



N_{ear}

F_{ield}

C_{ommunication}

What Is NFC ?

- ◆ NFC or **Near Field Communication** is a short range high frequency wireless communication technology.
- ◆ NFC is mainly aimed for **mobile** or **handheld devices**.
- ◆ A **radio communication** is established by touching the two phones or keeping them in a proximity of a few centimeters (up to **10 cm**) .
- ◆ It allows for simplified transactions, data exchange, and wireless connections between two devices.
- ◆ Allows communication between
 - Two powered (**active**) devices
 - Powered and non self-powered (**passive**) devices



*NFC trademark
logo*

Features

- ◆ NFC is an extension of **Radio frequency identification (RFID)** technology that combines the interface of a smartcard and a reader into a single device. This allow **two-way communication** between endpoints, where earlier systems were one-way only.
- ◆ It operates within the globally available and unlicensed radio frequency band of **13.56 MHz**, with a bandwidth of **14 kHz**.
- ◆ Working distance with compact standard antennas: up to **10 cm** .
- ◆ Supported data rates: **106, 212 and 424 Kbit/s**
- ◆ For two devices to communicate using NFC, one device must have an NFC **reader/writer** and one must have an **NFC tag**

NFC Reader

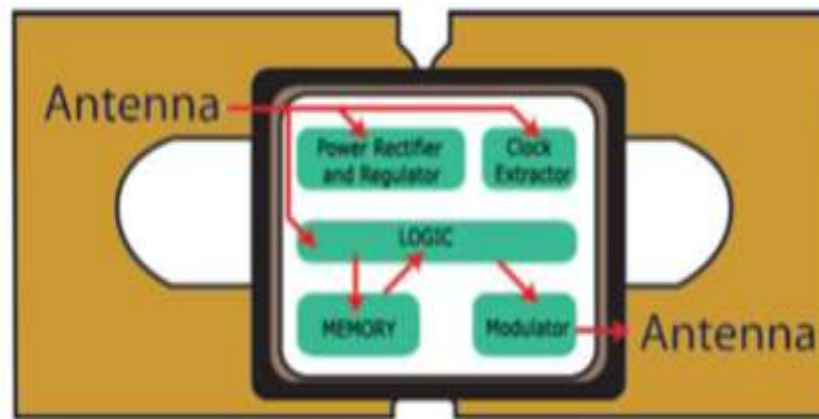
Usually a microcontroller-based (for example NFC enabled phones) with an integrated circuits that is capable of generating radio frequency at 13.56 MHz with other components such as encoders, decoders, antenna, comparators, and firmware designed to transmit energy to a tag and read information back from it by detecting the backscatter modulation. The reader continuously emits RF carrier signals, and keeps observing the received RF signals for data.



*An NFC Reader
(A Smartphone)*

NFC Tag

An RFID device incorporating a silicon memory chip connecting to external antenna. Tag does not have its own power source (**passive**). The passive tag absorbs a small portion of the energy emitted by the reader (phone), and starts sending modulated information when sufficient energy is acquired from the RF field generated by the reader. Data modulation (modulation for 0s and 1s) is accomplished by either direct modulation or FSK or Phase modulation.



Following figure shows the internal hardware of NFC tag where we can see its memory, logic etc.

Operation Of NFC

1. NFC has two communicative terminals :The **INITIATOR** is the one who wishes to communicate and starts the communication. The **TARGET** receives the initiator's communication request and sends back a reply

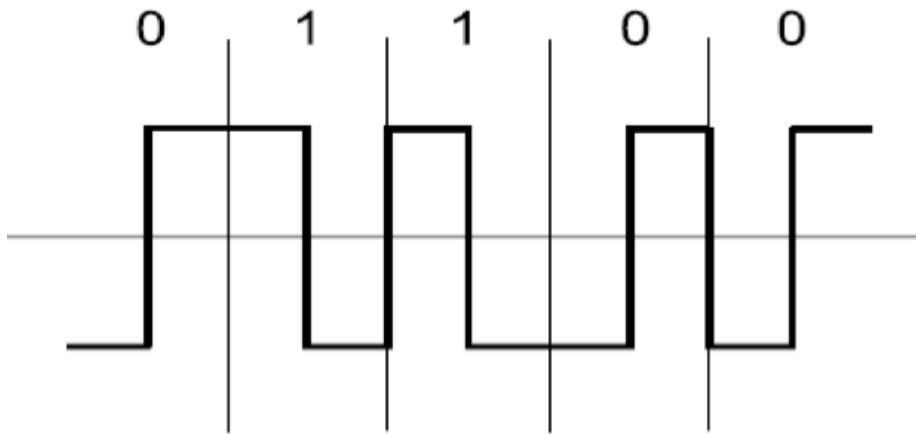


2. NFC employs two different coding to transfer data. If an active device transfers data at 106 Kbit/s, a **Modified Miller** coding with 100% modulation is used. In all other cases **Manchester coding** is used with a modulation ratio of 10%.

