Review of RFID, NFC Technology and Its Applications

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Abstract - **Near field communication is very advance technology. This technology is gradually increase in current world. Many inventors create various types of application which is based on NFC technology. They will operate various types of operating modes and communication modes. These modes are help to establish connection between mobile to mobile, payments, and fetch the information to the NFC tag. NFC is based on RFID technology. RFID is very easily operate and his tag is very environment friendly. There are three types of RFID tag. Active tag, semi-passive tag, passive tag. But passive tag is very usefully to user.**

1. INTRODUCTION

NFC is new technology which is wireless. NFC has two communication modes and three operating modes. In an NFC communication, two equipment are involved. One equipment is originator which is an active mode and liable for initiating the conversation, whereas second device is called target and replies the originator's desires. The conversation starts when the active device gets near to the target and creates a 13.56 MHz magnetic field and powers the target equipment. NFC technology has various advantages and one of them is that NFC technology can be mounted into mobile device and thus advantage from mobile phones' capabilities. Another key feature of NFC is that NFC enabled mobile devices can both read/write data from/to NFC tags and also can be used as a digital storage for NFC readers [1]. Reader/writer mode, peer to peer mode and card emulation mode are three operating modes which is facilities on NFC technology. And active communication mode and passive communication mode are communication mode [2]. The active communication mode allotted by RF field .When piece of equipment starts its self-power it is called an active device. In passive mode if device act as transponder (which is also known as a NFC tag) is called passive communication mode [3]. Operating mode is first one is reader/writer mode which is NFC equipment can read and modify or write the data which is stored in NFC tag or transponders. These NFC tag is used in various social environment field. Such as smart poster, menu card etc. Second one is card emulation mode which is very popular in NFC area. NFC technology is specially designed to solve the plastic smartcard problem. In card emulation mode mobile device act as smartcard which is use full for buy a

ticket of transport vehicles or any entertainment show ticket and payment also. Third one is Peer-to-peer mode permit two NFC enabled mobile device or equipment to communicate a two side connection to swapping data. To set up a connection a user (NFC peer-to-peer originator) is searching for host (NFC peer-to-peer object) to setup a connection [4]. A possible combination on communication mode is both originator device and target device are on active mode they will communicate always. Because they do not need power supply. But in second type of combination originator device is always on active mode is right but target device is always on passive mode. Otherwise conversation is break because passive device have no power supply [3]. RFID is Radio Frequency Identification. NFC technology is based on RFID technology. RFID technology uses magnetic field orientation to allow conversation two electronic devices in very close approx. 4inches. RFID technology gives seamless medium for the recognition rules that authenticate safe information transport. This allow client to complete safe, contactless transactions, and connect electronic devices only by touching or get devices into nearly [5]. There are two types of RFID tag. Active tag and passive tag. Tag is mounted anywhere or any object. Such as pallets, various types of goods, car, buses etc. Active tag is high data store capacity. And they need power from external source. And his distance is very long. Passive tag does not require power and his range is very short approx. 4 inches. And his storage capacity is very less than as compare to active tag [6]. Various types of application which is based on operating modes. In card emulation mode, mobile device emulates a regular smart card and makes this mode suitable because of the previously existing setup for the contactless costs by these smartcards companies. Thus NFC enabled mobile phones becomes a credit card In peer to peer mode phone allows to read passive RFID tags on posters, stickers, and other stationary matters that cover certain types of data on them. For instance, you could tap your device on the reader tag in a movie poster and it would begin playing the movie trailer, provide the ater times, locations, and so on. P2P offers communication among two active equipment such as phones. Using this mode, one could kind payments to another separate or business just by tapping the two phones organized. As the name implies, P2P could similarly go a long way in making an improved multiplayer gaming experience [7].

2. OPERATING MODES

Near Field Communication is created on inductive coupler, where lightly coupled inductive circuits part control and data finished a distance of a few inches. An NFC-enabled equipment can work in three kind of modes. They are reader/writer mode, peer-to-peer mode, and card emulation mode.

2.1. Reader/Writer Mode

NFC devices can contact contactless smartcards, RFID transponders and NFC tags. A transponder is a device that produces an identifying signal in reply to an interrogating established signal. In a transportations satellite, a transponder collects signals over a range of uplink frequencies and retransmits them on a different set of downlink frequencies to receivers on Earth, often without changing the content of the received signal or signals. Thus, this mode kinds NFC devices well-matched to existing contactless tokens [8] [9]. In this mode NFC devices allow to read/write information from/to NFC compatible tags [1].

