



# NFC Everywhere

Controller, frontend, and connected-tag solutions for the next generation of NFC applications



# NFC Everywhere – Delivering the next experience in wireless

**Near Field Communication, the tap-and-go technology co-invented by NXP more than ten years ago, has shifted into high gear.**

**This simple, intuitive technology, which lets you initiate interactions with a simple touch, is now in millions of smartphones, tablets, and other consumer electronics, with new devices arriving almost daily.**

**Why is NFC such a hot topic? Because it's fast, seamless, and easy to use – and like nothing else you've ever experienced.**

NFC is a different kind of wireless. To begin with, it's a proximity technology, which means it only works when two devices are brought close together. Eavesdropping is a near impossibility. Where other wireless technologies use the equivalent of a random shout to be heard, NFC speaks with intention, in a whisper.

What's more, NFC is unique in the way it uses energy. Or, more to the point, the way it doesn't. Only one of the two devices needs to be powered for an interaction to take place. The first can power the second, so the second can save its battery for other things – or not have a battery at all.

NFC offers the ultimate in convenience, and makes new experiences possible. It's an evolution of contactless smartcard technology but, unlike its predecessor, which can only communicate in one direction, NFC supports two-way interactions. That opens up a whole new range of possibilities, from the simple

exchange of business cards to more sophisticated things like personalized transactions, loyalty programs, and devices that can commission and configure themselves.

Also, because NFC is fully compatible with the established, trusted infrastructure behind contactless smartcards, NFC is ready to go. The same infrastructure that so many millions of people around the world rely on every day to make payments, access buildings, and ride public transport is also a solid platform for NFC, just waiting to launch new ideas.

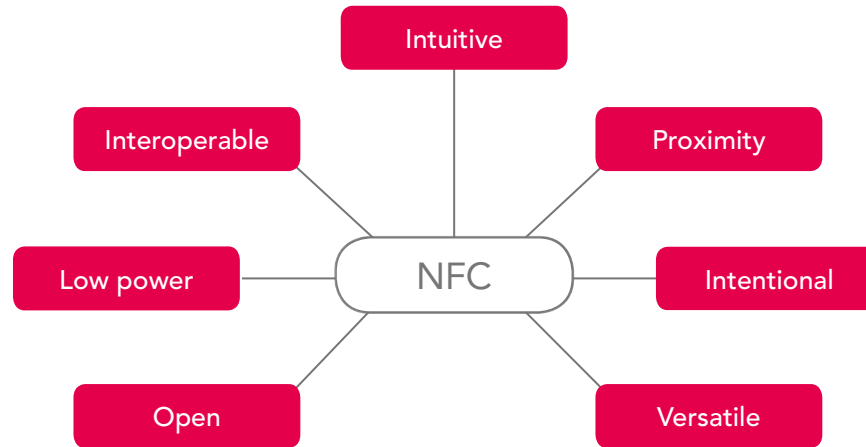
## **NXP IS THE CHOICE FOR NFC**

In many ways, NXP is NFC. As a co-inventor of the technology, we have led the effort to establish its worldwide acceptance. We helped found the NFC Forum, the standards-based organization that now includes more than 170 member companies, and we've played a pivotal role in expanding NFC's market presence.

We are the market leader in NFC, with top positions in the mobile and infrastructure sectors, and we've shipped hundreds of millions of NFC ICs for cellular phones, payment terminals, and other NFC-enabled systems. Our NFC technology is used in more than 80 percent of all NFC-enabled point-of-sale (POS) terminals, and in more than 90 percent of all NFC-enabled smartphone models.

Our success with NFC reflects our long-standing commitment to innovation in RFID, our extensive IP portfolio, and our more than 20 years of support for MIFARE, the world's first choice for contactless proximity technology.

Simply put, you won't find anyone better suited to make NFC a part of your world.



### NFC delivers

- Convenience
- Power savings
- Lower customer-service costs

### NFC at a glance

- ▶ Contactless proximity technology
- ▶ Intuitive connections
- ▶ Safe one- and two-way interactions
- ▶ RFID technology
- ▶ Operating frequency: 13.56 MHz
- ▶ Operating range: 10 cm (4 in)
- ▶ Maximum speed: 848 kbits/sec
- ▶ Standards: ISO/IEC 18092, ISO/IEC 21481, ISO/IEC 14443 A/B, ISO/IEC 15693, ISO/IEC 18000-3m3
- ▶ Compatibility: MIFARE, FeliCa
- ▶ Read/Write, Peer-to-Peer and Card Emulation Modes possible in one device
- ▶ Quick, seamless pairing with Bluetooth, WiFi



**By 2018, there will be 1.7 billion NFC-enabled smartphones in the market**

(ABI Research, 2013)

### HIGHLIGHTED APPLICATIONS

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More than  
**90 percent**  
of all NFC-equipped  
smartphone models use  
NXP technology

# NFC in action

NFC supports three communication modes: **Read/Write, Peer-to-Peer, and Card Emulation.** In all these modes, a simple tap is all it takes to initiate a transaction.



### Read/Write Mode

In **Read/Write Mode**, the system performs the functions of a contactless reader/writer. The system's NFC IC interacts with an NFC-enabled device – such as a contactless smartcard, an NFC tag, or an NFC-enabled smartphone (operating in Card Emulation Mode) – and either reads data in from the device or writes data out to it. This mode is used to get information or initiate an action.

#### Power savings

The NFC-enabled device that initiates the transaction generates an RF field, and then reads data from or writes data to a second NFC-enabled device. The second device does not generate its own RF field, but instead modulates the RF field created by the initiator. This is an important distinction, because it means the second device uses power from the initiator and doesn't need its own battery.

#### Secure transactions

To increase the security of Read/Write Mode, a Secure Access Module (SAM), which acts as a secure crypto coprocessor, can be used to encrypt data. The SAM also verifies the encrypted data for authenticity before the transaction (such as an online purchase or access to a building) can proceed.



### Peer-to-Peer Mode

**Peer-to-Peer Mode** is used to establish a two-way communication channel between a pair of NFC-enabled devices. Each NFC-enabled device serves as an endpoint, meaning the two systems can initiate a communication as equals, or peers. This mode uses either a passive or active communication scheme.

#### Two-way interactions

The two-way nature of Peer-to-Peer Mode enables more sophisticated interactions between devices, so you can, for example, pair with Bluetooth or WiFi, exchange business cards with a colleague, or receive frequent-flyer points when purchasing an airline ticket.

#### Power savings

Peer-to-Peer Mode can use a passive communication scheme. Only one device needs to be active, drawing power to generate the necessary RF field. The second device can remain passive, acting only as a target and modulating the field. Working in passive mode is a significant benefit, from the standpoint of power consumption, and is one of the requirements for compliance with the NFC Forum, the primary standards body for NFC technology.



### Card Emulation Mode

**Card Emulation Mode** lets the system behave as an ISO/IEC 14443-compliant contactless smartcard. This means that the NFC-enabled device can be used in the existing contactless card infrastructure, for things like ticketing, access control, transit, tollgates, and contactless payments.

#### Power savings

Card Emulation Mode saves power by using passive communication. In this mode, the smartcard or NFC device modulates the RF field generated by the initiator of the transaction, which is likely to be a contactless reader in a building-access or payment application. Since the smartcard or NFC device does not generate its own RF field, the transaction is highly efficient.

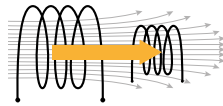
Battery-driven NFC devices that function exclusively in Card Emulation Mode consume very little power, since the system requires only enough energy to drive the onboard microcontroller. This results in very long lifetime in the field.

## PASSIVE communication scheme

Read/Write, Passive Peer-to-Peer, and Card Emulation Modes

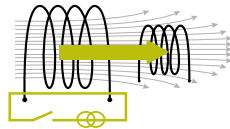
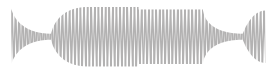
### 1. The initiator generates an RF field

The RF field is used for data exchange.  
The initiator and target are both powered internally.



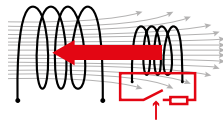
### 2. The initiator sends commands

The initiator modulates the RF field to send commands.



### 3. The target responds

The target uses backward modulation to transmit the response.



The initiating device produces a 13.56 MHz carrier field, and the target device, when introduced to this field, uses it to draw energy. The initiator transfers data by directly modulating the field, while the target transfers data by load-modulating the field. This method, required by the NFC Forum, is compatible with other contactless smartcard formats, including ISO/IEC 14443.

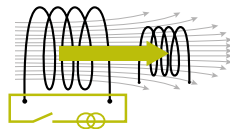
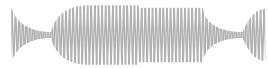
Operating distance	10 cm
Data rates	Up to 424 kbits/sec
Mandated by NFC Forum	Yes

## ACTIVE communication scheme

Active Peer-to-Peer Mode

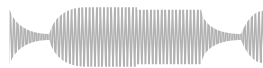
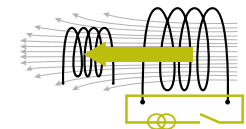
### 1. The initiator sends commands

The initiator generates an RF field, sends commands, and then cuts the field.



