services

► We address all the exploding identification technologies that include NFC, secure micro-controllers for smart cards and mobile applications, reader ICs, smart tags and labels, MIFARE family and authentication devices.

For more information

Eric Leroux
eric.leroux@themobileknowledge.com
+34 629 54 45 52