The NFC device performs as a reader for NFC tags, such as the contactless smart cards and RFID tags. It senses a tag suddenly in nearness by using the collision avoidance tool. A request on an NFC device can read information from and write information to the identified tag using the read/write mode actions. Or figure 1 setup of reader/writer mode in step 1 when active device closely to passive device they will create electronic magnetic field and generate 13.56 MHz frequency. This electronic magnetic field helps to NFC tag to getting powered. Then active device read/write the data in NFC tag. The reader/writer mode is about the conversation of an NFC enabled equipment with an NFC tag for the purpose of either read/write information from or to those NFC tags. It inside describes two different modes: reader mode and writer mode [2].

Fig: 1 Setup of reader/writer mode

2.1.1. In Reader Mode

The originator reads information from an NFC tag which previously contains of the requested information. There are some condition or NFC tag previously store requested information. This NFC tag also contain or store driver which makes the requested information to the originator.

2.1.2. In writer Mode

Figure 2 in writer mode shows in 1 step mobile device perform as the initiator and writes information to the NFC tag. In 2 step NFC tag already contains of any data previous to the writing procedure, this data will be overwritten [2].
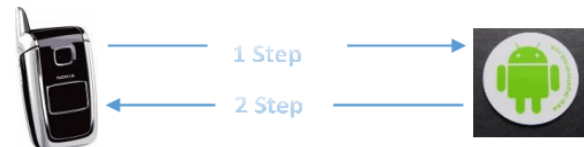

Fig: 2 Setup of writer mode

2.1.3. Application

Smart poster is a poster. NFC tag is mounted in smart poster. These tag store different type of program when NFC mobile phone close to the poster the program in tag will be activate. This is also called trigger. Smart poster is made on the bases of URL. Smart poster term refers to advertising materials or posters that are equipped with NFC tags. Those tags may contain different types of data such as a URL address, a couponing service, an SMS service, and so on[2]. The Smart Poster can also contain actions that will trigger an application in the device; for example, launching a browser to view a web site, or sending an SMS to a premium service to receive a ring tone. The Smart Poster concept is built around URIs (Uniform Resource Identifiers [RFC 3986]), which have develop the normal for referencing data around the Internet. URIs are very authoritative, and they can characterize everything from unique identifiers to EPC codes to web addresses to SMS messages to phone calls and beyond [10].

2.2. Peer to peer mode

In figure 3 shows peer to peer mode two NFC mobile device easily interact with each other and they can exchange information to each other such as whether to exchange business cards, photos, IDs or other type of personal information in "peer-to-peer" data transfers and data speed up to 424 Kbit/sec . This mode is based on ISO/IEC 18092 standard [11] [12].

NFCIP-1 and LLCP is two standard in peer to peer mode. In LLCP (Logical Link Control Protocol) standard device are identical in conversation. When starting process is complete, the result is complete by the application that is successively in the application layer NFCIP-1 takes benefit of the originator–target pattern in which the originator and the target devices are defined previous to early the communication [2]. In peer to peer mode data is exchange in bidirectional form, which means when one device is sending the data second device listen and first one is completed than second one is started to sending the data[13].

Peer to peer mode basically developed to exchange the data. There are various types of application developed in bases of all types of modes but in peer to peer mode less application developed as compare to other modes. Users exchanged their business cards by touching their NFC-enabled mobile phones. So benefits of peer-to-peer mode is able to deliver easy data exchange among devices [1].

Fig: 3 Peer to peer mode

2.2.1. Application

Exchanging Data in peer to peer mode data can easily exchange or transmit to one device to another device. When two NFC device exchange data to each other. The one mobile device transmit a radio signal to the other phone in the NFC radio field and initiates peer-to-peer communication. This operation is performed few centimeter or 4 inches. This is most important benefit to the user to assured his transmitting data is secure and safe. And transfer rate is very high approx. 424 Kbit/sec [2]