### 2. The target responds

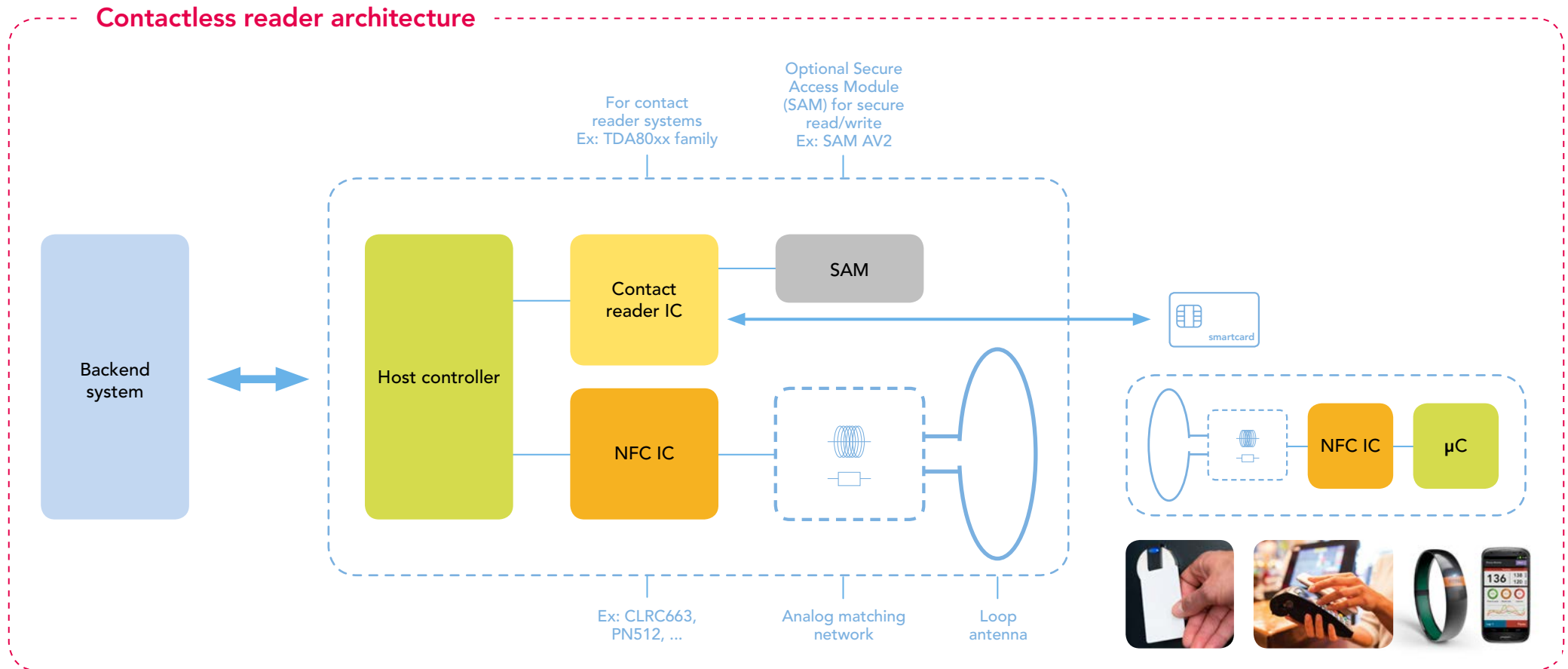
Once the initiator cuts its RF field, the target generates its own field and uses it to transmit responses.



The initiator and the target both generate an RF field. Each side transmits data by modifying its own field with Amplitude Shift Key (ASK) modulation. To avoid collisions, only the sending device emits an electromagnetic field. The receiving device switches off its field to listen. The send/receive roles can be reversed as needed to support the transaction.

Operating distance	10 cm
Data rates	Up to 424 kbits/sec
Mandated by NFC Forum	No

# Inside an NFC-enabled system



The diagram shows two NFC-enabled systems. The first, in the middle of the diagram, could be a POS terminal, a set-top box, or a consumer appliance like a microwave oven or a washing machine. It uses an NFC IC to support the three operating modes (Read/

Write, Peer-to-Peer, and Card Emulation). The host controller manages the NFC process, and any transactions that require a higher level of security are performed in the optional onboard Secure Access Module (SAM). The contact reader IC is also optional. It adds















support for contact-based smartcards, and makes the system compatible with payment, identification, and access cards that use standards like ISO/IEC 7816. The second NFC-enabled system, on the right, could be a smartphone, a contactless smartcard, or

some other electronic device equipped with an NFC tag. For NFC transactions, this second system can use the RF field generated by the first system. As a result, the second system doesn't need to be powered while the NFC transaction takes place.



## Where does NFC fit in the world of wireless?

NFC delivers short-range communication, similar to Bluetooth and WiFi, but with the ability to store and transmit data in much the same way that RFID tags and contactless smartcards do.

Technology	 Frequency	 Range	 Active/passive	Devices & applications
<b>NFC</b> (ISO/IEC 18092, NFC Forum)	13.56 MHz	10 cm	 / 	Smartphones, tablets, portable devices in a peer-to-peer network
<b>Contactless (proximity) smartcards</b> (ISO/IEC 14443)	13.56 MHz	10 cm		Ticketing, payment, access, passports, etc.
<b>RFID</b> (ISO/IEC 18000)	LF (120 to 150 kHz) HF (13.56 MHz) UHF (433 to 900 MHz)	< 40 m	 / 	Tagging and tracking of goods and items for manufacturing, logistics, retail, etc.
<b>IrDA infrared</b>	2.4 GHz	< 1 m		Remote controls, mobile phones, computers
<b>Bluetooth</b> (IEEE 802.15.1)	2.4 GHz	> 10 m		Smartphones, tablets, laptops, audio equipment, printers, other devices in a personal area network (PAN)
<b>WiFi</b> (IEEE 802.11)	2.4 GHz	> 100 m		Smartphones, tablets, laptops, routers, other devices in a local area network (LAN)
<b>ZigBee</b> (IEEE 802.15.4)	2.4 GHz	> 100 m		Lighting networks, home automation, industrial control
<b>2/2.5/3G cellular</b>	450 MHz to 2.7 GHz	Several km		Industrial devices, eMeters, Internet of Things (IoT) devices
<b>4G cellular</b>	450 MHz to 2.7 GHz	Several km		Smartphones, tablets

## Where did NFC come from?

Co-invented by NXP Semiconductors and Sony Electronics, NFC is a specialized subset of RF identification (RFID). It operates at 13.56 MHz and performs many of the same functions as RFID tags and contactless smartcards, while adding peer-to-peer communications.

### RFID (Radio Frequency Identification)

Generic term for contactless technology. Always used for applications relating to tagging of goods and items. Automatic detection of a unique identifier.

**Range** 1 to 100 m  
**Frequency** LF (120 to 150 kHz)  
 HF (13.56 MHz)  
 UHF (433 to 900 MHz)  
**Standard** ISO/IEC 18000

### Contactless proximity technology

Subset of RFID, with more memory and more security. Active action required (e.g. person presents smartcard to reader). In widespread use for access control, ePassports, payment cards, transport and event ticketing, etc.

**Range** 10 cm  
**Frequency** 13.56 MHz  
**Standard** ISO/IEC 14443 (includes MIFARE and FeliCA)

### NFC

Builds on contactless proximity technology to support three modes of operation: Read/Write, Peer-to-Peer, and Card Emulation.

**Range** 10 cm  
**Frequency** 13.56 MHz  
**Standard** ISO/IEC 18092, ISO/IEC 21481, NFC Forum



## NFC for payment

Today's POS systems are mounted on a counter or embedded in a piece of equipment, such as a gas pump or vending machine. Mobile versions (mPOS) are light enough and small enough to be carried by salespeople or connected to a smartphone, tablet, or laptop. mPOS systems let small businesses and individuals support cashless transactions with minimal investment, while larger retailers use mPOS to enhance their retail and payment processes.

With NFC on board, the user interface couldn't be simpler – you just tap your card or NFC-enabled smartphone to complete

the transaction – so payments are quicker and easier than ever to process. No more waiting for a contact smartcard to complete the transaction, and no more entering PIN codes for small transactions or having to re-slide a magstripe card because the first try failed.

### Enhanced services

NFC also lets you do more than just process payments, since NFC can collect data from the customer's smartcard or smartphone, for use with direct marketing campaigns and loyalty programs. The POS system can then send a paperless receipt to the customer's

email account, push a personalized text message to their smartphone, add points to their loyalty account, or send them exclusive coupons. The POS system becomes an integral part of customer service.

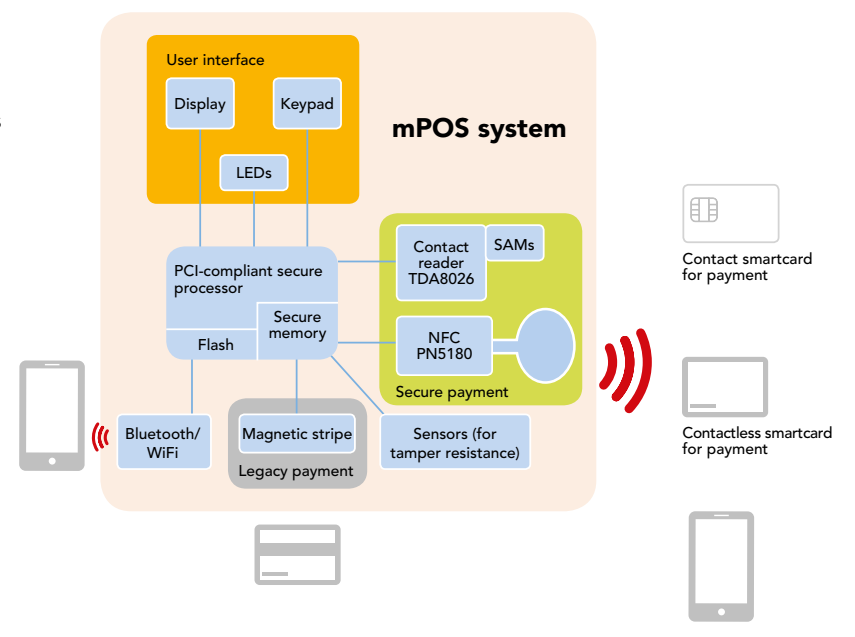
### NXP leadership

Eighty percent of all POS terminals use our technology. As the number-one supplier to the POS market, we have long-standing partnerships with industry leaders and have developed best-in-class systems that enable fast, secure transactions.

### POS/mPOS: A CLOSER LOOK

A basic POS system has a user interface, a keypad, LEDs, and a display. It uses a secure processor, compliant with PCI and EMV, for payments. The system can read various card formats, including NFC-enabled contactless cards, chip cards, and magstripe cards. The SAM fulfills the security requirements for closed-loop applications, such as loyalty schemes.

POS and mPOS terminals are very similar in terms of architecture and security requirements. The main difference is that mPOS terminals are designed to be portable, and enable online payment transactions for merchants on the move. The payment transaction takes place in a secure environment on the mPOS terminal. The mPOS terminal uses Bluetooth or WiFi to connect to a mobile phone, and the phone then connects to the backend payment system through a mobile network.







