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Comparative Review Of Existing Mobile Payment Systems

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Abstract:

The term "mobile phone" has become a heart for humans to survive in technical opportunity. Today the mobile phone is not only a full communication platform with email, instant messaging, video calls, and a social media interface, it also offers functional applications like navigation, e-commerce. In short, the Smartphone has become the most successful "functionality aggregator"**.** Mobile payment, also referred to as mobile money, mobile money transfer, and mobile wallet, generally it is refer to payment services operated from or via a mobile device [1]. In this paper, we will discuss about mobile payment technologies their characteristics which are required to be used by mobile payment systems, common-uncommon things among them and advancement in the system. We will also look a complete comparison between the commonly used technologies like: Bluetooth, Infrared data association (IrDA), Radio Frequency Identification (RFID) and Near Field Communications (NFC) according to the most common factors which affect the quality of mobile payment systems presented. In this paper evaluations of the advantages and issues involved with using these technologies are also presented.

1. INTRODUCTION

Mobile payments are payments for goods and services with a mobiledevice by takingadvantage of wireless and other communication technologies. Mobile payments can become advancement to cash, cheques, credit cardsand debit cards. It can also be used for payment of E-Bills with access to account-based payment method such as E-funds transfer, Internet banking, and direct debit payments, both at owner and vendor machines. A mobile payment as any other payment is carried out by using a specific payment instrument such as cash, credit card, or mobile phone wallet. In addition to pure mobile payment instruments, most electronic and many physical payment instruments have been“mobilized”. Payments fall broadly into two categories viz., payments for purchases andpayments of bills/invoices. In payments for purchases mobile payments compete with orcomplement cash, checks, credit cards, and debit cards. In payments of bills/invoices mobile payments typically provide access to account based payments such as money transfers, Internet banking payments, or direct debit assignments. The typical usage entails the user electing to make a mobile payment, being connected to a server via the mobile device to perform authentication and authorization, and subsequently being presented with confirmation of the complete transaction. A mobile payment service comprises of all technologies that are offered to the user as well as all tasks that the payment service providers perform to commit payment transactions. In this paper, all different methods which are already implemented on mobile payments and what all features are common and uncommon among them are represented. Here, a comparison between different proximity technologies used in mobile payment system and givesbest suited results among them.

2. FEATURES OF MOBILE PAYMENT

2.1 Universal Usage:

The payment system should provide ease for transactions between one customer to another customer, or from an owner to a customer or between owners. The system coverage should include domestic, regional and global environments. Payments must be possible in terms of both low value payments and high value payments.

2.2 Cost:

The m-payments should not be costlier than existing payment mechanisms. The mobile payment system should compete with other modes of payment in terms of cost.

2.3 Speed:

The speed at which m-payments are executed must be acceptable tocustomers and merchants.

2.4 Platform Independent (Interoperability):

Development should be based on standards and open technologies that allow one to implement the system to interact with other systems.

2.5 Security:

A customer must be able to trust a mobile payment application provider that his or her credit or debit card information may not be misused. Secondly, when these transactions become recorded customer privacy should not be lost in the sense that the credit histories and spending patterns of the customer should not be openly available for public scrutiny. Mobile payments have to be as anonymous as cash transactions. Thirdly, the system should be fool proof, resistant to attacks from hackers and terrorists. This may be provided by using public key infrastructure security, biometrics and passwords integrated into the mobile payment solution architectures.

3. MOBILE PAYMENT METHODS

The mobile payment technologies are used in order to meet the needs of data transfer from business and personal perspectives. The mobile payment had been implemented using different system which is explained accordingly.

3.1 IVR (Interactive Voice Response):

It is a telephony technology in which someone uses a touch-tone telephone to interact with a database to acquire information from or enter data into the database. IVR technology does not require human interaction over the telephone as the user's interaction with the database is predetermined by what the IVR system allows the user access to. It operates through pre-specified numbers that banks advertise to their customers. Customer's make a call at the IVR number and are usually greeted by a stored electronic message followed by a menu of different options. Customers can choose options by pressing the corresponding number through keypads, and then the corresponding information is read out, mostly using a text to speech program.

