



NFC Everywhere

Controller, frontend, and connected tag solutions for a new era in NFC

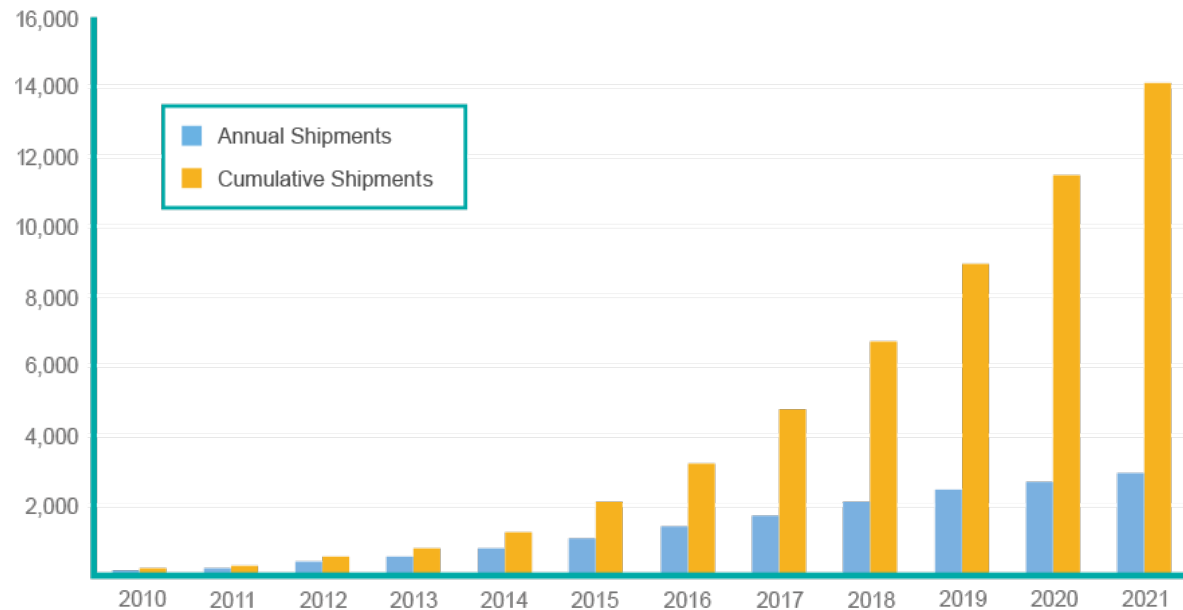
01 Introduction - A Different Kind of Wireless

2 billion

NFC-enabled devices
will be deployed in 2018

ABI Research, 2016

NFC-enabled Products, Total Annual and Cumulative Shipments



ABI Research, 2016



An NFC device can interact with ...



... any NFC tag or card



... any NFC-enabled smartphone



... any other NFC-enabled
embedded system

01 Introduction - Big Reasons to consider NFC



You'll Speak with Intention

NFC is more intuitive than other wireless technologies and more direct, since it only involves two devices at any given time.



You'll Use Power Very Efficiently

Only one of the devices needs to be powered for a two-way interaction. The second device saves battery for other things, or not have a battery at all.



You'll Play Well with Others

NFC is not a replacement for other wireless formats, but a trusted addition - especially when it comes to pairing of devices.



We Co-Invented the Technology

- Co-invented NFC in 2002 together with Sony
- Cofounded the NFC Forum with >170 member companies today

Nobody Ships More NFC ICs

- 80% of all NFC-enabled point-of-sales (POS) terminals by NXP
- 80% of all NFC-enabled smartphones by NXP

Nobody Gives You More Ways to Succeed

- Broadest NFC portfolio in the industry
- commitment to performance, power savings, and security



USE CASES

02 Use Cases - Access Control (Physical and Logical)



*Open doors with
your phone*



*Turn your wristband
into a special-
access pass*



*Grant temporary
access to service
personnel*



*Access to specialized
machinery*

- Log time and attendance for secure areas
- Manage key distribution remotely
- Set limits for access times (temporary personnel, tourists)
- Reduce maintenance and replacement costs, with fewer lost or damaged keys, cards, or badges

Which Product?