## NFC in pre-payment metering

Using NFC to add pre-payment functionality to a meter makes it easier to pay for a utility service, because consumers can use a smartcard or a mobile phone as a 24/7 payment option. The process is simple: buy the card, purchase a given amount of credits from the utility company, load the credits onto the card, and then tap the card to the meter to transfer the credits. The pre-paid amount can also be stored in the app of an NFC-enabled smartphone.

## POS design kit OM5597/RD2663

This full, EMVCo L1-compliant kit uses the LPC1768, TDA8026, and CLRC663. The contact reader is analog/digital-compliant with EMVCo 4.3, and the contactless interface is RF/digital-compliant with EMVCo 2.3.1.

## NFC enables

- ▶ Tap-and-pay convenience
- ▶ Enhanced security
- ▶ Paperless receipts
- ▶ Loyalty programs
- ▶ Electronic coupons
- ▶ Personalized messages

## Regulatory requirements

### PCI

The PCI Security Standard (PCI) enhances data security for payment cards. The PCI Data Security Standard (PCI DSS) defines a robust process that covers prevention, detection, and appropriate reaction to security incidents. To create a secure end-to-end system, the guidelines address terminal manufacturers, merchants, and software vendors across different certifications (PCI PTS, PCI PA DSS).

### EMVCo

The Europay, MasterCard, Visa (EMV) standard is for processing cards equipped with an integrated circuit (known as IC cards or chip cards). Information stored on the IC is used to generate dynamic data, meaning new data is created for each transaction. Using dynamic data ensures that, if the data is stolen, the content is rendered useless, since it can't be used a second time. With the EMV standard, the terminal authenticates the card's dynamic data before going online to process the transaction on the back end.

## Recommended NXP products

*NFC frontend solutions* PN5180, MFRC522 (for top-up utility metering)

*Contact reader solution* TDA8026 (for payment)

# NFC for access

Conventional keys can be copied inexpensively at corner shops, and research into 3D printing shows how easy it could soon be to replicate even sophisticated high-security metal keys. Plastic smartcards are cheaper than metal keys and harder to copy, and have been used as part of high-security access systems for more than two decades.

### Smart locks

By adding NFC functionality to a door lock, the same kind of smartcard technology that protects some of the world's most valuable objects can now be brought to everyday places like homes, apartment buildings, and hotels.

An NFC-enabled smartphone can be used to configure the lock, so homeowners can grant temporary access to a specific person or group. The cleaning service can only enter between 10 and 11 am, or emergency-service personnel can be given access at a moment's notice. Programmable locks are especially useful in apartment buildings, where turnover rates lead to frequent rekeying.

### Hotel access

Hotel guests, who are often juggling several pieces of luggage when they first arrive, can gain quicker access to their rooms with an NFC-enabled smartcard for

a key, since all they need to do is just tap the card to the lock. No more fumbling with card slots, or having to retry because the card wasn't inserted and removed the right way. Guests can even receive their keys over the air, via email, SMS, or a web platform, using their NFC-enabled smartphones. There's no need to check in at the front desk, and the hotel can stock fewer plastic cards.

### Beyond buildings

In amusement parks, NFC wristbands let kids roam freely, and make it possible to earn points as they participate in various activities or visit particular sites. Wristbands can be

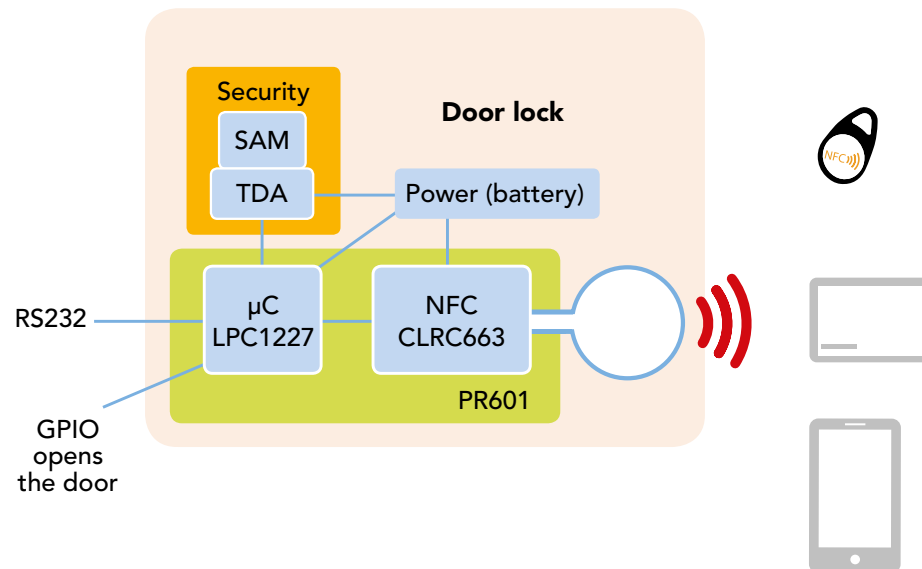
used more than once, so it's easier for visitors to come and go, and there's less waste.

### NXP leadership

NFC is compatible with NXP's industry-leading MIFARE technology – the proven solution of choice in hundreds of high-security access-management systems. MIFARE compatibility builds on Common Criteria EAL certification, and supports DES/3DES/4DES/AES crypto algorithms in hardware.

## DOOR LOCK: A CLOSER LOOK

The PR601, which combines a CLRC663 NFC IC with an advanced LPC1227 microcontroller, makes the design very compact. Also, because NXP uses the most robust, mass-tested NFC technology, the PR601 minimizes interference from magnetic fields, which can come from metal in the door or doorway. Using a feature exclusive to NXP, called low-power card detection, the reader terminal's microcontroller enters sleep mode while still polling for cards, thus ensuring energy-efficient operation.



## NFC enables

- ▶ Tap-and-enter convenience
- ▶ Enhanced security
- ▶ Temporary access for specific people
- ▶ Counterfeit-proof keys
- ▶ Remote key distribution and management



### NFC for building-automation networks

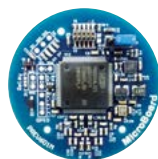
Individual door locks are just one part of the picture for large-scale facilities. Every door needs its own access privileges, and that means incorporating individual locks into a larger system. The fact that NFC can provide seamless connection to the Internet makes it easier for large-scale facilities to integrate each door into their building-automation systems and security setups.

### NFC for AFC

NFC-based payment functions are already compatible with the existing contactless infrastructure, which means they're easy to deploy in any of the 736 cities, in 70 countries, that already use MIFARE for transport ticketing. The same kinds of value-added services of paperless receipts, loyalty programs, couponing, and personalized messaging can be used for automatic fare collection (AFC), or at other venues, like amusement parks and sports arenas.

### NFC for virtual access

Beyond providing access to brick-and-mortar buildings and other real-world venues, NFC can also provide access in the virtual world. Gamers, for instance, can use NFC to access specific gaming environments or to enter virtual rooms to join their friends online.



### Access microboard

The PREV601M microboard is a compact PR601 design that can be implemented in a door lock. Application notes, which cover key diversification and generic data models, simplify development.

### Recommended NXP products

**NFC controller solution** PR601 (for use with custom software)  
**NFC frontend solution** MRFC630 (for optional use with a low-power NXP LPC microcontroller with limited Flash memory, such as the LPC800 or LPC1100 Series)



# NFC for Linux/Windows/Android systems

Security breaches relating to corporate data and personal information are becoming all too familiar in the daily news cycle, and are unsettling reminders of just how vulnerable we are when we go online or allow someone access to a virtual private network (VPN). It's clear that the simple combination of a username and password is not enough to ensure safe access. New devices come online every day, and if the system runs Linux, Windows, or Android, then NFC can provide the authentication services that make online access safer. Whether it's a desktop PC, a laptop, a tablet, or even a set-top box or gaming station, NFC can make it safe to go online, with just a tap of a badge, an ID, or a dedicated smartcard.

## Verified access

When workers log into a VPN, they can use a smartcard or NFC tag to launch pre-set configurations, so they can resume where they left off, even if they're using a different access point. Peer-to-Peer Mode enables intelligent white boards so it's easier to share work and deliver presentations. Educational programs that involve Massive Open Online Courses (MOOCs) can restrict access, so registered students are the only ones able to participate.

## Higher efficiency

NFC enhances productivity, too. A simple tap is all it takes to pair a laptop or tablet with Bluetooth and WiFi networks, so you don't waste time entering passwords and setting configurations. In Peer-to-Peer Mode, just one tap is all it takes to send files to a printer, stream music to an NFC-enabled speaker, or get contact information from a new colleague's NFC-enabled smartphone.

## Smarter entertainment

Payment functions, embedded into Linux-based entertainment systems, make it easy to pay for streaming services like video on demand. These systems can also be configured to start up using pre-set channel preferences, with just a tap of a smartcard or an NFC-enabled smartphone. Authentication features ensure that only the right people have access to online accounts, gaming environments, or social media.

## OS support

Android was one of the first operating systems to support NFC, and Windows 8 now includes NFC as part of its standard operation. NFC is also gaining momentum on Linux, with several initiatives, including one driven by Intel, working toward a

complete, open-source and hardware-independent approach to supporting NFC within the Linux environment. Designing NFC to work with these operating systems means meeting specific design requirements, mandated by standards organizations, and NXP offers specific tools to help meet all of them.