Operation Of NFC

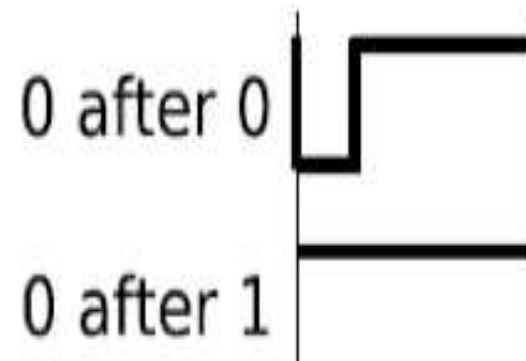
Manchester Coding

- A low-to-high transition expresses a 0 bit, whereas a high-to-low transition stands for a 1 bit.



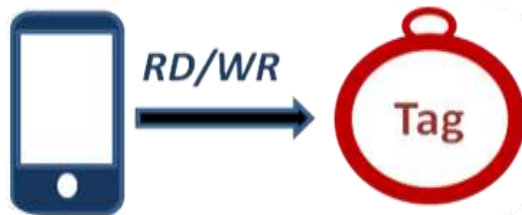
Modified Miller Coding

- This line code is characterized by pauses occurring in the carrier at different positions of a period. While a 1 is always encoded in the same way, coding a 0 is determined on the basis of the preceded bit.



Operation Of NFC

There are two mode of communication



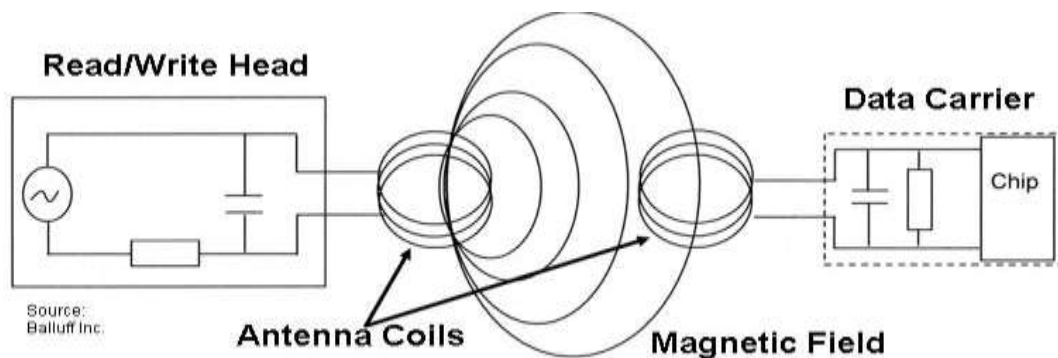
Passive Communication Mode: The Initiator device provides a carrier field and the target device answers by modulating existing field. In this mode, the Target device may draw its operating power from the Initiator-provided electromagnetic field.



Active Communication Mode: Both Initiator and Target device communicate by alternately generating their own field. A device deactivates its RF field while it is waiting for data. In this mode, both devices typically need to have a power supply.

Operation Of NFC

- ▶ NFC devices communicate via **magnetic field induction**, where two loop antennas are located within each other's **near field**, effectively forming an **air-core transformer**.
- ▶ The reader continuously generates an RF carrier sine wave (at **13.56 MHz**), watching always for modulation to occur. Detected modulation of the field would indicate the presence of a tag.



Operation Of NFC

- ▶ A tag enters the RF field generated by the reader. Once the tag has received sufficient energy to operate correctly, it divides down the carrier and begins clocking its data to an output transistor, which is normally connected across the coil inputs.
- ▶ The tag's output transistor shunts the coil, sequentially corresponding to the data which is being clocked out of the memory array.
- ▶ Shunting the coil causes a momentary fluctuation (dampening) of the carrier wave, which is seen as a slight change in amplitude of the carrier.
- ▶ The reader peak-detects the amplitude modulated data and processes the resulting bit stream according to the encoding and data modulation methods used.