CLRC662 *plus*, PN7462, PN736x, MIFARE® DESFire® EV2



02 Use Cases - Pairing and Commissioning



Pair with Bluetooth devices faster, without conflicts



Share music or videos



View images on the big screen, with just a tap



Add nodes to your network without entering codes

- Enable two-way interactions with Peer-to-Peer mode
- **Pair devices 20x faster than with BLE or Wi-Fi**
- Identify a device instantly (no device conflicts or codes)
- Make devices easier to use
- Reduce tech-support costs
- Tap to exchange credentials inherently secure
- Use protocol-agnostic operations to trigger actions

Which Product?

NTAG® I²C *plus*, PN71xx



02 Use Cases - Authentication & Identification



*Combat counterfeits
by authenticating
accessories*



*Create more
interactive and
personal experiences*



*Order branded
replacements/
consumables with a
single tap*



*Automatically
choose the right
tool every time*

- Authenticate replacement parts and automatically adjust settings of the main unit based on the accessory attached
- Identify users and immediately provide personalized settings
- Send notifications when accessories are nearing replacement

Which Product?

MFRC630, NTAG21x, MIFARE ULTRALIGHT[®], ICODE SLIX, ICODE DNA, PN71xx



02 Use Cases - Extended User Interface



Get complete control over every setting and configuration



Enable full interactions with small, sealed devices that are not powered



Read out data, access manuals, or copy settings from one device to another



Use a screen to perform diagnostics, even if the device is unpowered

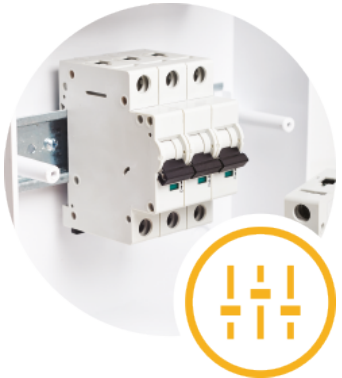
- **Use energy harvesting to draw power and extend battery life**
- Handle device settings easily on the touchscreen
- Offer new levels of interaction, without adding buttons or displays
- Connect your device to the Internet via phone or tablet
- Upgrade device firmware using phone/tablet connection
- Implement password protection

Which Product?

NTAG I²C plus



02 Use Cases - Device-to-Device & In-Device Communication



Let a fully sealed, battery-free sensor unit interact with the meter housing



Record mechanical-stress readings on moving parts



Avoid galvanic connections by letting machines talk without wires



Make wireless chargers smarter and more cost-effective

- Get instant readouts of device status, usage and diagnostics
- Give battery-free devices the ability to communicate
- Let two sealed, IP-rated devices share information
- Send data at up to 848 kbit/s with a reader or up to 106 kbit/s with a connected tag

Which Product?

MFRC630, NTAG I²C plus



02 Use Cases - Payment



Offer new kinds of loyalty and couponing programs



Create self-service kiosks while selling more tickets



Get access to any kind of energy through prepaid systems



Use a secure, protected connection to initiate transactions

- Offer tap-and-pay convenience with enhanced security
- Accept EMV and MIFARE payments, and send paperless receipts
- Increase engagement with messages, loyalty, and couponing
- Use system-level solutions to save design and certification time

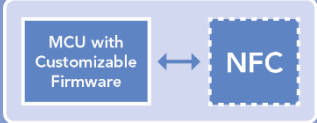
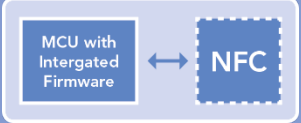
Which Product?