## NXP leadership

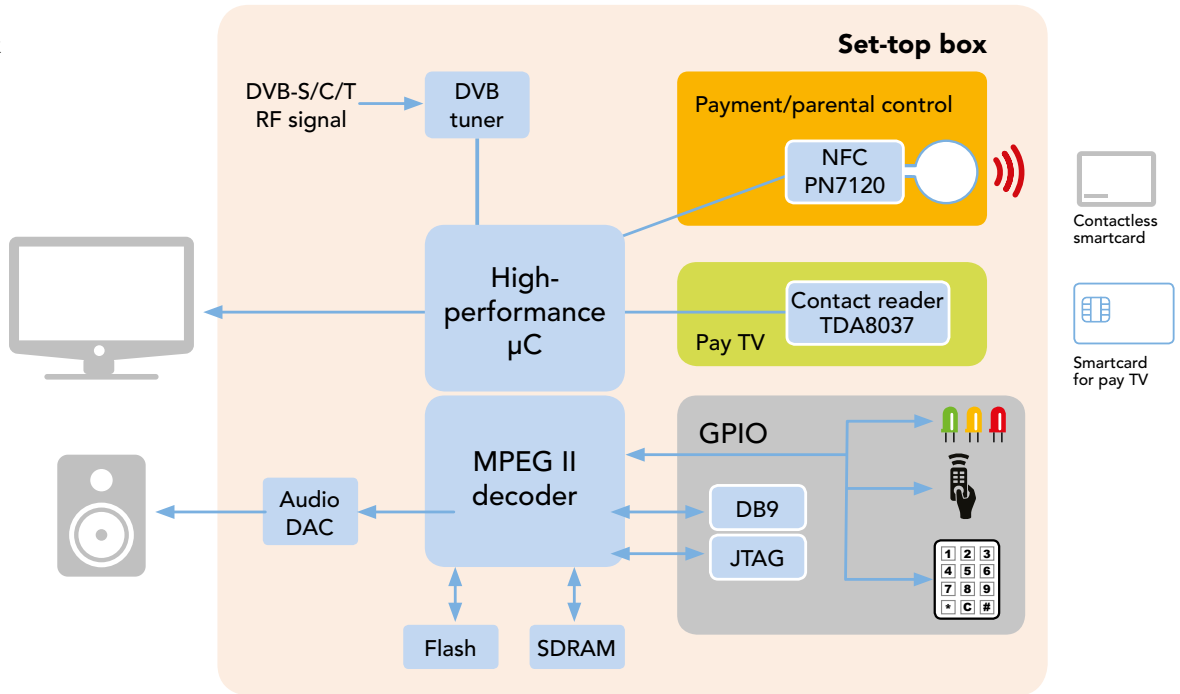
Our relationships with Google, Microsoft, and Intel were key to the introduction of NFC for Android, Linux, and Windows. We have long-standing partnership with leaders in this industry and offer NFC drivers for all Windows and Android systems.

We are fully qualified on Intel reference designs and new Intel chipsets, and offer a complete NFC module reference design that can be integrated into a laptop or tablet.



## SET-TOP BOX: A CLOSER LOOK

This Linux-based set-top box is equipped with a PN7120 NFC controller IC and a TDA8037 contact reader, so it can process payments for pay TV, video-on-demand, and pay-per-view. The PN7120 is pre-configured with firmware that supports the Linux OS, and uses the NCI interface as mandated by the NFC Forum. NXP is the world leader in contact smartcard readers for pay TV. Having a TDA8037 contact reader in the system enables access to an encryption program for authorization of regional or pay-TV channels.



## Help for manufacturers: The NCI specification

The NFC Controller Interface (NCI) specification, developed and maintained by the NFC Forum, defines a standard interface between the NFC controller and the system's main application processor. The interface manages interactions between the CPU and NFC IC, and speeds time-to-market for NFC-enabled PCs, laptops, and tablets.

## NFC enables

- ▶ Tap-and-authenticate PC/VPN logins
- ▶ Tap-and-connect password managers
- ▶ Tap-and-pair Bluetooth/WiFi connections

## NFC for home banking

NFC can make home banking and online purchases both safer and more convenient. Now, instead of typing in a PIN code or a credit-card number, you simply present your debit or credit card to the NFC-enabled system and the computer executes the transaction, in much the same way that a point-of-sale (POS) terminal does.

## Recommended NXP products

- NFC controller solution** PN7120 (with integrated firmware, NCI interface)
- Contact reader solution** TDA8037 (for interaction with pay-TV card)

# NFC for connected home and the Internet of Things

Today's homes are increasingly connected. Everyday appliances are connecting to the Internet, and even things like lights and ceiling fans and thermostats can now be controlled using Internet-based protocols and hardware. The Internet of Things (IoT), which refers to the increasing number of devices that now use online connections, is redefining our at-home environment, and creating new ways to manage energy, increase comfort, and enhance entertainment.

NFC is an important part of this transition to connected living, and provides new levels of convenience and interaction throughout the home. New devices can be added to the home network with a single tap – no more manual entry of complex product codes or passwords to have the router accept a new arrival – and, with the right app on board, an NFC-enabled smartphone or tablet can be used to control or configure just about anything.

Parental controls can easily be applied to a set-top box or TV, to ensure that kids only watch suitable channels for a specified period of time.

### Smarter appliances

NFC enables an added level of intelligence, so appliances can do more for their owners. In the kitchen, for example, tap the package of a frozen dinner to the microwave, and the oven does the rest, using optimal

settings to ensure the best results. Similarly, wine-storage cabinets can automatically download the perfect temperature settings for a particular collection of wines.

An NFC-equipped appliance can also send a message to the manufacturer, to register the product and set its warranty date. Machines can even be configured to contact their owners, sending SMS messages or emails that remind them to schedule periodic service, invite them to renew their warranties, or offer personalized recommendations and discounts.

### Extended displays

When it's impractical to integrate a large display – because there isn't enough room or the design budget won't support it – a connected NFC tag is a cost-effective way to add an interactive display, by using an external device as the interface. Communication with a washing machine, for instance, becomes as simple as opening an app on an NFC-enabled smartphone or tablet, and then tapping the device to the washing machine's control panel. All the extended settings – extra rinse cycles, or cycles that sanitize clothes or remove allergens – are available in one convenient, easy-to-navigate location.

### Better customer service

Repair technicians can use NFC to access the appliance's repair manuals or order replacement parts onsite, with just a tap of

their NFC-enabled smartphone or tablet. All the necessary data – model number, serial number, usage, status – can be accessed in an instant. Homeowners can have greater control over the maintenance process, too, by using NFC to troubleshoot a problem, reset the machine, download firmware, or request a visit from a repair person who will arrive with the relevant spare parts already in hand. NFC can also give consumers one-tap access to the help desk, for immediate, personalized service.

### Improved supply chain

Manufacturers in the consumer segment can use NFC to support late product customizations, offer features on demand, and protect their brand. They can set the operating language or configure automatic software updates before the system leaves the factory, and they can scale the offering by adding features in the store or after the sale. Manufacturers can also use NFC for authentication, to ensure that consumers use only branded or certified accessories. Once the right item – a branded ink cartridge, battery, or coffee pod, for example – has been authenticated, the NFC-enabled appliance can also optimize operation to suit the part. What's more, a brief pass of an NFC-enabled smartphone or tablet over a particular product can initiate a purchasing cycle for authentic replacements, with links to various sites that carry the item.







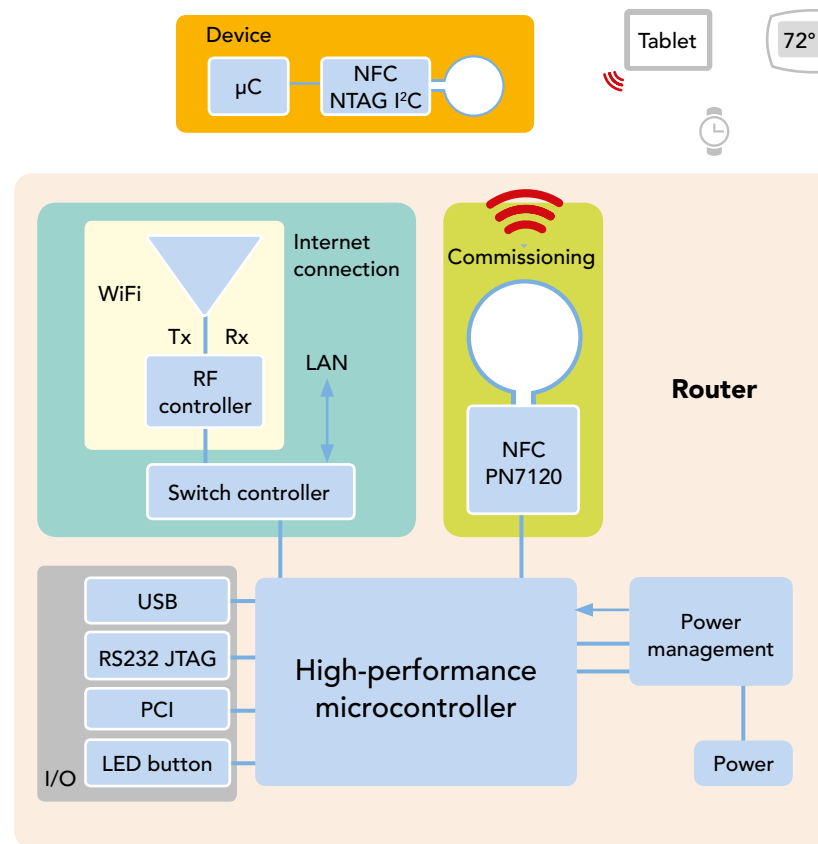
## NFC enables

- ▶ Tap-and-go experiences
- ▶ Faster product registration
- ▶ Intuitive commissioning
- ▶ Quick pairing with Bluetooth and WiFi
- ▶ Extended user interfaces
- ▶ Personalized settings
- ▶ Parental controls
- ▶ Authentication and access rights
- ▶ One-step payments
- ▶ Easy access to online maintenance
- ▶ Efficient data tracking
- ▶ Interactive and personalized advertising



## THE HOME GATEWAY: A CLOSER LOOK

A growing number of homes use a WiFi router to make Internet access more convenient, and now, as homes become more connected and the number of Internet-ready devices continues to expand, the router is truly the heart of home-based IoT networks. The router acts as a home gateway, providing Internet access to everything from mobile phones and laptops to appliances like washing machines and refrigerators, wearables, thermostats, multimedia players, and even fish tanks. With NFC, the router can send credentials to any new device equipped with an NFC tag, for quick commissioning, and the consumer's NFC-enabled smartphone or tablet can be used as a bridge, to make the interaction even easier. The NFC IC inside the router generates the necessary RF field for communication, so the device being commissioned doesn't need to be powered, and that saves energy.



## Gaming, toys, and the entertainment industry

NFC makes gaming more enjoyable and brings toys to life. With just a tap, new purchases can perform service discovery, connect to the home network, or pair with other components, such as a big-screen TV or high-end speakers. Parental controls can be configured in an instant, to ensure that children are only allowed to play age-appropriate games, and different users can launch pre-set configurations with just a tap of a smartcard or tag.