- **Limitations:**

The greatest disadvantage of IVR systems is that it can be only used for Enquiry based System and voice call involve in this system makes it more expensive as compared to SMS and WAP based system.

3.2 SMS/USSD- Based Transactional payment

3.2.1 SMS (Short Messaging Service)

In the predominant model for SMS payments, the consumer sends a payment request via an SMS text message or an USSD to a short code and a premium charge is applied to their phone bill or their online wallet. The merchant involved is informed of the payment success and can then release the paid for goods.

- **Limitation:**

This feature is related to text services only so its quite slow and network dependent.

3.2.2 MMS(Multimedia Messaging Service)

A Multimedia Messaging Service can also deliver barcodes which can then be scanned for confirmation of payment by a merchant. This is used as an electronic

ticket for access to cinemas and events or to collect hard goods. Since a trusted physical delivery address has typically not been given, these goods are most frequently digital with the merchant replying using a Service to deliver the purchased music, ringtones, wallpapers etc.

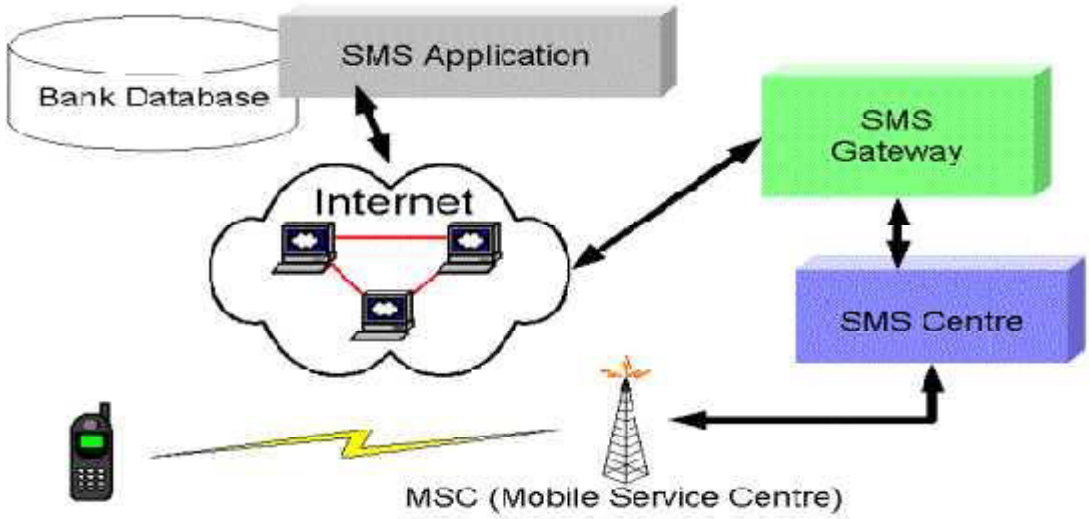

Figure 1: SMS Architecture [5]

- **Limitation:**

The major concern about this system is security, that's why it couldn't succeed.

3.2.3 Mobile Web Payments (WAP)

The next type of mobile payment is using the Wireless Application Protocol (WAP). In this scheme, the user connect to the banks by using WAP gateway and can do the transaction online. WAP sites offer the familiar form based interface and can also implement security quite effectively. The actual forms are stored into a mobile application on a WAP server, and served on demand. The WAP Gateway forms an access point to the Internet from the mobile network.

- **Limitation:**

The mobile account is directly charged through a mobile network operator, the use of a credit/debit card or pre-registration at online payment solution such as PayPal is still required just as in a desktop environment.