2.3. Card emulation mode

Card emulation mode delivers the opportunity for an NFC mobile phone to role as a smartcard [2]. In this situation an outside reader cannot differentiate between a smart card and an NFC mobile phone Mobile phone can even collected various smart card {NFC device security and privacy}. In This card emulation mode allow mobile phone user to perform a contactless business transaction, in the same technique smart cards are used today. This mode of process enables mobile devices to be used for ID, payment and access control applications [14]. Figure 4 shows setup of card emulation mode when NFC mobile phone closely to initiator, Initiator will generates 13.56 MHz magnetic field at that time NFC mobile phone read the information on the card. In this mode user replace all smart card to NFC enabled mobile phone. Because this mobile acts as a smart card. So user did not carry multiple smartcard. User carry mobile with them most of the time so link mobile phones with the human body fits with their use. One can expect that in the close future people will carry NFC enabled mobile phones not just to gain mobility but also to perform daily purposes as well. So in mobile phone embedded ticket, credit card, keys. Etc. Hence, there will be more chances to integrate daily objects into NFC enabled mobile phones in the future [2]. In this operational mode and NFC mobile device does not produce its individual RF field; the NFC reader creates this field instead because in card emulation mode NFC mobile phone acts as tag. Otherwise NFC mobile phone is reader [11] [2].
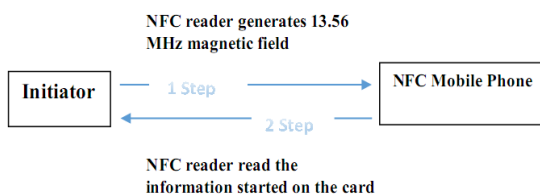

Fig: 4 Setup of Card Emulation Mode

2.3.1. Application

Access control use cases allow people to save their access control matters in their mobile phone. Examples of these cases contain electronic keys for cars, secure areas, and hotel. Hotel registration is an exciting use case that allows the room key to be conventional via OTA technology previous to entering at the hotel and straight inspection into the room. Thus there is no reason to spend time at the reception on arrival in this instance [2].

3. COMMUNICATION MODES

There are two type of communication modes. First one is active communication mode and second one is passive communication mode. These communications modes are catagiozed by self-radio frequency area. Devices that can create its radio frequency are called as active devices such as mobile. A device that uses other devices radio frequency is called as passive devices as tag [3].

3.1. Active communication mode

Active mode is where originator device and target device both conversation by initiating their self-electric magnetic fields [3]. In active mode device can conversation with other NFC-enabled devices and communication points to exchange documents bi-directionally. They permit people to entrance, for example, any documents from a "tap point" such as a public transport turnstile, or a so-called smart poster. A smart poster, for the most part, receipts the form of a poster or billboard in or on which clear NFC tags have been located. These NFC tags cover info which is read by your smartphone, such as the web address of the advertiser [14]. In active mode, both devices create an RF field. Each device communicates information by transforming its individual RF field, using an Amplitude Shift Keying (ASK) modulation pattern. To avoid crashes, only the transferring device produces a electromagnetic field; the getting object switches off its field while listening. If needed these characters can modification as often as necessary. Advantages compared to passive mode is a bigger working distance (up to 20 cm) and upper broadcast speeds (eventually over 1 MBit/sec) [15]. In active communication mode technique in NFC the mode of operation in ISO/IEC 18092 "Equipment to equipment communication" distance is 10cm [16].

3.2. Passive communication Mode

The initiator mobile device offers a carrier field and the objective device responses by modulating the present field. In this mode, the Objective device may draw its operating power from the Initiator-provided electromagnetic field, thus construction the Target device a transponder [5]. Or In passive mode only the equipment that initiate the conversation (the initiator) produces the 13.56 MHz carrier field. A target presented to this field may use it to draw energy but must not produce a carrier field at its individual. The originator transmissions information by straight modulating the field, the target by load-modulating it. In both ways the coding complies with ISO14443 or Felicia, correspondingly. This mode permits NFC-devices to

connect with present contactless smart cards. The term load modulation defines the effect of load changes on the originator's carrier field's amplitude. These changes can be perceived as info by the initiator. Depending on the size of the coils, ranges up to 10 cm and data rates of 106, 212, and 424 Kbit/sec are possible [15]. In passive communication mode technique in NFC, the mode of operation in ISO/IEC 14443 and IOC/IEC 15693 "Reader to Tag communication (Proximity Coupling Device1 mode)" and "Reader to Tag communication (Vicinity Coupling Device2 mode)" distance is 10cm and 1 m [16].