PN5180, CLRC663 *plus*, PN7462, TDA8035, TDA8026

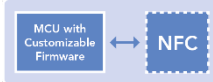


PRODUCTS

03 Products - The widest selection of form, fit, and function

			
Connected Tags • Small, passive tag ICs • most cost-effective solution to interact with NFC reader or NFC • RF interface fully compliant with NFC Forum specifications • Support energy harvesting	NFC Frontends • Most flexible way to add NFC connectivity to a system • Supported by NFC Reader Library for fast and easy design-in	NFC Controllers with Customizable Firmware • Combine an NFC frontend with freely programmable 32-bit Cortex-M0 microcontroller • Create a fully custom design • Very compact footprint • Support for contactless and contact technologies	NFC Controllers with Integrated Firmware • Plug-and-play solutions combine an NFC frontend with a 32-bit Cortex-M0 microcontroller • Equipped with integrated firmware • Optimized for use with an OS • Linux, Android, and WinIoT drivers • NCI interface

03 Products - Which NFC Product Category is right for you?

	Connected Tag 	NFC Frontend 	NFC Controller with Customizable Firmware 	NFC Controller with Integrated Firmware 
I want to communicate with NFC smartphones	X	X	X	X
I want to add NFC to a non-powered system	X			
I want to read/write NFC/RFID HF tags		X	X	X
I want to add NFC to my OS-based design (Linux/Android/WinIoT)				X
I want the smallest HW footprint	X		X	
I want to add NFC to my host MCU	X	X		X
I want NFC with an integrated microcontroller			X	X
I want to offload the memory of my main MCU			X	



03 Products - We make NFC easy

Links to the support tools on nxp.com/nfc.

NFC Implementation Process		NFC Support	
	Decide the functionality	 Online selection tools, including selection app, parametric search, and product details on nxp.com	 NFC Everywhere brochure
	Select IC	 Z-card with NFC Reader Portfolio	 NFC use case and product webinars
	Evaluate Features	 Full range of development kits for every NFC Product  NFC Cockpit	 Compatibility with common MCU boards and single-board computers  NFC product support package and antenna design webinars
	Prototype	 Gerber files for development kits online	
	Test & Debug	 NFC Library  Sample code  NFC Cockpit	 App notes  Tutorials  Design files for development kits  Online trainings on software integration and antenna design
	Get Certified	 DPC, strong RF power generation, RF wave shaping, and HW-based EMD error handling	 EMVCo L1 (analog and digital) library in source code

Independent Design Houses certified by NXP IDH Partners
www.nxp.com/partners
 select "HW/SW engineering service"



Technical NFC Community
<https://community.nxp.com/community/nfc>



03 Products – Connected Tags

- Easy link to the cloud offering a RF and a host interface
- Configure memory for multiple rewrites or password protect it
- Originality Signature enables tag validation without a cloud connection
- Field detection to save power
- Pass-through mode (SRAM) lets NTAG I²C *plus* act as a modem for direct communication between the NFC device and the MCU

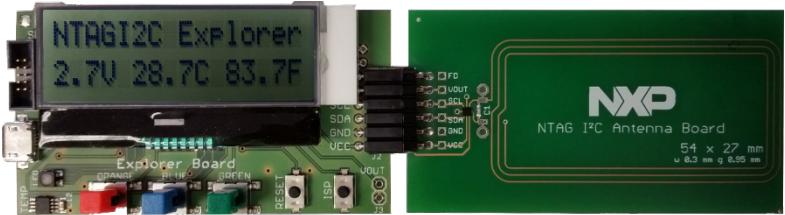
Software

From the MCU side, the NTAG I²C plus looks like an I²C memory, and from the phone side it looks like an NFC tag.
 All source code: [OM5569-NT322ER](#)

Tools	OM5569-NT322E	NTAG [®] I ² C plus Explorer Kit
	OM5569-NT322ER	NTAG [®] I ² C plus Explorer Kit with NFC Reader
	OM5569-NT322F	NTAG I ² C plus Flex Kit