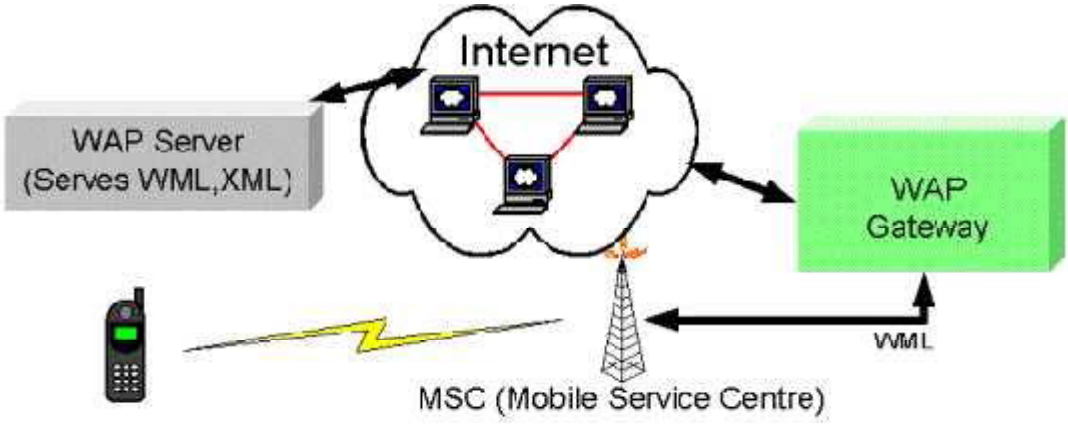

Figure 2: WAP Architecture [3]

3.2.4 Phone-Based Application

Phone-Based applications are the ones that are most suitable to implement complex banking transactions like trading in securities etc. They can be easily customized according to the user interface complexity supported by the mobile. In addition, mobile applications enable the implementation of avery secure and reliable system. The important requirement is that it should be installed on client and merchants mobile device.

- **Limitation:**

The major disadvantage of mobile application clients is that the applications needs to be customized to each mobile phone on which it might finally run.

3.2.5 Cloud-based Mobile Payment

Cloud-based mobile payments store your payment information "in the cloud" (i. e. on a remote server), and not on your mobile device. Consumers can typically register one or more payment accounts to be used with the mobile wallet including bank accounts, credit and debit cards, pre-paid cards, store cards, gift cards, and loyalty cards. Most commonly, the consumer accesses their mobile wallet from an application on their mobile device. During registration, the consumer can typically set up a username, password, or PIN to secure access to their wallet – credentials that are stored in the cloud as well. Once the account is set up, there are several methods to employ the wallet from a mobile device to complete an in store payment. In each case, the customer's registered account is debited at the time of transaction.

- **Limitation:**

The major concern in this type of system is Security. All the account related information of clients and merchants are stored on cloud and encryption of this information should be strict.

3.2.6 Audio Signal-based Payments

The audio channel of the mobile phone is another wireless interface that is used to make payments. Several companies have created technology to use the acoustic features of cell phones to support mobile payments and other applications that are not chip-based. The technologies Near sound data transfer (NSDT), Data Over Voice and NFC 2. 0 produce audio signatures that the microphone of the cell phone can pick up to enable electronic transactions.

- **Limitation:**

As the name suggest it will be totally dependent on audio signal for transaction.

3.2.7 Wireless Technologies used in Mobile Payment

The different types of wireless technologies are explained below:

a. Bluetooth

Bluetooth wireless technology is a cable replacement technology that provides wireless communication between portable devices, desktop devices and peripherals. It is used to swap data and synchronize files between devices without having to connect each other with cable. The wireless link has a range of 10m which offers the user mobility. This technology can be used to make wireless data connection to conventional local area networks (LAN) through an access point. There is no need for the user to open an application or press button to initiate a process. Bluetooth wireless technology is always on and runs in the background. Bluetooth devices scan for other Bluetooth devices and when these devices are in range they start to exchange messages so they can become aware of each other's capabilities. These devices do not require a line of sight to transmit data with each other. Bluetooth is the official name for characteristics of wireless technology that lets any Bluetooth enabled devices communicate with each other in short distance by using a secure radio frequency (RF). In addition to the easy of connectivity with Bluetooth, communications are secure, inexpensive, and execute at a fairly high data transmission rate without both the devices in the lineof sight. All these characteristics make Bluetooth asuitable technology for multiple situations. As Bluetooth wireless technology is included in more personal mobile devices, it provides newpossibilities for those mobile devices. One of such possibilitiesis using a mobile device as a method of payment application for goods and services and for many other mobile applications. Any terminal that is used for payment transactions could incorporate Bluetooth wireless technology and thus connect to other Bluetooth devices to execute retail transactions. A mobile phone or other Bluetooth enabled device could be used to pay for goods and services using Bluetooth communication links with a cash register.