Character-based toys can take on new life, too, by using NFC to connect to a gaming console. Update points, add new powers or additional weapons, and play with the newly added capabilities. The toy can remain in passive mode while using NFC, so less power is used overall and the battery lasts longer. The play environment becomes more mobile, too, because a toy can easily be connected to any network, whether it's at a friend's house, an Internet café, or a community gaming center or amusement park.

NFC can enhance the experience with any kind of toy, including classic board games. The board can react when it recognizes that a game piece has moved or landed on a particular card. Trading cards can be recognized by NFC-enabled smartphones or board games, triggering pre-defined actions, or different toys can interact with a simple tap.

## Homecare as an extension of healthcare

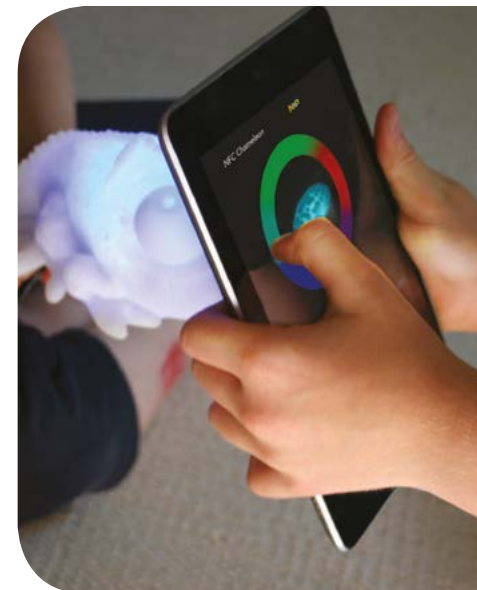
NFC makes the home a connected part of the healthcare system, with devices that can monitor and record vital statistics and then report the accumulated data to a care provider. Glucose meters, for example, can upload measurements for long-term monitoring. Bringing the meter close to an insulin pump can also set the wearer's optimum dosage.

NFC can help at the doctor's office or in an emergency situation, because an updatable NFC smartcard can store a person's vital statistics, medications, allergies, or test results, for easy reference by clinicians and first responders.

NFC can also be used to track medications at home, to ensure patients are taking them when and how they're needed. Prescription bottles equipped with an NFC tag can "talk" to the patient, using an NFC-enabled smartphone or tablet to play recorded messages about dosages, potential side effects, or interactions with other drugs. Medication packaging can even be configured to place a refill order when the supply is running low or nearing its expiration date.

## NFC for wearables

Small, portable devices that can be worn on the wrist or attached to the body – items called wearables – are increasingly popular with consumers. Fitness-tracking bracelets, for example, help people set fitness goals and track progress against those goals. Tap the bracelet to an NFC-enabled smartphone or tablet, and launch an easy-to-read, fully interactive display where it's simple to configure settings, control backups, and upload data to the cloud. The wearable can operate in passive mode, without being powered, so battery life gets a boost.



### Recommended NXP products

For systems running Linux

For systems that need a small footprint

For systems with a dedicated MCU

For peripherals with NFC connectivity

PN7120 (with NCI interface)

PR601 (with built-in MCU)

PN512, CLRC663

NTAG I<sup>2</sup>C





# NFC for smart manufacturing

The emergence of smart manufacturing facilities – what some term the fourth industrial revolution, or Industrial 4.0 – is creating a new level of automation in the factory, with intelligent object networking, independent process manufacturing, and frequent use of interactions between the real and virtual worlds. These trends are changing how manufacturers manage their production networks, and making it possible to operate in what is almost real time.

NFC has an important role to play in this new environment, because NFC helps reduce the time it takes to process items, can enable customization at any point in the production process, and simplifies logistics.

## Smart objects

NFC creates smart, autonomous objects that can interact with machinery and contribute to the decision-making process.

In a typical setup, NFC ICs are integrated into the manufacturing equipment, and products running along the assembly lines are outfitted with NFC tags, either as part of their onboard circuitry or as a sticker placed somewhere on the item. The tag can instruct each piece of equipment which steps to use at a given point, telling the machine, in essence, “this is what you should do with me.”

## More flexibility

NFC tags give the product a smart memory, and can contain all the relevant information as the product passes through the factory, the warehouse, and beyond, throughout the supply chain. A single tag can be configured for different purposes at different points in the process, so the instructions can change as needed. Using NFC tags enables late customization, with manufacturers setting the language for the user interface or configuring other settings before shipping the product to

a particular region. NFC tags can also be used to verify the authenticity of individual components or tools, to ensure that robots use the right item for a given task.

## Any environment

Adding NFC functionality to just about any kind of tool, machine, or motor – whether it’s in a state-of-the-art facility or in a more traditional manufacturing environment – makes it possible to add a display for enhanced interactions. The display on a worker’s tablet or on a piece of equipment can be used as the man-machine interface, so it’s easier to verify or change parameters, check calibrations, refine settings, or simply monitor activity.

## Cloud access

NFC connectivity also enables tap-and-go cloud access from the manufacturing floor, for quick referrals to operating manuals, automatic firmware downloads, and other kinds of assistance.

## NFC enables

- ▶ Smarter production lines
- ▶ Increased automation
- ▶ Extended display interfaces
- ▶ Authenticated components and tools
- ▶ Easy pairing with Bluetooth and WiFi
- ▶ Cloud access from the manufacturing floor
- ▶ Enhanced logistics
- ▶ Late customization

## NFC for a controlled environment

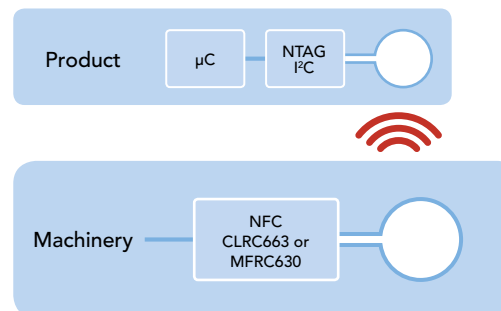
As in any workplace, NFC can be used to restrict physical and logical access in the manufacturing facility, ensuring that only authorized people have access to production areas and the network that controls machinery.

## Recommended NXP products

- NFC controller solution **PR601**
- NFC frontend solutions **MFRC630, CLRC663**
- Connected NFC tag solution **NTAG I²C**

## SMART MANUFACTURING: A CLOSER LOOK

Machines along the production line are equipped with an NFC IC, and workers can use their tablets to read NFC tags, too. If the product in question has an onboard microcontroller, a connected NFC tag is a natural addition to the system, since the I<sup>2</sup>C interface supports testing during development but can be disabled for production. With products that don’t use electronics, a basic NFC tag, in the form of a sticker, can be affixed to the product. Either way, the tag can provide processing and status information to machines and workers alike – and can be wirelessly reconfigured at any point in the process.



# A portfolio like no other

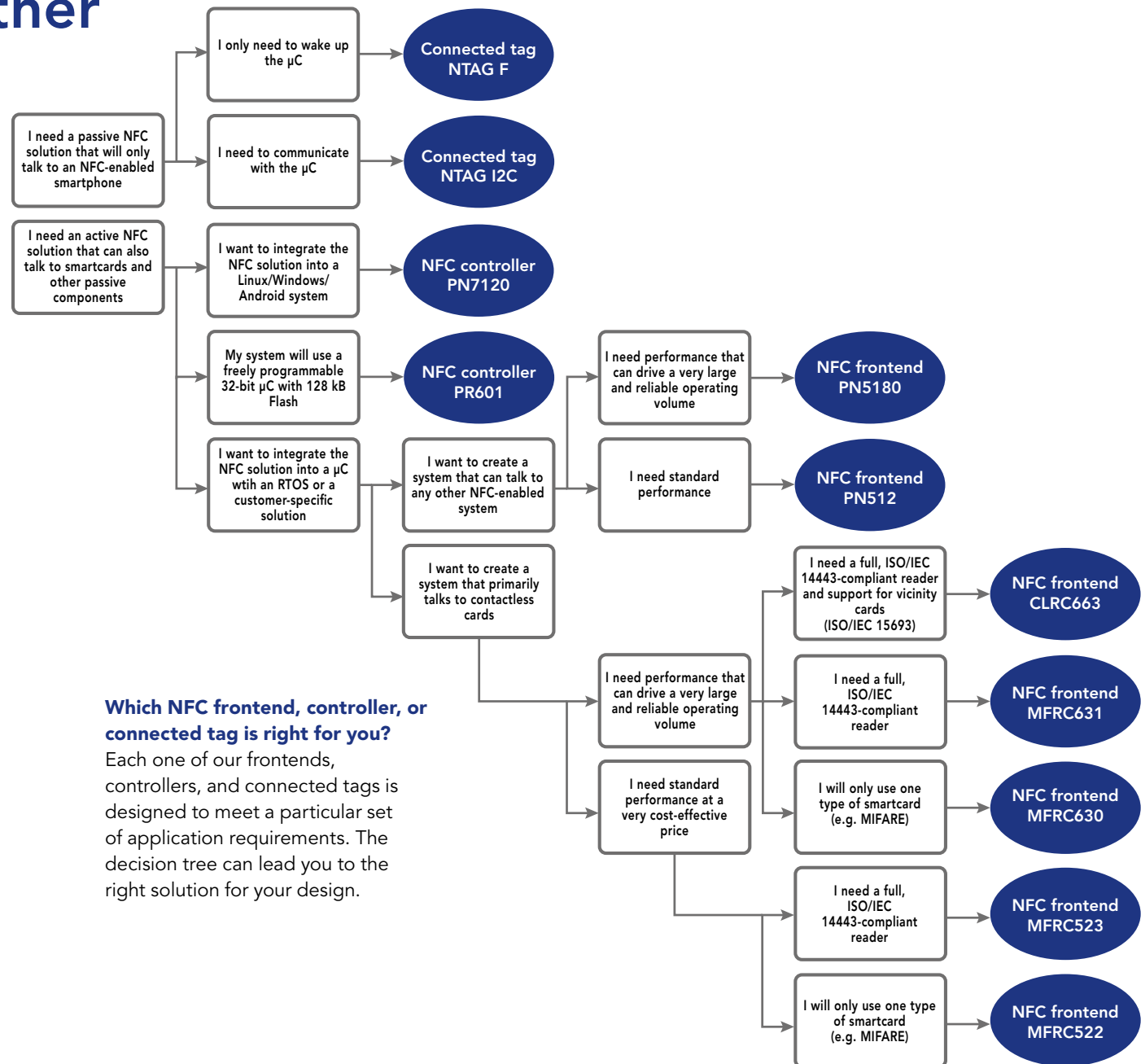
## Leadership, selection, and commitment

Nobody gives you more options for NFC than NXP. Our portfolio reflects our deep commitment to contactless technology and delivers best-in-class performance for the NFC infrastructure.