Selection Guide

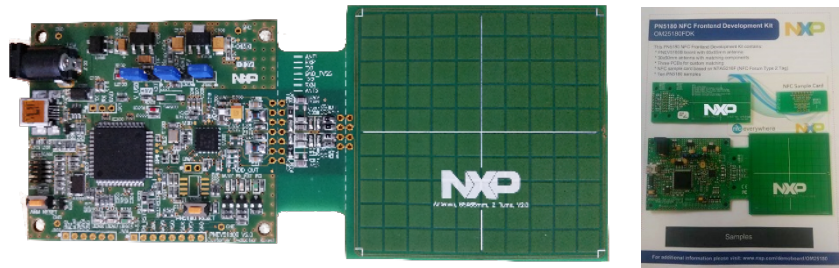
	NTAG 216F/213F	NTAG I ² C plus
NFC Forum Tag Format	Type 2	Type 2
User Memory (B)	888 (216F) 144 (213F)	888 or 1912
RF Baud Rate (kbit/s)	106	106
Fast READ Command	x	x
Fast WRITE Command		x
Originality Signature	x	x
NFC Counter	x	
Memory Access Protection	RF Interface	RF Interface & I ² C (Read/Write)
Field Detection	x	x
Energy Harvesting		x
Pass-Through Mode (~40 kbit/s)		x



03 Products - NFC Frontends

- Libraries for embedded systems, fully compliant with ISO/IEC, EMV, and the NFC Forum
- Energy-saving features: low-power card detection extend battery life

Tools	OM25180	PN5180 Development Kit
	OM26630	CLRC663 plus Development Kit
	CLEV6630A	MFRC630/SLRC610 Development Board
	OM2xxxx	NFC Antenna Kit



Selection Guide

	PN5180	CLRC663 <i>plus</i>	MFRC630	SLRC610
Reader/Writer				
ISO/IEC 14443 A&B	x	x	x	
FeliCa	x	x		
ISO/IEC 15693	x	x		x
ISO 18000-3M3	x	x		x
Reads NFC Forum Tag Type	1,2,3,4,5	1,2,3,4,5	1,2,4A	5
Peer-to-Peer Support				
Passive Initiator	x	x		
Active Initiator	x			
Card Emulation				
Emulate NFC Forum Tag Types	4A			
Other Features				
External Clock Support Eliminates 27.12-MHz Crystal	x			
Autonomous Transmitter And Receiver Control	x			
Best For Battery-Powered Designs		x		
Ambient Temperature Range	-30 to +85 °C	-40 to +105 °C	-25 to +85 °	
Package	HVQFN, TFBGA	HVQFN		