- **Limitations:**

The major disadvantage of Bluetooth technology is that the connection between two medium is not constant, it means connection can be dropped by small interruption. The drawback with Bluetooth 2. 1 was authentication but in later versions of Bluetooth this encryption problem has been solved.

Class	Maximum Permitted Power		Range (approximate)
	mW	dBm	
Class 1	100 mW	20 dBm	~100 metres
Class 2	2.5 mW	4 dBm	~10 metres
Class 3	1 mW	0 dBm	~1 metres

Figure3: Different Classes of Bluetooth [5]

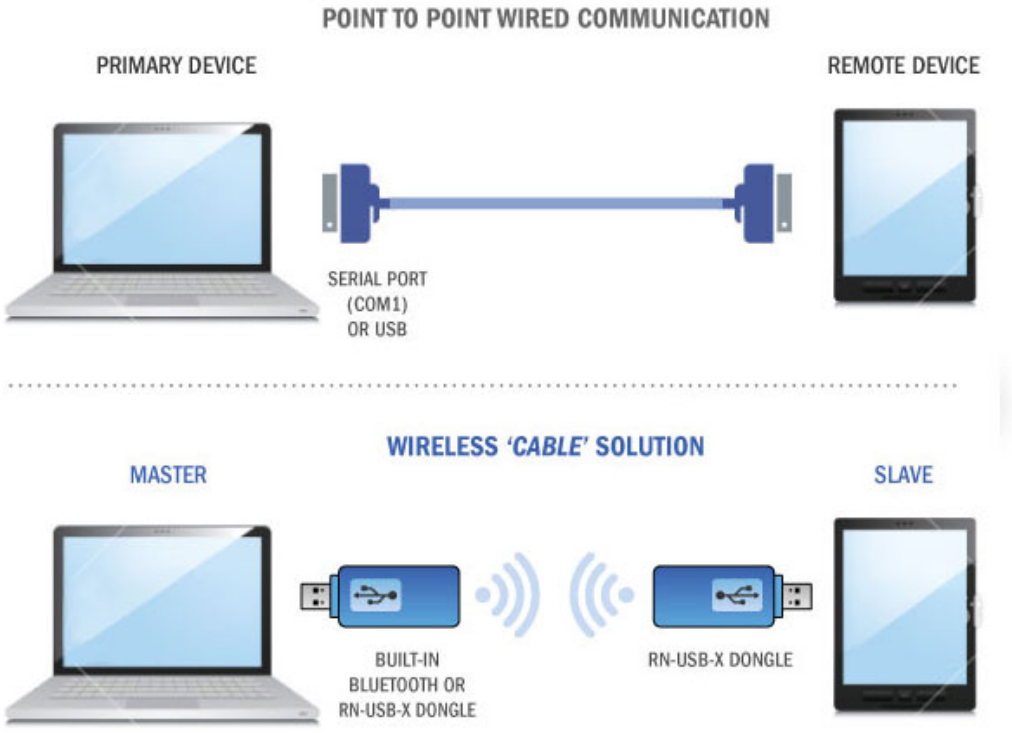

Figure 4: Bluetooth Connectivity [21]

b. Infrared (IrDA)