Our leadership in NFC is due, in part, to the fact that we own more than 100 patent families relating to contactless proximity technology and NFC. In fact, contactless technology is one of our core strengths. We build on more than 20 years of success with MIFARE, the world's first contactless ISO/IEC 14443 memory IC with cryptography. MIFARE is now the foundation for dozens of applications in more than 100 million locations. In total, more than 1.2 billion people have access to MIFARE-based systems in over 70 countries.

We are the identification industry's #1 semiconductor supplier, with the top position in eGovernment, bank cards, smart mobility (MIFARE) cards, tags and authentication, RFID/NFC readers, and, of course, NFC-enabled smartphones.

This section highlights our portfolio for NFC frontends, controllers, and connected tags. For complete NFC product listings, with detailed specs and side-by-side comparisons, refer to our Z-card, titled *NFC Everywhere* and available at [www.nxp.com/nfc](http://www.nxp.com/nfc).





## 1 NFC controller solutions

Designed for today's compact systems, our NFC controller solutions enable higher integration with fewer components, since they combine an NFC frontend with an advanced 32-bit microcontroller. Options include integrated firmware, for an easy, standardized interface, or a freely programmable microcontroller with the ability to load fully-custom applications.

### NFC CONTROLLER WITH INTEGRATED FIRMWARE

The PN7120 is an ideal solution for designers working in Linux, Windows, or Android environments, because the basics of the design are already there. The PN7120 comes pre-loaded with embedded NFC firmware and uses the NFC Forum's NCI interface, which is required for designs that use a full OS. That means designers get a head start on their system, and can focus on system optimization and differentiation.




### NFC CONTROLLER WITH CUSTOMIZABLE FIRMWARE

The PR601 is the choice for designers who want to use their own, privately-developed software. Integrating a powerful, yet power-efficient LPC1227 microcontroller, the PR601 is supported by our NFC Reader Library, and makes it easy to create a fully tailored, one-of-a-kind application.



## NXP LPC1227 microcontroller

- ▶ 30 MHz ARM Cortex-M0 processor
- ▶ Memory: 8 kB SRAM, 128 kB on-chip Flash
- ▶ Timers: 4 general-purpose, 1 Watchdog, 1 systick, 1 RTC
- ▶ Serial interfaces: 2 UARTs, 1 Fm+ I<sup>2</sup>C, 1 SPI/SSP
- ▶ Analog: 8 ch/10 b ADC, 2 comparators
- ▶ 39 or 55 GPIO
- ▶ Supply: 3.2 to 3.6 V
- ▶ Temp range: -40 to +85 °C
- ▶ Package: LQFP48/64
- ▶ Additional DMA controller
- ▶ CRC engine
- ▶ RS-485 interface

Product	Description
PN7120	Full NFC Forum-compliant controller with integrated FW and NCI interface 
PR601	High-performance multi-protocol NFC controller with customizable FW



## 2 NFC frontend solutions

Our standalone frontends, which work seamlessly with the NFC Reader Library, are the most flexible way to add NFC to a system.

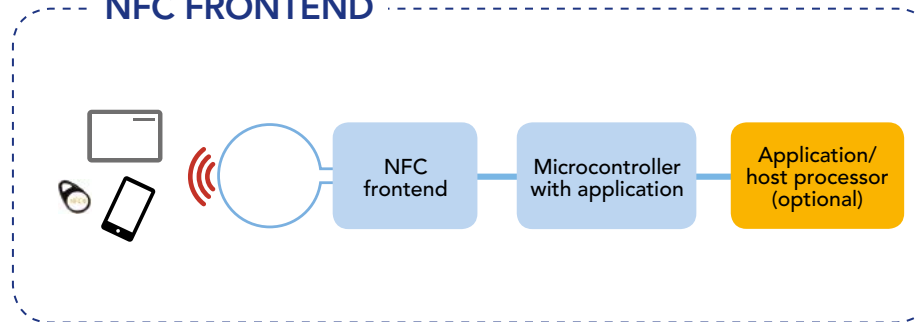
We offer a variety of options, so you can find the right fit for your requirements. Design-in is easier, since you don't have to deal with extra operating modes you won't need, and it's more cost-effective, too, since you only pay for the features you'll actually use. All our frontend solutions reflect

our active involvement with regulatory bodies, including the FCC, CE, Paypass, and EMVCo, and build on our deep commitment to interoperability and environmental quality.

The PN512 and PN5180, which are specially designed for applications that need to comply with the NFC Forum, deliver full compliance with their standards. Our standard and high-performance reader IC solutions meet the "strong" requirements of contactless and NFC readers, and

offer best-in-class robustness and range. They support all the relevant contactless reader and proximity standards – including ISO/IEC 14443 A and B, and ISO/IEC 15693 – and can interact in passive mode, to save power.

### NFC FRONTEND



Product	Description
<b>NFC frontends delivering full NFC Forum compliance</b>	
PN5180	High-performance multi-protocol full NFC Forum-compliant frontend <span style="float: right; border: 1px solid black; padding: 2px;">AVAILABLE H22015</span>
PN512	Full NFC Forum-compliant frontend
<b>High-performance NFC frontends</b>	
CLRC663	High-performance multi-protocol NFC frontend
MFRC631	High-performance ISO/IEC 14443 A/B frontend
MFRC630	High-performance MIFARE frontend
SLRC610	High-performance ISO/IEC 15693 frontend
<b>Standard-performance NFC frontends</b>	
MFRC523	Standard 3 V ISO/IEC 14443 A/B frontend
MFRC522	Standard 3 V MIFARE frontend

### 3 Connected NFC tag solutions

Our connected NFC tag solutions include a passive NFC Forum type 2 tag RF interface, an EEPROM, and a field-detection function (NTAG F) or a field-detection function with an I<sup>2</sup>C interface (NTAG I<sup>2</sup>C).

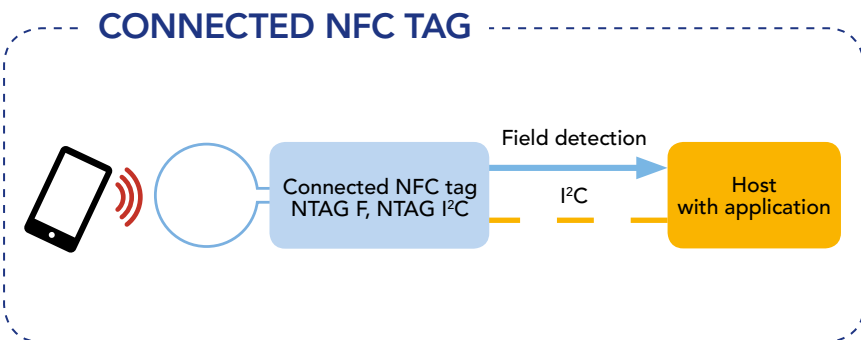
The NTAG F portfolio is particularly well suited for use with battery-powered systems, such as speakers and headsets, where it can wake the system and

initiate Bluetooth or WiFi pairing. For more on NTAG F, please visit [nxp-rfid.com/products/ntag](http://nxp-rfid.com/products/ntag).

The NTAG I<sup>2</sup>C portfolio supports full bidirectional communication between an NFC-enabled device and the host system's microcontroller, making it an ideal solution for NFC implementations that interface with a range of electronic devices. An innovative energy-harvesting function,

which makes it possible for the NTAG I<sup>2</sup>C tag to power external components, like a microcontroller, makes NTAG I<sup>2</sup>C an excellent choice for low-power applications. For more on NTAG I<sup>2</sup>C solutions, please refer to the brochure titled *NFC for embedded applications*, downloadable from [nxp-rfid.com/ntag-i2c](http://nxp-rfid.com/ntag-i2c).

Product	Description
NTAG I <sup>2</sup> C 2k	Passive NFC tag with I <sup>2</sup> C interface, 1904 bytes
NTAG I <sup>2</sup> C 1k	Passive NFC tag with I <sup>2</sup> C interface, 888 bytes
NTAG 216F	Passive NFC tag with field-detection output signal, 888 bytes
NTAG 213F	Passive NFC tag with field-detection output signal, 144 bytes



ntag

ntag I<sup>2</sup>C



## 4 Products that complete the system

### TDA80xx contact smartcard reader ICs

[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics/contact\\_smart\\_card\\_reader\\_ics/](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics/contact_smart_card_reader_ics/)

We are an industry leader in ISO/IEC 7816-compatible contact reader ICs, and are the world's number-one supplier of contact reader ICs for pay TV. We can provide EMVCo L1 and NDS/Cisco-compliant smartcard reader interfaces for any application, and offer an extensive range of support tools, including demo boards and software libraries. Building on the proven performance of our existing product range, the extended TDA80xx family enables easy design-in for a range of applications.

Product	Description
TDA8007	Multi-protocol card interface
TDA8020	Dual card interface
TDA8023	Low-power card interface
TDA8024	Standard smartcard interface
TDA8026	Multiple smartcard slot interface
TDA8029	Low-power, single-card reader
TDA8034	Low-power smartcard interface
TDA8035	Highly integrated, low-power smartcard interface
TDA8037	Low-power, single-slot 3 V card reader

### Secure Access Modules (SAMs)

[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics/mifare\\_sams/](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics/mifare_sams/)

Our SAMs handle all the crypto-related functions inside a reader terminal, ensuring the highest levels of security, including 3DES and AES cryptography, for MIFARE applications of all kinds.