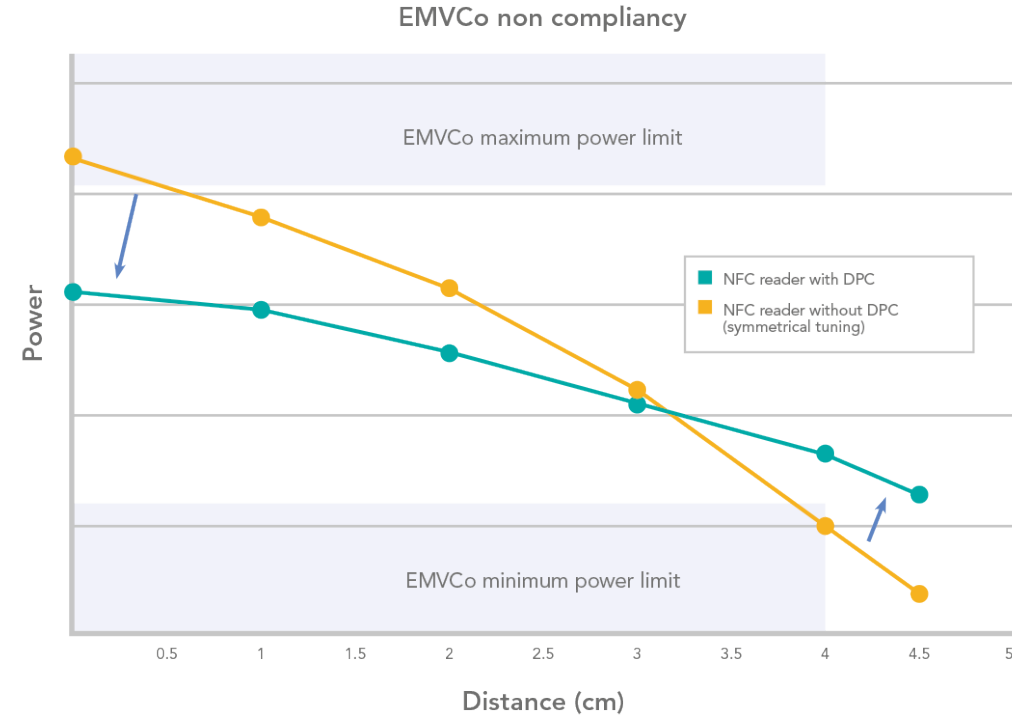
03 Products - NFC Frontends Software

Software

- Dynamic Power Control (DPC)
- Adaptive Waveshaping Control (AWC)
- Adaptive Receiver Control (ARC)
- automatic EMD Error Handling
- All according latest ISO/IEC14443 and EMVCo specifications
- Execution without host interaction
- Support preemptive multi-tasking operating systems like Linux or Android.



Watch [NFC Innovation Lab video](#) to learn more



Dynamic Power Control

- Improves performance when in the presence of metal, other cards, or a mobile phone
- Reduced power consumption
- Best output power for long reading distances and improved compliance with EMVCo



03 Products - The NFC Reader Library

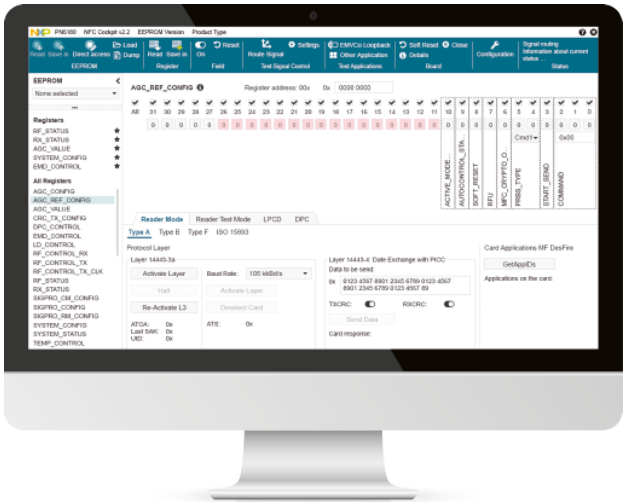
Focus on Scalability

Simplify Test & Debug

Optimize Performance

Validate Interoperability

Application					
Application Layer (AL)			NFC activity	SNEP	NFC P2P
MIFARE card operations	NFC Forum tag type operations	...	Discovery loop	LLCP	
Protocol Abstraction Layer (PAL) for contactless communication protocols					
ISO/IEC 14443 A	ISO/IEC 14443 B	FeliCa-compliant protocol	...	ISO/IEC 18092 (P2P)	
Hardware Abstraction Layer (HAL) supporting our NFC solutions					
Generic					
NFC frontends		NFC controller with customized firmware			
Bus Abstraction Layer (AL) with all low-level functions					
Generic					
Interfaces	SPI	I ² P	...		



The NFC Cockpit

- Let the HW designers optimize antenna parameters, including wave shape, while the SW designers work on other things
- Fine-tune the DPC and LPCD settings
- Activate a contactless smartcard, including basic card communication, with options for APDU and EMVCo polling
- Implement FW updates for the PN5180
- Access all EEPROM cells and registers



03 Products - NFC Controllers with Customizable Firmware

- Combining an NFC frontend with an advanced, power efficient 20-MHz ARM Cortex-M0 microcontroller
- Best choice for compact systems, since they require fewer components
- The flash memory can be loaded with fully-custom applications
- Optimized antenna operation, in combination with low-power modes, delivers best-in-class performance

