**Near field communication**, or **NFC**, is a set of short-range wireless technologies, typically requiring a distance of 4 cm or less. NFC operates at 13.56 [MHz](http://en.wikipedia.org/wiki/MHz%22%20%5Co%20%22MHz)and at rates ranging from 106 kbit/s to 848 kbit/s. NFC always involves an initiator and a target; the initiator actively generates an [RF](http://en.wikipedia.org/wiki/Radio_frequency) field that can power a passive target. This enables NFC targets to take very simple form factors such as tags, stickers, key fobs, or cards that do not require batteries. NFC peer-to-peer communication is of course possible, where both devices are powered. According to the NFC Forum, the three main uses of NFC currently are “sharing, pairing, and transaction.” [[1]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-0) Global companies are interested in NFC’s ability to provide pervasive marketing, simplify processes, and facilitate contactless payment for goods.

NFC tags contain simple data or elaborate instructions that enable them to perform such functions as unlocking doors, paying for goods, launching phone calls or exchanging data between users. The majority of tags for consumer applications are read-only. However, NFC tags can also be read and rewriteable. They can be custom-encoded by their manufacturers or use the specifications provided by the NFC Forum, an industry association charged with promoting the technology and setting key standards. The tags can securely store personal data such as debit and credit card information, loyalty program data, PINs and networking contacts, among other information. The NFC Forum defines four types of tags which provide different communication speeds and capabilities in terms of configurability, memory, security, data retention and write endurance. Tags currently offer between 96 and 512 bytes of memory.

Essential specifications

* As with [proximity card](http://en.wikipedia.org/wiki/Proximity_card) technology, near-field communication uses [magnetic](http://en.wikipedia.org/wiki/Magnetic_field) [induction](http://en.wikipedia.org/wiki/Electromagnetic_induction) between two [loop antennas](http://en.wikipedia.org/wiki/Loop_antenna) located within each other's [near field](http://en.wikipedia.org/wiki/Near_and_far_field), effectively forming an air-core [transformer](http://en.wikipedia.org/wiki/Transformer). It operates within the globally available and unlicensed [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency) [ISM band](http://en.wikipedia.org/wiki/ISM_band) of 13.56 [MHz](http://en.wikipedia.org/wiki/MHz%22%20%5Co%20%22MHz). Most of the RF energy is concentrated in the allowed 14 kHz bandwidth range, but the full spectral envelope may be as wide as 1.8 MHz when using [ASK](http://en.wikipedia.org/wiki/Amplitude-shift_keying) modulation.[[2]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-1)
* Working distance with compact standard antennas: up to 20 cm
* Supported data rates: 106, 212, 424 or 848 [kbit/s](http://en.wikipedia.org/wiki/Kbit/s%22%20%5Co%20%22Kbit/s)
* There are two modes:
	+ Passive communication mode: The initiator device provides a carrier field and the target device answers by modulating the existing field. In this mode, the target device may draw its operating power from the initiator-provided electromagnetic field, thus making the target device a [transponder](http://en.wikipedia.org/wiki/Transponder).
	+ Active communication mode: Both initiator and target device communicate by alternately generating their own fields. A device deactivates its RF field while it is waiting for data. In this mode, both devices typically have power supplies.

|  |  |  |
| --- | --- | --- |
| [**Baud**](http://en.wikipedia.org/wiki/Baud) | **Active device** | **passive device** |
| **424 [kBd](http://en.wikipedia.org/wiki/Baud%22%20%5Co%20%22Baud)** | Manchester, 10% [ASK](http://en.wikipedia.org/wiki/Amplitude-shift_keying) | Manchester, 10% ASK |
| **212 kBd** | Manchester, 10% ASK | Manchester, 10% ASK |
| **106 kBd** | Modified Miller, 100% ASK | Manchester, 10% ASK |

* NFC employs two different [codings](http://en.wikipedia.org/wiki/Coding%22%20%5Co%20%22Coding) to transfer data. If an active device transfers data at 106 kbit/s, a modified [Miller coding](http://en.wikipedia.org/wiki/Miller_coding) with 100%[modulation](http://en.wikipedia.org/wiki/Modulation) is used. In all other cases [Manchester coding](http://en.wikipedia.org/wiki/Manchester_coding) is used with a modulation ratio of 10%.
* NFC devices are unable to receive and transmit data at the same time. Thus, they need to check the radio frequency field and can detect a collision if the received signal matches the transmitted signal's modulated frequency band.