Comparison With Existing Technologies

	NFC	RFID	IrDa	Bluetooth
Set –up time	<0.1ms	<0.1ms	~0.5s	~6 sec
Range	Up to 10cm	Up to 3m	Up to 5m	Up to 30m
Usability	Human centric Easy, intuitive, fast	Item centric Easy	Data centric Easy	Data centric Medium
Selectivity	High, given, security	Partly given	Line of sight	Who are you?
Use cases	Pay, get access, share, initiate service, easy set up	Item tracking	Control & exchange data	Network for data exchange, headset
Consumer experience	Touch, wave, simply connect	Get information	Easy	Configuration needed

Operating Modes of NFC devices



Reader/writer mode

the NFC device is capable of reading NFC Forum-mandated tag types, such as a tag embedded in an NFC smart poster



Peer-to-Peer mode

Two NFC devices can exchange data. For example, you can share Bluetooth or Wi-Fi link set-up parameters or you can exchange data such as virtual business cards or digital photos.



Card Emulation mode

The NFC device appears to an external reader much the same as a traditional contactless smart card. This enables contactless payments and ticketing by NFC devices without changing the existing infrastructure.

Specifications

The NFC Forum has issued various specifications to date:

Specification	Purpose
NFC Data Exchange Format (NDEF)	Defines a common data format between NFC-compliant devices and tags
Record Type Definition (RTD)	Specifies rules for building standard record types Five specific RTDs (Text, URI, Smart Poster, Generic Control, and Signature) are used to build standard record types
Logical Link Control Protocol (LLCP)	Defines a protocol to support peer-to-peer communication between two NFC-enabled devices
Connection Handover	Defines how to establish a connection using other wireless communication technologies
Operations Specifications for Four Tag Types (1/2/3/4)	Enable core interoperability between tags and NFC devices

Benefits of NFC

NFC provides a range of benefits to consumers and businesses, such as:

- ◆ **Versatile:** NFC is ideally suited to the broadest range of industries, environments, and uses
- ◆ **Open and standards-based:** The underlying layers of NFC technology follow universally implemented ISO, ECMA, and ETSI standards
- ◆ **Technology-enabling:** NFC facilitates fast and simple setup of wireless technologies, (such as Bluetooth, Wi-Fi, etc.)
- ◆ **Inherently secure:** NFC transmissions are secure due to short range communication
- ◆ **Interoperable:** NFC works with existing Contactless card technologies
- ◆ **Security-ready:** NFC has built-in capabilities to support secure applications

NFC is as simple as a >>



touch

Application of NFC



Application of NFC

Smart Posters

- An object that has, affixed to or embedded in it, one or more readable NFC tags with NDEF messages stored in them.
- Each tag is read when an NFC device is held close to it
- “N-Mark” shows touch point
- Not only a paper poster on the wall
- Billboard, garment tag, magazine page, even a three-dimensional object



The Smart Poster record defines a URI plus some added metadata about it



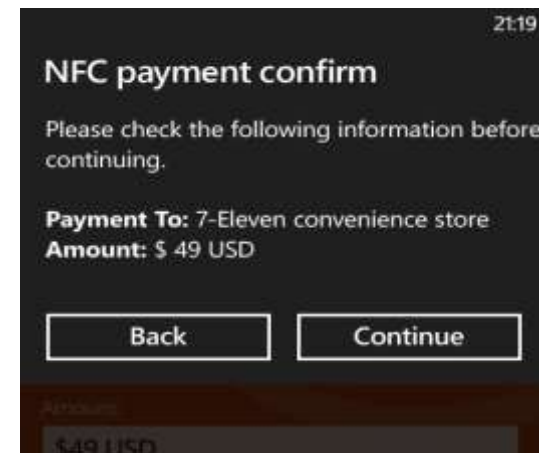
NDEF Message				
Sp (Smart Poster)				application/vcard
URI	Text	Action	Configuration	vCard data

Application of NFC

NFC and Mobile Payment

A customer makes his payment through mobile phone using NFC

- ▶ NFC phone will open **wallet** application
 - Wallet will display product cost when user clicks “Buy”
- ▶ At check out, wallet will display all credit/debit cards in wallet for payment
- ▶ Customer will select card for payment
- ▶ Wallet will show the confirmation page with the check out basket
- ▶ Wallet will connect to retailer back end for authorization and display tracking information



Application of NFC

Peer-to-peer

- ◆ **Connection Handover** : A handover use case is the exchange of configuration information via the NFC link to easily establish a connection over (for e.g. **Bluetooth or Wi-Fi**) and carry the information to be shared. Connection can be set between NFC devices



Speakers (touch to connect)

- Home computer components
- Home entertainment systems
- Cameras and printers
- In-car devices
- Headsets and handsets
- Secure WLAN modem set-up

- ◆ If the amount of information is relatively small (up to one kilobyte), it is possible to use NFC to transmit the data itself (e.g. **electronic business cards, contacts**).