Selection Guide

	PN7462	PN7362	PN7360
Flash Memory (KB)	160	160	80
Contact Interface	x		
HVQFN (9 x 9 mm)	x	x	x

Tools

OM27462	PN7462/PN736x Development
---------	---------------------------

Software

- Freely downloadable **NFC Reader Library**
- Sample source code
- Dynamic Power Control for frontend



03 Products - NFC Controllers with Integrated Firmware

- Combining an NFC frontend with an advanced, power efficient 20-MHz ARM Cortex-M0 microcontroller
- Pre-loaded with drivers for Linux, Android, and WinIoT
- Designed to save time when developing a system that uses an OS
- Communication via the NCI interface

Software



libnfc-nci library for smooth integration into GNU Linux-based systems



Patches to Android Open Source Project (AOSP)



Natively supported as proximity platform devices, through the universal NFC device driver model of the Win10 IoT OS



Code examples running on NXP LPC, Kinetis, and i.MX MCUs or a system that doesn't use an OS.

Selection Guide

	PN7150	PN7120
ROM with NFC Firmware	x	x
RF Driver Supply Voltage (V)	2.7 to 4.75	2.7 or 3.3
NFC Forum Type 3 Tag (FeliCa)	x	
Load Modulation Concept	Active	Passive
Package	HVQFN40	VFBGA49

Tools	OM5578/PN7150ARD	PN7150 Board with Arduino-Compatible Header
	OM5578/PN7150RPI	PN7150 Board for Raspberry Pi
	OM5578/PN7150BBB	PN7150 Board for BeagleBone Black
	OM5577/PN7120ARD	PN7120 Board with Arduino-Compatible Header
	OM5577/PN7120S	PN7120 Board for Raspberry Pi and BeagleBone Black



TECH ESSENTIALS

04 Tech Essentials - NFC Communication Modes

Read/Write Mode

This is where NFC spends most of its time, with one NFC-enabled device interacting with another to get information or initiate an action. The initiating device can read data in from the second device or write data out to it



Peer-to-Peer Mode

Sometimes referred to as “P2P” mode, this is the one you can use to exchange files between smartphones, or receive loyalty points when making a purchase.



Card Emulation Mode

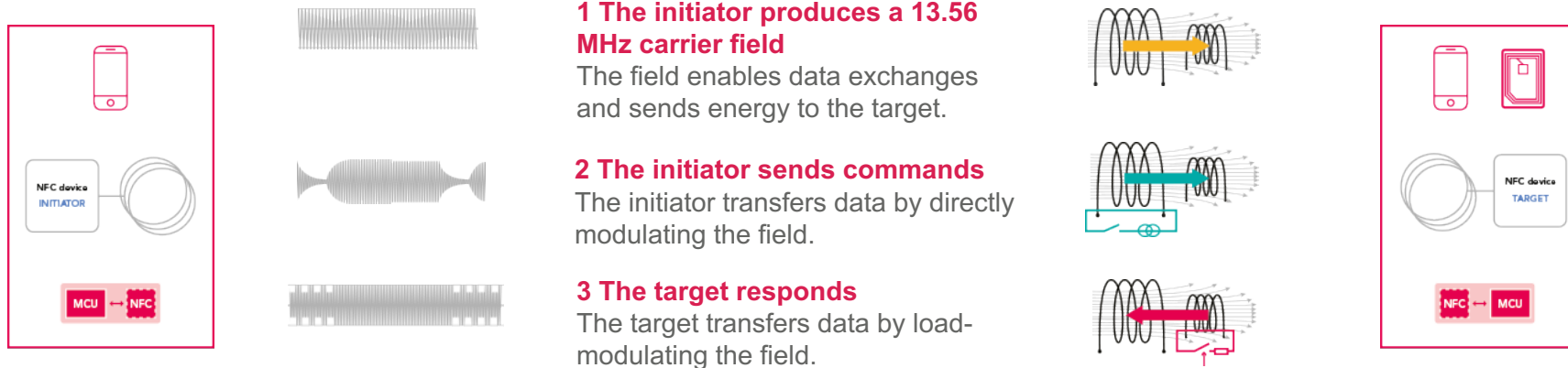
This mode, used almost exclusively by NFC smartphones, lets the system behave as an ISO/IEC 14443-compliant contactless smartcard. That means your phone can be used in the existing contactless infrastructure, for things like ticketing, access control and