Infrared connectivity is an old wireless technology used to connect two electronic devices. It uses a beam of infrared light to transmit information and so requires direct line of sight and operates only at close range. IR was superseded by Bluetooth, which has the advantage of operating at longer distances (around 30 feet) and being Omni-directional. Infrared is electromagnetic energy at a wavelength or wavelengths

somewhat longer than those of red light. The shortest-wavelength IR borders visible in theelectromagnetic radiation spectrum;the longest-wavelength IR borders radio waves[12]**.** IR wireless is used for short- and medium-range communications and control. Some systems operate in *line-of-sight mode*; this means that there must be a visually unobstructed straight line through space between the transmitter(source) and receiver (destination). Other systems operate in*diffuse mode*, also called *scatter mode*. This type of system can function when the source and destination are not directly visible to each other. An example is a television remote-control box. The box does not have to be pointed directly at the set, although the box must be in the same room as the set, or just outside the room with the door open.

- **Limitations:**

IR communications or control is generally not possible between different rooms in a house or between different houses in a neighbourhood (unless they have facing windows).

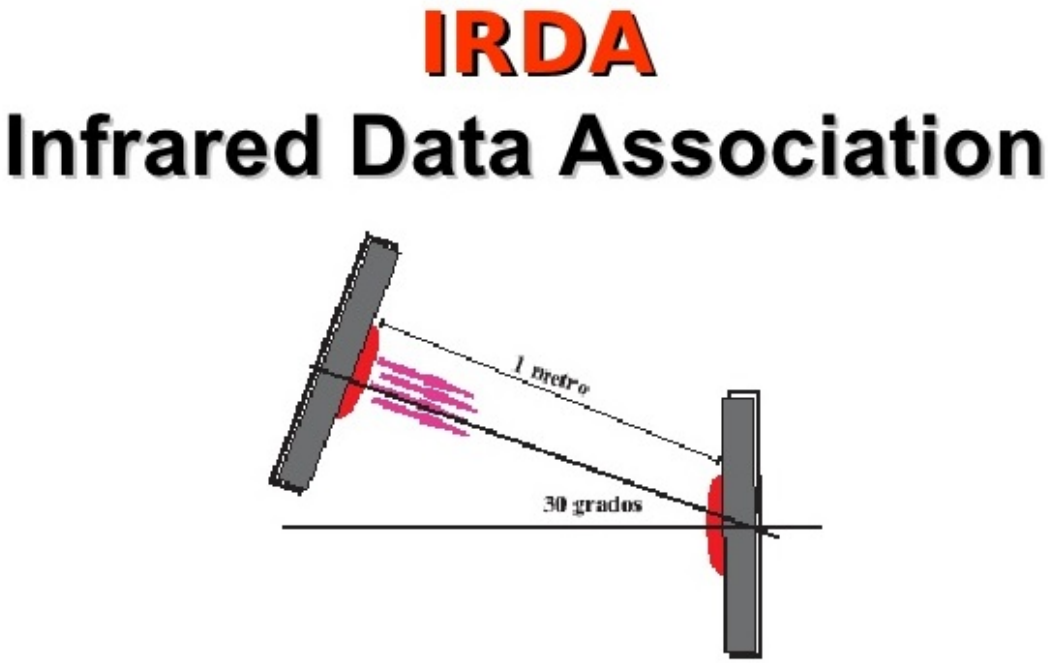

Figure 5: IrDA Working [20]

c. RFID Radio Frequency Identifications (RFID)

RFID systems consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted. RFID systems can be used just about anywhere, from clothing tags to missiles to pet tags to food -anywhere that a unique identification system is needed. The tag can carry information as simple as a pet owners name and address or the

cleaning instruction on a sweater to as complex as instructions on how to assemble a car. Some auto manufacturers use RFID systems to move cars through an assembly line. At each successive stage of production, the RFID tag tells the computers what isthe next step of automated assembly [13]**.** RFID tags are built in the form of labels and placed on the objects which are going to be managed [14]. RFID tags can be distinguished into two categories depending on their data storage capability: Read-Only and Read/Write Tags. Most Read-Only tags do not have data storage capacity. They only have a unique ID pre-written to them which points to a database, thus providing information about the object the tag is attached to [14]. The main advantages of RFID system are the non-contact and non-line-of-sight characteristics of the technology. Tags can be read through a variety of visually and environmentally challenging conditions such as snow, ice, fog, paint, grime, inside containers and vehicles and while in storage. With a response time of less than 100ms, an RFID reader can read many (several hundred) tags virtually instantaneously. Tags coupled with sensors can provide important information on the state of the goods.

