An Introduction to Near Field Communication (NFC) And it's Benefits.

Shalini Bhickta

Amity University of Engineering and Technology, Uttar Pradesh

Abstract

NFC is a short-range device wireless technology, where NFC is the combination of contactless identification RFID and mobile phone devices.NFC represents the 2nd generation of the proximity contact-less technology, which beyond the RFID supports peer-to-peer communication, and enables consumer access to aggregated services. This paper discusses the NFC technology which is based on RFID working principles having different operating modes to study the benefits of various applications and future scenarios; also the architecture describes the secure and easy communication in mobile applications.

Introduction

Near Field Communication is a set of short-range wireless technologies which allows electronic devices (like mobile phones, notebooks, printers, TV's etc) to share information, news or ideas with other similar devices. This is possible only when other devices are in vicinity where this distance should not be more than few centimeters usually less than 10 cm [2].NFC are set of standards for smart phones and other similar devices that initiate a radio communication just by touching each other. This short range data communication technology works in 13.56 MHz frequency band.

Bluetooth, WI-Fi, infrared, RFID, UWB are the other short range technologies which differ from NFC which has shorter transmission range and slower data rates but if compared to Bluetooth NFC sets up more quickly than any other short range technology and no unauthorized communication can take place. With NFC, unlike Bluetooth manual configurations for identifying devices are not required because connection between two NFC devices is automatically established when brought in close proximity. Maximum data transfer rate of NFC is 424 Kbps with set up time of less than 0.1s. Though NFC Operates at slower speeds than Bluetooth but consumes less power and don't require pairing techniques.

NFC was jointly developed by Philips/Sony in 2002 for contactless communications. NFC forum - created in 2004 to bring mobile existing RFID standards efforts and create new short range communication ability. They aim to advance the use of NFC short range wireless interaction in consumer electronics mobile devices and PC's. NFC can carry out device to device communication with ease, can read other contactless chips (RFID) and also emulate contactless cards [3].

How it works?

NFC traces it root back to radio-frequency identification or RFID technology [4] and works on the same principles as RFID does. NFC has defined standards which consists of communication protocols and data exchange formats which are based on present RFID standards [ ]. NFC device generates a low frequency radio-wave field of 13.56 MHz spectrum. When this device gets in close proximity of another NFC device i.e. close enough to contact the field, magnetic inductive coupling takes place which transfers energy and data from one device to the other. The use of magnetic coupling brings the principal difference between NFC & other technologies such as Bluetooth, WI-Fi.

NFC Technology

NFC technology is based on RFID or we can say it is a subset of RFID technology. RFID technology was developed for automatic wireless data collection systems [6]. RFID systems consists of two important components first is the transponder also called contactless target or tag and second is the transreceiver also called Reader or Writer. Transponder contains information like an ID number, a product price or a date of the objects to which it is attached and to be identified. Transreceiver either read the tag's information or alter it, assuming tag's rewritable. RFID readers are quite small to integrate them in mobile phones, PDA's or tablets.

A. From RFID to Near Field Communication(NFC):

NFC being a subset of RFID technology uses same working principles. NFC devices are compatible to read out RFID transponders and emulating them. In NFC, P2P communication is also possible when two NFC devices come in contact with each other. RFID has two components the transponder or the tag and the transreceiver or read-write device. The transceiver emits an electromagnetic signal that activates the tag and enables to read from and possibly write to the tag. Communication modes in NFC are active and passive device

- **Active** : Devices containing power sources are called as active, In NFC model active device options are
  –Mobile phone
  –NFC reader

- **Passive:** Devices without any available power sources are called as passive, in NFC model there exists only one passive device i.e. –RFID tag.

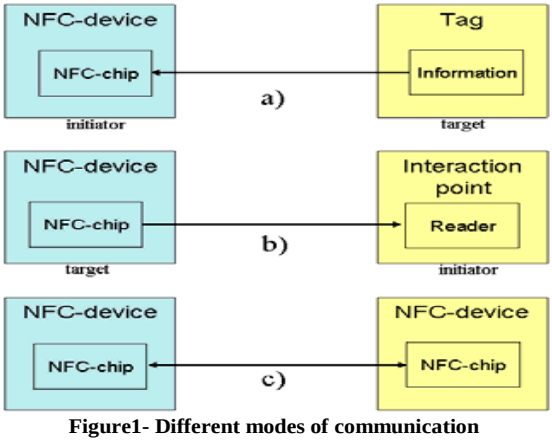

Figure1- Different modes of communication

B. NFC standards protocol

NFC is specified in two ECMA standards. These standards define a protocol each that must be implemented by NFC devices. These protocols are

- **NFCIP – 1**: This standard states the modulation and bit encoding schemes along with the frame architecture for particular data rate of 424 kbps. NFC standardizes the communication signal interface and the protocol flow. It also defines active and passive communication modes as explained above. In active mode, both the initiator and the target generate a radio frequency field whereas in passive only one will generate radio field.

- **NFCIP – 2**: This standard states the method for choosing one communication mode out of the three. NFCIP acts as a gateway between existing interface standards. Also, this protocol is used not to disturb any ongoing communication on the frequency spectrum – 13.56 MHz. This is done using CSMA, hence NFCIP-2 device will not activate its RF field when an external radio field exceeding a certain threshold level.