04 Tech Essentials - Passive or Active Communication?

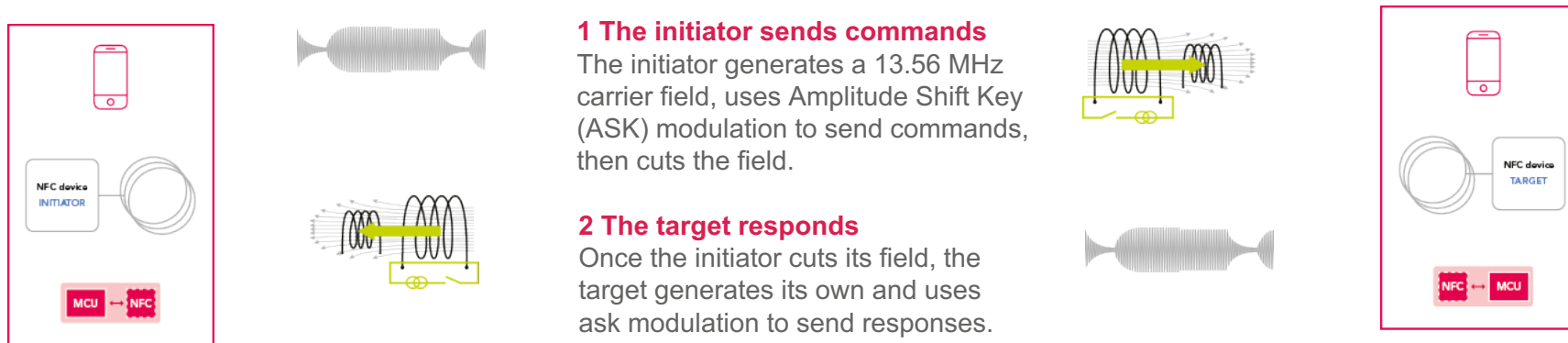
PASSIVE communication scheme

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



ACTIVE communication scheme

Active Peer-to-Peer Mode



04 Tech Essentials - The World of Wireless

The term “wireless” can refer to a number of different but related technologies, and has relevance in just about every kind of application. The table below gives a rough overview of what’s what.

	NFC (ISO/IEC 18092 NFC Forum)	 13.56 MHz	 10 cm	Smartphones, tablets, portable devices in a peer-to-peer network	(A)/(P)
	Contactless (proximity) smartcards (ISO/IEC 14443)	 13.56 MHz	 10 cm	Ticketing, payment, access, passports, etc	(P)
	RFID (ISO/IEC 18000-3)	 13.56 MHz	 < 40 cm	Tagging & tracking of goods and items for manufacturing, logistics, retail, etc	(A)/(P)
	IrDA infrared	 Infrared	 < 1 m	Remote controls, mobile phones, computers	(A)
	Bluetooth (IEEE 802.15.1)	 2.4 GHz	 > 10 m	Smartphones, tablets, audio equipment, printers, other devices in a personal area network (PAN)	(A)
	Wi-Fi (IEEE 802.11)	 2.4 GHz	 > 100 m	Smartphones, tablets, laptops, routers, other devices in a local area network (LAN)	(A)
	ZigBee (IEEE 802.15.4)	 2.4 GHz	 > 100 m	Lighting networks, home automation, industrial control	(A)
	Thread (IEEE 802.15.4)	 2.4 GHz	 > 100 m	Sensors, actuators, lighting networks, home automation, industrial control	(A)
	2/2.5/3G cellular	 450 MHz to 2.7 GHz	 Several km	Industrial devices, eMeters, Internet of Things (IoT) devices	(A)
	4G cellular	 450 MHz to 2.7 GHz	 Several km	Smartphones, tablets	(A)

 Range
 Frequency
 (P)
 (A) Passive Active



SECURE CONNECTIONS
FOR A SMARTER WORLD

04 Tech Essentials - A Few More Details

NFC Forum Tag Types

The NFC Forum mandates that all their defined tag types be interoperable with NFC devices. All the tag types are based on existing contactless formats.