- **Limitations:**

RFID chips have high power consumption and therefore result in reduced battery life theyalsoadd an addition cost to the mobile phone. It's a combination of these factors that have prevented RFID chips been included in all mobile phones.

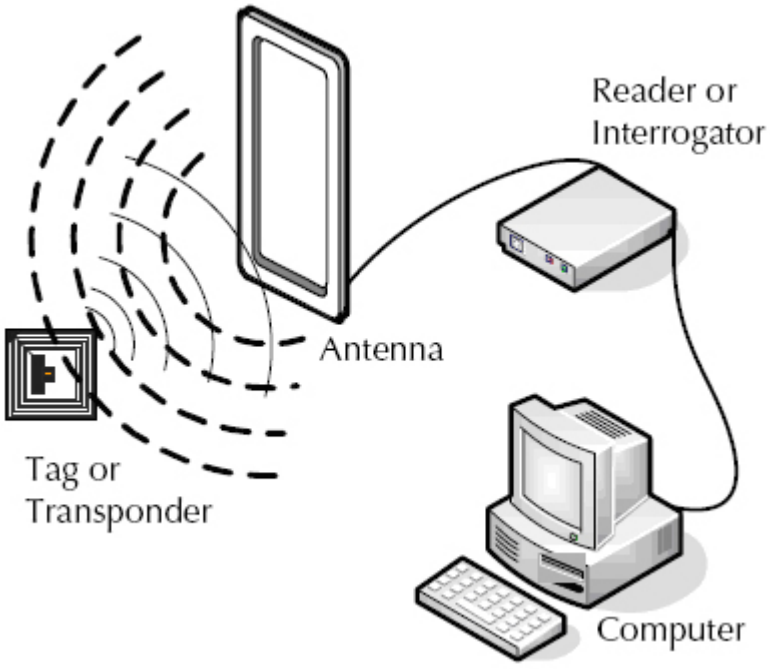

Fig 6: RFID Architecture [18]

d. Near Field Communication (NFC)

Near field communication (NFC) is a set of ideas and technology that

enables Smartphone and other devices to establish radio communication with each other by touching them together or bringing them into proximity, typically a distance of 10 cm (3. 9 in) or less. Each full NFC device can work in 3 modes: NFC target (acting like a credential), NFC initiator (as a reader) and NFC peer to peer. Most of the first business models like advertisement tags or other industrial applications have not been successful, always overtaken by another technology (3D barcodes, UHF tags)**[15].** NFC is the fusion of contactless smartcard (RFID) and a mobile phone. The mobile phone can be used as a contactless card. NFC enabled phones can act as RFID tags orreaders. NFC chips are embedded within mobile hand-sets enabling them to read NFC tags. Mobilephone industry has shown several NFC mobile phones manufactured in last few years. It isalso possible to include NFC chip within Subscriber Identity Module (SIM) card or even inmicro SD cards. Therefore, hand-sets manufactured without NFC chips from industry canalso be made 'NFC-equipped' by inserting NFC-SIM or NFC-micro SD cards **[16]**. Most popular usage of NFC has been in mobile payment solution. NFC handsets can workin a card emulation mode. It could emulate credit cards, point cards, etc. from several vendorsin a single device. This enables users from hassle free hold of their money. Even with themobile handsets, especially Smartphone, there are various applications dedicated forpayments. Several banks provide SMS banking for their customers. Infrared enabled POSterminals are popular in many countries. Especially, in mobile payment solution, there hasbeen advent of many techniques for customers **[16]**.

- **Limitations:**

It only works at very short distances.