Smart Tags

Application of NFC

Additional Use Cases for NFC Smart Posters

- **Asset Management** - Use NFC phones to read smart tags per product for inventory
- **Access** - Ensure secure building area access for personnel with NFC device and contactless reader
- **Parking** – Use NFC to authenticate parking entry and keep record .
- **Meal orders** – Customers order their meals by touching NFC Smart Posters.
- **Remote worker reporting** – Remote workers confirm locations visited and tasks completed
- **Maps** – An interactive NFC Smart Poster map allows the user to download the map, get additional information on relevant services, and access coupons, etc.
- **Events calendar** – Users can download tickets or coupons or be linked to event websites



NFC Parking >>

<< Security Gate



History of NFC

1983

- The first patent to be associated with the abbreviation RFID was granted to Charles Walton.

2004

- Nokia, Philips and Sony established the Near Field Communication (NFC) Forum.

2011

- First mobile phone(Nokia 6131) with NFC released by NOKIA.

2010

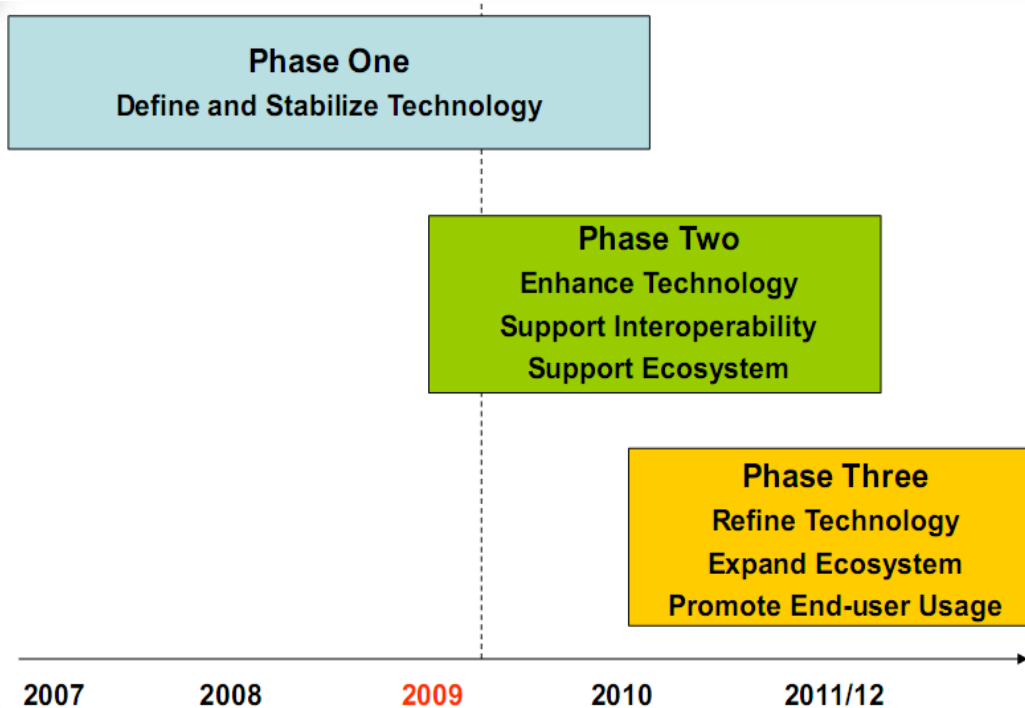
- Samsung Nexus S: First Android NFC phone.

2011

- NFC support becomes part of the Symbian mobile operating system and Blackberry OS.

Evolution and Future of NFC

NFC Projected Development



NFC Forum

The NFC Forum is a non-profit industry association to advance the use of NFC short-range wireless interaction in consumer electronics, mobile devices and PCs.

The NFC Forum promotes implementation and standardization of NFC technology to ensure interoperability between devices and services. In September 2008, there were over 150 members of the NFC Forum.



CONCLUSION

Mobile handsets are the primary target for NFC and soon NFC will be implemented in most handheld devices. Even though NFC have the shortest range among radio frequency technologies but it is revolutionary due to its *security, compatibility, user friendly interface, immense applications etc*

The above mentioned scenarios are just a few examples of how NFC will change our lives for the better. With the high level of interest by corporations, as well as involvement of individual developers and users in this short range communication standard, the possibilities are endless.

THANK YOU

Akshat Rohatgi