[[edit](http://en.wikipedia.org/w/index.php?title=Near_field_communication&action=edit&section=2)]Uses and applications

NFC technology is intended mainly for use in mobile phones.[[3]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-2) There are currently three specific uses for NFC according to the NFC Forum:

* Reader/writer mode: the NFC device is active and reads a passive RFID tag. Example: smart posters.
* P2P mode: two NFC devices exchange data. Example: virtual business cards or digital photos.
* Card emulation: the NFC device behaves like an existing contactless card and can be used with existing technology infrastructures.[[4]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-3)

A wide range of applications are possible, such as:

* Mobile ticketing for public transport including rail, metro, and airline journeys; movies; concerts; and sporting events. In the case of public transport, European passengers are using NFC-enabled phones to obtain schedule updates, register points of boarding and departure, automatically calculate fares, pay for trips and parking and purchase snacks.[[5]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-4),[[6]](http://en.wikipedia.org/wiki/Near_field_communication%22%20%5Cl%20%22cite_note-name-5) The business driver for ticketing operators is cost savings, as electronic ticketing is significantly cheaper than paper ticketing. Juniper Research forecasts that more than 15 billion mobile tickets will be issued by 2014, up from just two million in 2010.[[7]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-6)
* [Mobile payment](http://en.wikipedia.org/wiki/Mobile_payment): Telecommunications companies, banks, and other entities in countries such as Canada, Finland, France, Japan, Korea, the United Kingdom, the United States and others, are testing and launching mobile payment services, which permit location-based commerce and peer-to-peer payments.[[8]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-7) Users can pay for goods using NFC-enabled devices, either NFC-enabled phones with stored data that act as a debit/credit payment card or NFC-powered contactless payment cards they touch to readers. Globally, 100 million people use mobile payment outside the U.S., but only 3.5 million use the technology in the U.S.[[9]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-8) After trialing solutions, many companies are launching nationwide services in 2010 and 2011, and a few have even targeted deployment to entire regions.
* Smart posters and objects: NFC-enabled phones can be used to read RFID tags on commercial establishments’ signs for information or promotions or scan outdoor billboards. Smart posters have application across a wide array of industries, including public transport, retail promotions and event ticketing, among others. Other items, such as business cards, picture frames, bulletin boards, schedules, conference or study rooms and vending machines can become “smart” with NFC tags, permitting data exchange, launching applications, or granting usage privileges.
* Bluetooth pairing: In the future, pairing of Bluetooth 2.1 devices with NFC support will be as easy as bringing them close together and accepting the pairing. The process of activating Bluetooth on both sides, searching, waiting, pairing and authorization will be replaced by simply bringing the mobile phones close to each other.

Emerging applications include:

* [P2P payment](http://en.wikipedia.org/w/index.php?title=P2P_payment&action=edit&redlink=1): Users can make payment to each other by tapping phones together and entering the amount of money to be transferred.
* [Identity documents](http://en.wikipedia.org/wiki/Identity_document): Governments, employers, and other organizations will use NFC to power contactless identity cards. Employee and student NFC cards will likely gain traction before national identity cards do, as single organizations can mandate usage more easily, and governments will need to allay citizens’ security concerns and work with international organizations to create and enforce security standards. The security of national ID cards and passports will be strengthened with biometric applications such as facial recognition or fingerprint swipes.
* [Mobile commerce](http://en.wikipedia.org/wiki/Mobile_commerce): NFC can enable the delivery of in-store promotions and couponing, driving sales of products or value-added services. Meanwhile, smart posters enable consumers to gain more information on retailers or specific products.
* [Electronic keys](http://en.wikipedia.org/wiki/Remote_keyless_system): NFC-enabled phones can serve as replacements for physical car keys, house/office keys, and hotel room keys. As such, NFC-enabled devices can be used by hotels and rental car companies to provide VIP service to customers. In corporate settings, NFC-enabled devices can control access to facilities and computer networks while also authenticating users.
* Ubiquitous information applications, such as audio tour guides for art museums or public monuments, book sales and lending, movie trailers, DVD rentals, and music purchases. Users can touch NFC-enabled phones to smart posters or tagged items to hear marketing information or view or hear media.
* Health and safety applications, such as water monitoring;[[10]](http://en.wikipedia.org/wiki/Near_field_communication%22%20%5Cl%20%22cite_note-9) diet, diabetes, blood pressure, and alcohol consumption monitoring; home healthcare visits; and campus safety check-ins. In these scenarios, NFC-enabled phones and tagged items are often paired with other devices to provide consumers with personalized services and facilitate exchange of encrypted private data to doctors or other healthcare workers.
* Social networking: Users can exchange contacts, resumes, and location-based personal networks using NFC-enabled phones or smart business cards and P2P file exchange.[[11]](http://en.wikipedia.org/wiki/Near_field_communication#cite_note-10) In addition, they can alert friends to their location, check into commercial establishments to gain rewards, and rate products and services in real-time. Google is among the companies pioneering location-based rating services with its Google Places services, which has now been extended to several U.S. cities.
* Smart mobility: Consumers can obtain access to shared car and bicycle services and search for rides with carpoolers.
* Entertainment: Consumers can use NFC-enabled phones to participate in multiplayer games,[[12]](http://en.wikipedia.org/wiki/Near_field_communication%22%20%5Cl%20%22cite_note-11) create and track athletic challenges and participate in urban games.