## LPC microcontrollers

[www.nxp.com/microcontrollers](http://www.nxp.com/microcontrollers)

NXP's LPC portfolio includes more than 400 highly integrated devices that represent the very latest innovations in 32-bit microcontroller technology. Ten LPC product series enhance the ARM Cortex-M core architecture with patented features that deliver industry-leading performance, best-in-class connectivity, design simplicity, and power efficiency.



### Entry-level LPC microcontrollers

For NFC applications that need exceptional power efficiency and a small footprint, with lower requirements for Flash memory, entry-level LPC MCUs are the ideal choice.

Series	ARM core	Flash/RAM (max kB)	Description
LPC800	30 MHz Cortex-M0+	32/8	Exceptional power efficiency, small packages
LPC1100	50 MHz Cortex-M0+ or M0	256/32	Low power, broad feature and package selection, USB, CAN
LPC1200	45 MHz Cortex-M0	128/8	Noise immunity for industrial applications

### High-performance LPC microcontrollers

For NFC applications that are more complex – requiring advanced connectivity, sophisticated peripherals, and more memory – high-performance LPC MCUs offer a wide range of solutions.

Series	ARM core	Flash/RAM (max kB)	Description
LPC1300	Up to 72 MHz Cortex-M3	64/12	Performance and basic connectivity
LPC1500	Up to 72 MHz Cortex-M3	256/36	High-precision motor control, CAN, USB
LPC1700	Up to 120 MHz Cortex-M3	512/96	High performance, advanced connectivity, USB, graphic LCD controller
LPC4000	Up to 120 MHz Cortex-M4 or M4F	512/96	High performance with DSP options, advanced connectivity, USB, graphic LCD controller
LPC1800	Up to 180 MHz Cortex-M3	1024/1360/200	Best performance, multi-high-speed connectivity, USB, graphic LCD controller
LPC4300	Up to 204 MHz Cortex-M4F & M0+	1024/1360/282	Best performance with DSP and dual-core options, multi-high-speed connectivity, USB, graphic LCD controller
LPC54100	Up to 100 MHz Cortex-M4F & M0+	512/104	Best-in-class power consumption, scalable performance, small package

### Developers ecosystem

The ecosystem for LPC microcontrollers offers advanced yet low-cost ways to evaluate and develop applications. The NXP LPCXpresso IDE includes a complete Eclipse-based toolchain and is available in free and

Pro editions. In addition, popular toolchains from IAR, Keil, and other vendors incorporate full support for LPC products. Developers gain easy access to MCU features through an extensive set of free, RTOS-agnostic libraries, called LPCOpen,

which include chip- and board-level drivers, TCP/IP protocol stacks and other middleware, graphics libraries, code examples, easy interfacing to third-party libraries, and more. For more information about NXP's LPC development tools, visit [lpcware.com](http://lpcware.com).

# Our support for NFC

Our support tools simplify design and reduce time-to-market. We make it easy to find the right product for your particular application, and we supply the hardware and software tools that help you develop firmware, manage protocols, and differentiate your design. We work with an established ecosystem of NFC experts, for best-in-class technology support, and we collaborate with industry leaders to drive the expansion of NFC.

## Start here

The NXP website is your starting point for any NFC design. It's where you'll find online resources that help you select a product, order samples, and begin development. The following links take you through the process.

### 1 CHOOSE A PRODUCT

#### NFC controller and frontend solutions

[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics)

Click the "Products" tab to see a list of available products. The page for each type number provides detailed information, including datasheets, application notes, and other useful material.

#### Connected NFC tag solutions

[www.nxp.com/products/identification\\_and\\_security/smart\\_label\\_and\\_tag\\_ics/ntag](http://www.nxp.com/products/identification_and_security/smart_label_and_tag_ics/ntag)

Look for NTAG213F, NTAG216F, NT3H1101, and NT3H1201 in the list of available products. Information about NTAG I<sup>2</sup>C products can also be found on [nxp-rfid.com/ntag-i2c/](http://nxp-rfid.com/ntag-i2c/).

### 2 ORDER SAMPLES FROM A LOCAL DISTRIBUTOR

#### Order portal for NXP's global network of distribution partners

[www.nxp.com/order-portal?topId=53420&subId=71110](http://www.nxp.com/order-portal?topId=53420&subId=71110)

The order portal lists items by product number. You can also place an order from any product page by clicking the "Ordering" tab. Check the list for your nearest distributor, and click "Buy" to access their website for immediate ordering.

### 3 FIND A DEMO BOARD, REFERENCE DESIGN, OR EVALUATION KIT

#### NFC controller and frontend solutions

[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics)

Click on the "Demo boards" tab. This tab links to individual pages for each demo board. Available applications notes and software tools are listed on each demo-board page, on the "Documentation" tab.

#### Connected NFC tag solutions

[www.nxp.com/demoboard/OM5569.html](http://www.nxp.com/demoboard/OM5569.html)  
or [www.nxp-rfid.com/ntag-i2c](http://www.nxp-rfid.com/ntag-i2c)

This page includes documentation and software relating to the NTAG I<sup>2</sup>C Explorer Demonstration and Development Kit, an all-in-one demonstration and development resource for our NFC connected tags. Click the link "Get started" to learn more.

### 4 DOWNLOAD SOFTWARE

#### NFC controller and frontend solutions

[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics)

To access the software library, click on the "Demo boards" tab, then click the relevant demo board to be forwarded to its dedicated page. On this page, click the "Documentation" tab to see a list of all downloadable software for the board. You can also type the order number for the demo board (e.g. PREV601, CLEV663) into the NXP search field. The search results will list the dedicated page for the board, where you'll find the "Documentation" tab that lists downloadable software.

#### Connected NFC tag solutions

[www.nxp.com/products/identification\\_and\\_security/smart\\_label\\_and\\_tag\\_ics/ntag/series/NT3H1101\\_NT3H1201](http://www.nxp.com/products/identification_and_security/smart_label_and_tag_ics/ntag/series/NT3H1101_NT3H1201)

This page provides access to an Android app for the NTAG I<sup>2</sup>C demo board, firmware for the use with an LPC microcontroller, and other software items.



## 5 GET DESIGN SUPPORT

### Application notes and FAQs for NFC controller and frontend solutions

[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics)

Click on the "Products" tab, then click on the relevant part number to go to its dedicated product page. Then click the "Documentation" tab to see a list of available application notes (and software).

### NXP knowledge base

[www.nxp.com/knowledge-base/53420/71110](http://www.nxp.com/knowledge-base/53420/71110)

Questions are listed in order of posting. Use the search field, at the top of the page, to find a topic.

### MIFARE/NFC community

[www.mifare.net/en/micomcommunity/forum/mifare-and-nfc-reader-ics](http://www.mifare.net/en/micomcommunity/forum/mifare-and-nfc-reader-ics)

Use the menu on the left-hand side of the page to locate a topic and its discussion thread.

### NFC training and webinars

[www.nxp.com/products/related/customer-training](http://www.nxp.com/products/related/customer-training)

Here's where you'll find pre-recorded webinars that introduce NFC technology, antenna design, NXP solutions, and more. You can also use this site to download training schedules and register for an upcoming session.

### Technical support from a local distributor

[www.nxp.com/about/sales-offices-distributors](http://www.nxp.com/about/sales-offices-distributors)

Many of our distribution partners provide dedicated technical support for our NFC solutions. To find the partner nearest you, browse our list of distributors.

## 6 GET CE CERTIFICATION

Our NFC ICs are designed with CE certification in mind. Several of our development boards comply with the mandated directives and help prepare your design for submission. Most of our evaluation boards are CE certified, and many of them have FCC certification.

Home > Products > Demo boards > PNEV512B

Overview | Documentation | Ordering | Products | Design support | Show all

### Documentation for this product

Download all documentation (zip)




File name	Title	Type	Format	Date
AN11308	Quick Start Up Guide PNEV512B Board	Application note	pdf	2014-07-25
AN11342	How to Scale Down the NXP Reader Library	Application note	pdf	2013-03-19
AN11367	How to build a NFC Application on Android	Application note	pdf	2013-06-19
AN11583	Guide about how to port the Passive Target example from the NFC Reader Library to another MCU	Application note	pdf	2014-08-12

## Hardware tools

NXP's demo boards are PCBs specially designed to showcase a specific NFC product. Depending on their configuration, they can be used to evaluate functionality, compare solutions, or begin development. We supply a wealth of resources to support these boards, including application notes, user manuals, "get started" guides, software tools, and sample source code. All these resources are available from the NXP website (see page 26 for details).






The tables in this section, organized by product category, are just a sampling of what's available. We regularly update our selection, so check the NXP website for the most up-to-date listings for each product. You'll find them on the product overview page for NFC solutions ([www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics/nfc\\_contactless\\_reader\\_ics/](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics/nfc_contactless_reader_ics/)), under the "Demo board" tab.

## DEMO BOARDS FOR NFC CONTROLLER SOLUTIONS

Product	Board	Photo	Description	Product page for board
PN7120 (with embedded firmware)	OM5577/PN7120S		NFC Forum-compliant development board with Raspberry Pi and BeagleBone interface.	
PR601 (without embedded firmware)	PREV601M		Microboard with PR601 and 13.56 MHz antenna. Powered by a single battery, and supported by the NFC Reader Library.	<a href="http://www.nxp.com/demoboard/PREV601M.html">www.nxp.com/demoboard/PREV601M.html</a>

## DEMO BOARDS FOR NFC FRONTEND SOLUTIONS

These boards are supported by the NFC Reader Library, downloadable from each board's product page.