NFC Forum	Type 1	Type 2	Type 3	Type 4	Type 5
ISO/IEC 14443 A	x	x			
JIS X 6319-4			x		
ISO/IEC 14443 A or B				x	
ISO/IEC 15693					x

Formats for Data Exchange (NDEF, RTD, SNEP)

All NFC Forum-compliant devices and tags support the same NFC Data Exchange Format (NDEF).

NDEF lets you encode data into the device or tag so it can share information with other NFC Forum-compliant devices and tags.

Common NFC Record Types

NDEF RTD	What It Covers
Device Information (Di)	Basic details about the device model and its identity, for use when the device acts as host
Smart Poster (Sp)	Text strings, such as URLs, SMS messages, or phone numbers stored in an NFC tag
Text (T)	Text strings in multiple languages
URI (U)	Universal Resource Identifiers (URIs), which include web addresses (URLs) and other network resources and files
Connection Handovers (Hr/Hs/Hc)	Pairing with Bluetooth, Wi-Fi, or other protocols. Includes record formats for handover request (Hr), select (Hs), and carrier (Hc).
Signature (Sig)	Provides an algorithm or certificate type for use as a digital signature

For more on these formats, check the NFC Forum website (nfc-forum.org).



04 Tech Essentials - Relevant Standards & Specifications

Standard	Subject	Relationship to NFC
EMVCo	Payment	Provides guidelines for NFC systems that accept payments or act as payment cards. Level 1 addresses the conformance of interface modules.
FeliCa	Contactless Smartcard	Developed by Sony and used primarily in Hong Kong, Japan, and Singapore, FeliCa is a contactless RFID smart card system that complies with JIS: X6319-4 and is also included as a condition for compliance with the NFC Forum specification.
GlobalPlatform	Secure Element	Specifies a multi-application architecture for the secure elements used to protect transactions in NFC systems.
ISO/IEC 7816	Contact smartcard	Defines a contact format compatible with NFC and ISO/IEC 14443. Most ISO/IEC 14443 contactless cards use the ISO/IEC 7816-4 command set.
ISO/IEC 10373-6	Proximity Card	Defines test methods specific to proximity cards and objects.
ISO/IEC 14443	Proximity Card	Defines the most widely used standard for proximity cards, objects, and readers in payment, transport, identification, and more. Type A and Type B cards use the same transmission protocol, but differ in their modulation methods, coding schemes, and procedures for protocol utilization. NFC Forum Type 2 and Type 4 Tags are based on the ISO/IEC 14443 series.
ISO/IEC 15693	Vicinity Card	Defines a contactless card that can be read at a range of up to 1 m, a longer distance compared to proximity cards. The NFC Forum Type 5 Tag is based on ISO/IEC 15693, and delivers an expected read range with mobile phones that is slightly longer than with Type 2 Tags.
ISO/IEC 18000-3M3	Item-level RFID	Defines an EPC Global Gen2 HF reader with an air interface at 13.56 MHz, the same operating frequency as NFC. Used for highly stackable tags with fast bulk reading.
ISO/IEC 18092	NFC Interface and Protocol	Defines Near Field Communication. Incorporates portions of ISO/IEC 14443 and FeliCa.
MIFARE	Contactless Smartcard	Refers to a contactless smartcard format compatible with NFC. Includes proprietary technologies based on various levels of the ISO/IEC 14443 A standard.
MISRA-C	Automotive	Provides NFC developers with guidelines for C programming in automotive. Developed by the Motor Industry Software Reliability Association.
NFC Forum Specification	NFC Devices	Defines an NFC implementation that enables interoperability across NFC applications.