NFC can be used to configure and initiate other wireless network connections such as [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth), [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi_Protected_Setup) or [Ultra-wideband](http://en.wikipedia.org/wiki/Ultra-wideband).

A patent licensing program for NFC is currently under development by Via Licensing Corporation, an independent subsidiary of [Dolby Laboratories](http://en.wikipedia.org/wiki/Dolby_Laboratories).

A public, platform-independent NFC library is released under the free [GNU Lesser General Public License](http://en.wikipedia.org/wiki/GNU_Lesser_General_Public_License) by the name [libnfc](http://www.libnfc.org/).

In December 2008 the application eCL0WN[[13]](http://en.wikipedia.org/wiki/Near_field_communication%22%20%5Cl%20%22cite_note-12) was released which allows you to read and copy the chip content of biometric passports.

[[edit](http://en.wikipedia.org/w/index.php?title=Near_field_communication&action=edit&section=3)]Comparison with Bluetooth

|  |  |  |  |
| --- | --- | --- | --- |
|  | **NFC** | **Bluetooth** | **Bluetooth Low Energy** |
| [**RFID**](http://en.wikipedia.org/wiki/RFID)**compatible** | ISO 18000-3 | active | active |
| **Standardisation body** | ISO/IEC | Bluetooth SIG | Bluetooth SIG |
| **Network**[**Standard**](http://en.wikipedia.org/wiki/Technical_standard) | ISO 13157 etc. | IEEE 802.15.1 | IEEE 802.15.1 |
| **Network Type** | Point-to-point | WPAN | WPAN |
| **Cryptography** | not with RFID | available | available |
| **Range** | < 0.2 m | ~10 m (class 2) | ~1 m (class 3) |
| **Frequency** | 13.56 MHz | 2.4-2.5 GHz | 2.4-2.5 GHz |
| **Bit rate** | 424 kbit/s | 2.1 Mbit/s | ~1.0 Mbit/s |
| **Set-up time** | < 0.1 s | < 6 s | < 1 s |
| **Power consumption** | < 15mA (read) | varies with class | < 15 mA (xmit) |

NFC and [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth) are both short-range communication technologies which are integrated into mobile phones. As described in technical detail below, NFC operates at slower speeds than Bluetooth, but consumes far less power and doesn’t require pairing.

NFC sets up faster than standard [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth), but is not much faster than [Bluetooth low energy](http://en.wikipedia.org/wiki/Bluetooth_low_energy). With NFC, instead of performing manual configurations to identify devices, the connection between two NFC devices is automatically established quickly — in less than a tenth of a second. The maximum data transfer rate of NFC (424 kbit/s) is slower than that of Bluetooth V2.1 (2.1 Mbit/s). With a maximum working distance of less than 20 cm, NFC has a shorter range, which reduces the likelihood of unwanted interception. That makes NFC particularly suitable for crowded areas where correlating a signal with its transmitting physical device (and by extension, its user) becomes difficult.

In contrast to Bluetooth, NFC is compatible with existing passive RFID (13.56 MHz ISO/IEC 18000-3) infrastructures. NFC requires comparatively low power, similar to the Bluetooth V4.0 low energy protocol. However, when NFC works with an unpowered device (e.g. on a phone that may be turned off, a contactless smart credit card, a smart poster, etc.), the NFC power consumption is greater than that of Bluetooth V4.0 Low Energy. Illumination of the passive tag needs extra power.