Product	Board	Photo	Description	Product page for board
PN5180	PNEV5180B	In development	An NFC Forum-compliant board with two antennas, a small one for high integration and a large one for optimal communication distance. Can be connected to an LPC-Link board for use with NXP's LPC microcontrollers.	
PN512	PNEV512B		A two-board combination that stacks a PN512 board on an LPC-Link prototyping board, for use with NXP's LPC microcontrollers. NFC Forum-compliant and listed on the Forum's certification register ( <a href="http://certification.nfc-forum.org/certification_register/">http://certification.nfc-forum.org/certification_register/</a> ).	<a href="http://www.nxp.com/demoboard/PNEV512B">www.nxp.com/demoboard/PNEV512B</a>
PN512	PNEV512R		An expansion board, designed for use with Raspberry Pi, which is a card-sized ARM-based computer running Linux.	<a href="http://www.nxp.com/demoboard/PNEV512R">www.nxp.com/demoboard/PNEV512R</a>
CLRC663	CLEV663		Evaluation board for multi-protocol CLRC663.	<a href="http://www.nxp.com/demoboard/CLEV663">www.nxp.com/demoboard/CLEV663</a>
CLRC663	CLEV663B		A two-board combination, with a CLRC663 board stacked on an LPC-Link prototyping board for use with NXP's LPC microcontrollers.	<a href="http://www.nxp.com/demoboard/CLEV663B">www.nxp.com/demoboard/CLEV663B</a>



### DEMO BOARDS FOR CONNECTED NFC TAG SOLUTIONS

The board is supported by dedicated software, downloadable from the board's product page.

Product	Board	Photo	Description	Product page for board
NTAG I <sup>2</sup> C	NTAG I <sup>2</sup> C Demo Kit OM5569/NT312D		Includes the NTAG I <sup>2</sup> C demo board plus a Class 5 antenna board.	<a href="http://www.nxp.com/demoboard/OM5569">www.nxp.com/demoboard/OM5569</a>



## SOFTWARE TOOLS

### Software for NFC controller solutions

To support designs that use a PN7120 in a Linux environment, we've released the required drivers to Linux NFC, an open-source community for drivers (<https://01.org/linux-nfc>). The drivers have been validated on Raspberry Pi with various versions of the Linux kernel (including v3.8.13, 3.11.10, and 3.14.5).

For designs that use a PR601 with customized software, the necessary drivers are included in the NFC Reader Library.

### Software for NFC frontend solutions

The NFC Reader Library supports our entire line of NFC frontend solutions.

### Software for connected NFC tag solutions

We offer a number of support tools for use with our NFC tag solutions. For interaction with NTAG I<sup>2</sup>C kits, an Android app is available on the Google Play website ([play.google.com](https://play.google.com) – search for "NTAG I<sup>2</sup>C Demoboard"), and source code can be downloaded from the NTAG I<sup>2</sup>C product page ([www.nxp.com/products/identification\\_and\\_security/smart\\_label\\_and\\_tag\\_ics/ntag/series/NT3H1101\\_NT3H1201.html](http://www.nxp.com/products/identification_and_security/smart_label_and_tag_ics/ntag/series/NT3H1101_NT3H1201.html)). The NTAG I<sup>2</sup>C product page is also where you'll find firmware for use with an LPC microcontroller. The MIFARE Software Development Kit ([www.mifare.net/en/products/mifare-sdk/](http://www.mifare.net/en/products/mifare-sdk/)) provides an easy way to make use of all the NTAG F and NTAG I<sup>2</sup>C functions when developing an Android app.



## NFC Reader Library

Written in C language, the NFC Reader Library makes it easy to create a software stack and an application for an NFC IC, based on one of our NFC frontends or the PR601, our NFC controller with customizable firmware.

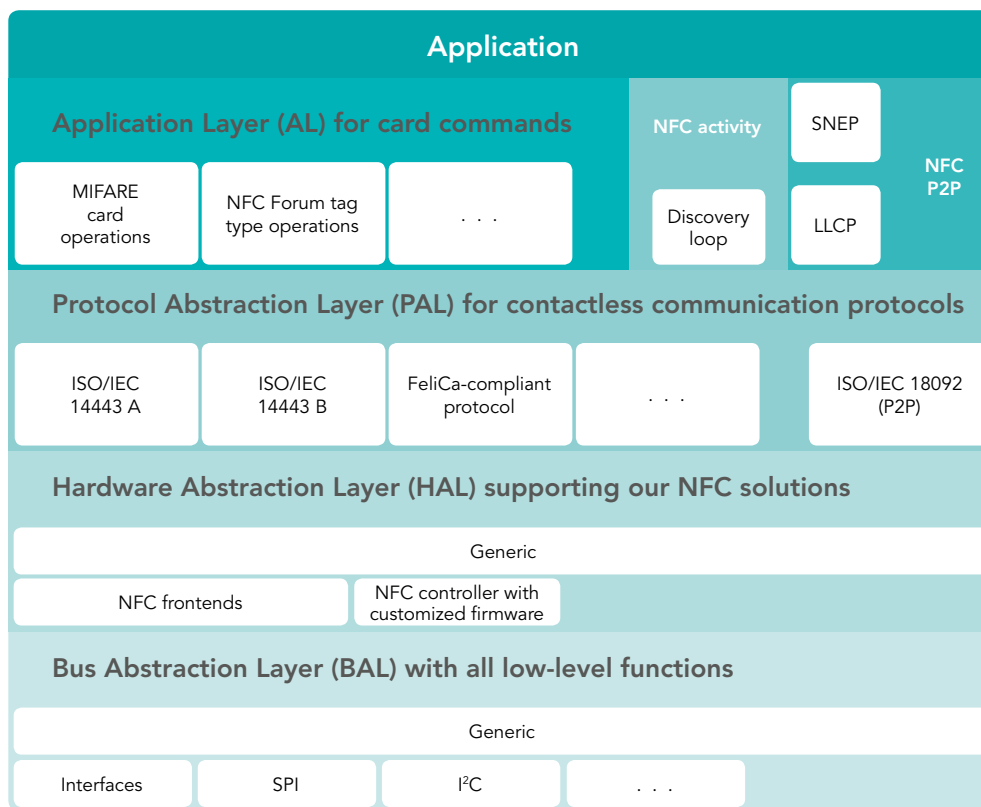
## Interfaces & protocols

The NFC Reader Library implements all the lower-layer functions, such as I<sup>2</sup>C and SPI interfaces. It also implements the contactless protocol, the drivers for an NFC frontend (including the one used in the PR601), and the command set for the card. Having all these up-front steps taken care of by the Reader Library lets you focus on the key features that differentiate your application.

The NFC Reader Library also includes all the components needed for communication in Peer-to-Peer Mode – including all the required protocols and link layers, like SNEP and LLCP – and supports all the polling methods needed to discover a device.

## Flexible layers

Everything is modular, so you can add or subtract components from a layer without disturbing the rest of the stack. The application layer and the protocol abstraction layer operate independently from the microcontroller, so they're not bound to or dependent on any specific hardware. Similarly, the application layer, the protocol abstraction layer, and the hardware abstraction layer are platform-independent, so they don't depend on any



specific underlying communication interface with the host. You can use these layers seamlessly with any communication interface supported in the bus abstraction layer.

The NFC Reader Library is designed to work with NXP's other design tools for NFC – including those for our NFC frontends and the PR601 controller with customizable firmware – and we supply a number of

project examples so you can get started right away.

## Common Criteria

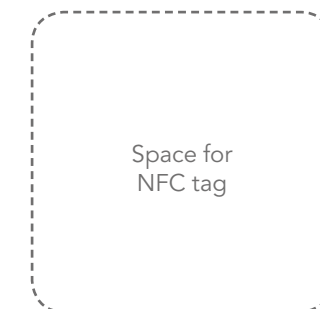
If you need to support export-controlled smartcards or products that are Common Criteria certified, we can authorize you to import library components under NDA. Please contact your NXP sales office or distributor for more information.

## MORE ABOUT THE NFC READER LIBRARY

Download the NFC Reader Library, along with user manuals, application notes, and examples of NFC frontends that use LPC MCUs, from these pages:

[www.nxp.com/demoboard/PNEV512B.html#documentation](http://www.nxp.com/demoboard/PNEV512B.html#documentation)

[www.nxp.com/demoboard/CLEV663B.html#documentation](http://www.nxp.com/demoboard/CLEV663B.html#documentation)



## Where to learn more

### NFC Everywhere

[www.nxp.com/nfc](http://www.nxp.com/nfc)

#### NFC TECHNOLOGY

[Intro to NFC technology / pre-recorded webinars](#)  
[www.nxp.com/products/related/customer-training](http://www.nxp.com/products/related/customer-training)

[NXP knowledge base for NFC](#)  
[www.nxp.com/knowledge-base/53420/71110](http://www.nxp.com/knowledge-base/53420/71110)

[MIcommunity website for MIFARE and NFC](#)  
[www.mifare.net/en/micommunity/forum/mifare-and-nfc-reader-ics](http://www.mifare.net/en/micommunity/forum/mifare-and-nfc-reader-ics)

[NFC white papers at the NFC Forum](#)  
[members.nfc-forum.org/resources/white\\_papers](http://members.nfc-forum.org/resources/white_papers)

[NFC trainings](#)  
[www.themobileknowledge.com](http://www.themobileknowledge.com)

#### NXP PRODUCT FAMILIES

[NFC Everywhere](#)  
[www.nxp.com/techzones/nfc-zone/products](http://www.nxp.com/techzones/nfc-zone/products)

[NFC controller and frontend solutions](#)  
[www.nxp.com/products/identification\\_and\\_security/nfc\\_and\\_reader\\_ics](http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics)

[Connected NFC tag solutions](#)  
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[www.nxp-rfid.com](http://www.nxp-rfid.com)

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[www.mifare.net](http://www.mifare.net)

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[www.nxp.com/products/microcontrollers](http://www.nxp.com/products/microcontrollers)

[RFID portfolio](#)  
[www.nxp-rfid.com](http://www.nxp-rfid.com)

#### NFC COMMUNITY RESOURCES

[NFC Forum website](#)  
[nfc-forum.org](http://nfc-forum.org)

[NFC community website](#)  
[www.nearfieldcommunication.com](http://www.nearfieldcommunication.com)

[Google Play](#)  
[play.google.com](http://play.google.com)  
(Search for NFC Product Selection, NTAG I<sup>2</sup>C Demoboard, NFC Tag Info by NXP, or NFC TagWriter by NXP)

[Windows Store](#)  
[apps.microsoft.com](http://apps.microsoft.com)  
(Search for NFC TagWriter by NXP)

[MIFARE SDK](#)  
[www.mifare.net/en/products/mifare-sdk](http://www.mifare.net/en/products/mifare-sdk)



[www.nxp.com](http://www.nxp.com)

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