4. RFID TECHNOLOGY

The invention of RFID technology in the 19th century when luminaries of that era made great scientific advances in electromagnetism [17]. The RFID technology is a means of collecting information nearly an assured article without the want of touching the information carrier, through the usage of inductive coupling or electromagnetic waves. The information carrier is a microchip mounted to an antenna the latter allowing the chip to communicate info to a reader (or transceiver) within an assumed range, which can forward the info to a host computer. The middleware and the tag can be improved by data encryption for security-critical application at an additional cost, and anti-collision algorithms may be applied for the tags if numerous of them are to be read concurrently [18]. In various types of RFID, they will uses in different application. Various RFID system has various power bases. The properties and regulatory limits of a specific RFID system will control its developed costs, physical specifications, and performance. Some of the most familiar RFID applications are item-level tagging with electronic product codes, closeness cards for physical access control, and contact-less payment systems. Many more applications will become economical in the coming years [17]. Main advantage of RFID is to give unique identification. One possible method to item identification is the EPC (Electronic Product Code), providing a uniform number in the EPC global Network, with an Object Name Service (ONS) allowing the adequate Internet addresses to access or update instance-specific data. However, currently, ONS cannot be used in a worldwide environment, and since it is a proprietary service, its use is relatively expensive, especially for participants with restricted resources such as SMEs [18].

4.1. Working of RFID Technology

RFID is based on radio frequency communication. When RFID reader produces energy when radio waves produces on RFID reader on dedicated frequency, which is used to power and conversation on RFID tags. As the radio waves propagate through the environment, their energy gradually dissipates – so a tag that is beyond a certain distance from the RFID reader will not be able to choice up sufficient signal to run consistently. A typical range for a passive RFID system will be anywhere between a few centimetres and a few meters. If a battery is incorporated into the tag, the range is increased dramatically, too many tens of meters or more [19].

4.2. Comparisons of RFID and Barcode

Table No. 1 Comparisons of RFID and Barcode [19].

Categorized	RFID	Barcode
Identifying a computer system	Tag	Label
Economic region	Information store in RFID is change time to time. So it is better to economic region.	Once information is store in barcode. This information is permanent. So it is not better to economic region.
Scanning Process	Easy, because RFID tag is scanned automatically without human involment.	Typical, barcode have to be scanned purposely by a user in a process that is typically hard to user.
Requirement or orientation range of scanning	RFID tag can be read in any orientation to the reader range.	Barcode required line if sight to read.
Environment friendly	RFID is able to operate in rough environment	Barcode not work well if they will dirty, damaged.

4.3. RFID Tag

RFID is most important technology. In RFID there are three types of tag. But passive tag is most common tag in environment.

4.2.1. Passive tag

In passive tag is getting power to creating RF energy to the active device. Range of passive tag is very short approx. >10m. But this is very cheapest compare to the other RFID tag. And this tag only use to communicate in response only [17].

4.2.2. Semi-Passive tag

In semi-passive tag is operate by battery. Range of semi-passive tag is long as compare to passive tag. approx. >100m. But this is expensive compare to the other passive tag. And this tag only use to communicate in response only [17].

4.2.3. Active tag

In active tag is operate by battery. Range of active tag is very long as compare to other RFID tag. approx. >100m. But this is most expensive compare to the other type of RFID tag. And this tag use to communicate in response and initiate only [17].

4.4 Application

One of the first applications of a radio frequency identification system was in "Identify Friend or Foe" (IFF) systems used by the British Royal Air Force during World War II. IFF permitted radar operators and pilots to robotically differentiate friendly aircraft from opponents via RF signals. IFF structures helped defence "friendly fire" cases and aided in interrupting opponent aircraft. Progressive IFF systems are used today in aircraft, although much of the technology remains confidential [17].

5. CONCLUSION

NFC technology is very useful in today's life. People go to the bus stop and buy a ticket with the help of the NFC enabled mobile phone. So there are various benefits related to the NFC technology which is based on various NFC modes. Modes in NFC are divided in to two parts. Operating modes and communication modes. Communication modes help to setup connection between mobile to mobile or NFC tag. NFC technology is based on RFID technology. RFID technology is very easily operatable by user. In current world wall mart is using RFID technology. Applications in NFC is very easily handled by a user.

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