Operating modes

An NFC device consists of following operating mode [7]:

- **Reader/Writer Mode**: In this the NFC device can read and change data stored in NFC passive (without battery) transponders. These kinds of tags are found on Smart Posters that allows the user to get additional information about the tag by reading it with a NFC device.

- **Card Emulation Mode**: The NFC device operating in this mode act as smart card (ISO 14443) when switched into card emulation mode. In this case an external transreceiver cannot distinguish between a smart card and an NFC device. Card emulation mode is in payment and ticketing application.

- **Peer to Peer mode**: An NFC P2P mode allows NFC devices establish a two way connection and exchange contacts eg. Bluetooth pairing for exchanging information or data.

Architecture of NFC enabled mobile phones

NFC technology integrated in a mobile device consists of several IC's which are SE's and an NFC interface [8]. For a dynamic and secure environment of program and data SE are used. Secure Element provides secure storage of valuable and private data such as user's credit card information and also secure execution of NFC enabled services (as contactless payments).The NFC Interface which consists of NFC contactless front end (CLF) or Analog to Digital contactless front end, an NFC antenna and an NFC controller IC, to activate NFC transactions.

A mobile phone integrated with NFC has at least one SE connected with the NFC controller for secure transfer of data with other external NFC devices. Host Controller is also used to exchange data with the SE as illustrated in Figure. NFC controller performs A/D conversion of signals. Interface between NFC controller & SE is defined as Signal-in Signal-out connection S2C or SWP (Single Wire protocol).

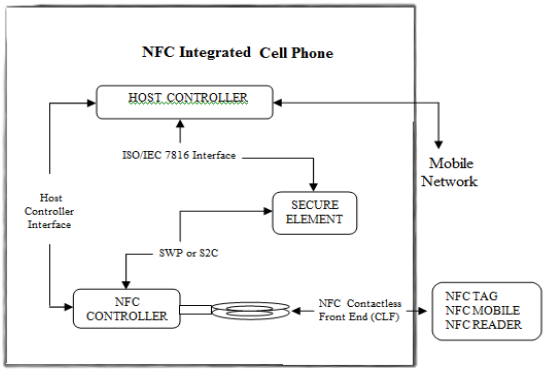

Figure-2 Architecture of an NFC phone.

NFC Application

- **Payment & Ticketing**: NFC devices can replace a contactless payment system that is currently used in credit cards and electronic ticket smart cards with mobile payments.

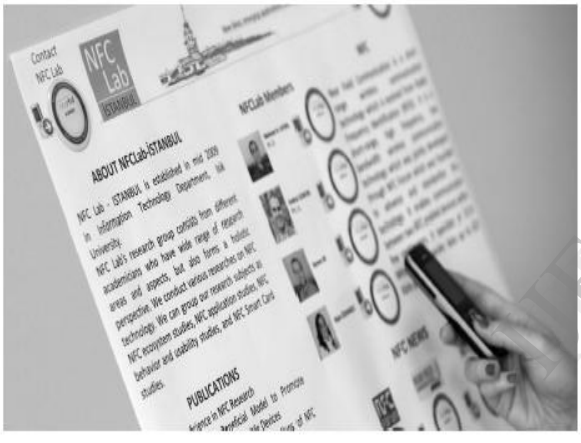

Figure 3- Smart Poster Applications [9]

- **Service Initiation**: NFC offers a simple setup for pairing and establishing a Bluetooth connection for file transfer. NFC technology paired Bluetooth headsets & speakers by NFC enabled devices.

- **Sharing & P2P**: Peer-to-peer mode enables two NFC enabled mobile devices to exchange information such as a contact record, a text message, or any other kind of data.

Figure 4- Pairing, Sharing and Exchanging Applications[9]

Current Benefits of NFC Services

We study the benefits of investigated applications and future scenarios by classifying them into NFC operating modes because the communication way is different in each NFC mode and these differences make change in benefits and usage areas.

Benefits

- **Card Emulation Mode**

When we investigate payment applications, the usage of mobile phone eliminates carrying contactless credit, smart cards, or cash. Instead, a user makes payment with his or her mobile phone.

- **Reader/Writer Mode**

In reader/writer mode, data stored in an NFC tag is read by an NFC-enabled mobile phone and then that data is used to process further operations. This is implemented in smart poster application, where we give information to users for example when a user touches NFC enabled mobile device to a NFC tags on the poster we get useful information.

- **Peer-to-Peer Mode**

Peer-to-peer mode provides easy data exchange between two devices. Bluetooth pairing, exchanging business cards by touching two NFC-enabled mobile phones to each other are examples of this mode.

Conclusion

Near Field Communication represents an extremely interesting technology nowadays that offers the possibility to modify the whole payment system and as a consequence people's habit in money usage. NFC promises to eliminate problems like difficult configuration, long duration of connection establishment and high power consumption.

Here, we studied the short range NFC technology for smart phones devices where the distance has to be less than 10 cm. NFC makes the mobile phones use as a contactless card or smart cards, or cash. NFC enabled phones can also share information through Bluetooth.

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