NFC-Forum standard	Polling or listening	Coding	Modulation	Data rate	Carrier frequency
NFC-A	Polling	Modified Miller	ASK 100%	106 kbits/s	13.56 MHz
NFC-A	Listening	Manchester	Load (ASK)	106 kbits/s	13.56 MHz + 848-kHz sub-carrier
NFC-B	Polling	NRZ-L	ASK 10%	106 kbits/s	13.56 MHz
NFC-B	Listening	NRZ-L	Load (BPSK)	106 kbits/s	13.56 MHz + 848-kHz sub-carrier
NFC-F	Polling	Manchester	ASK 10%	212/424 kbits/s	13.56 MHz
NFC-F	Listening	Manchester	Load (ASK)	212/424 kbits/s	13.56 MHz (no subcarrier)

Figure 7: Different Variants of NFC [1]

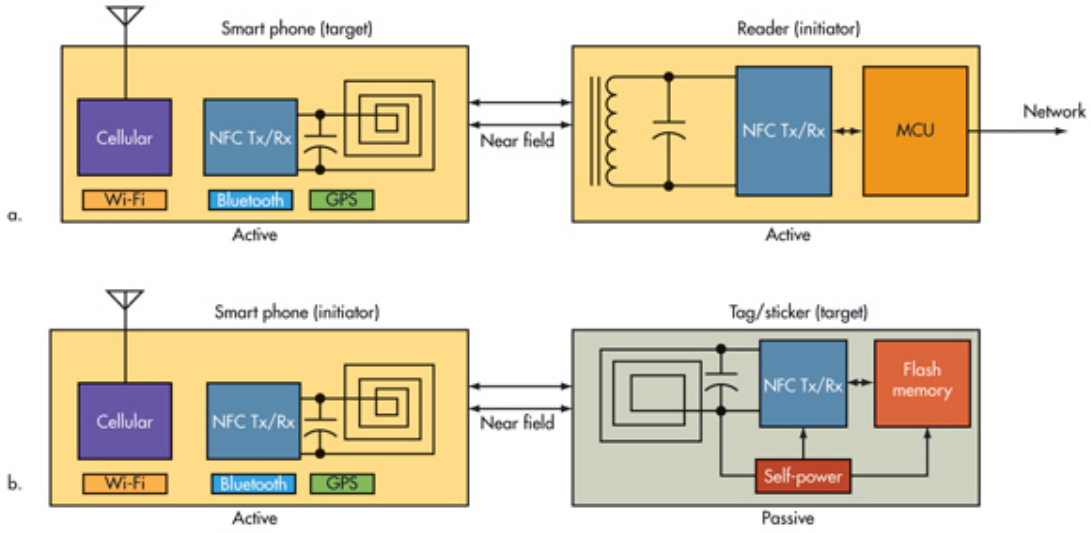

Figure 8: NFC Architecture [17]

4. COMPARATUVE DETAILS BETWEEN DIFFERENT TYPES OF WIRELESS TECHNOLOGIES

	BLUETOOTH	**NFC**	**RFID**	**INFRARED**
Range	Upto 100M	Upto 0. 1M	Upto 1M	Upto 2M
Network type	Point to Multiple	Point to Point	Point to Point	Point to Point
Communication	Two way	Two way	One way	One way
Data transfer rate	Upto 24Mbps	Upto 424Kbps	Upto 128Kbps	Upto 16Mbps
Line of Sight required	No	Yes	Yes	Yes
Authentication & Encryption	Yes	Yes	Yes	No
Availability in Consumer Devices	High	Moderate	Very Low	Low
Cost effectiveness	Low	High	High	Low
Operating frequency	2. 4GHz	13. 56MHz	13. 56MHz	38KHz

Figure 9: Comparative details about wireless technologies[5]

5. Conclusion

This paperpresents comparative details about existing mobile payment system. It is

clear and obvious that wireless technologies are superior as compared to other technologies described in this paper for implementation of mobile payment system. The figure 9 compares several different types of wireless technologies that can be used for mobile payments and deducing from this figure and other aforementioned details, it is certain that Bluetooth technology is the most viable solution to implement a mobile payment system.

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