

EMERGENCE OF PAYMENT SYSTEMS IN THE AGE OF ELECTRONIC COMMERCE: THE STATE OF ART

Singh Sumanjeet¹
University of Delhi, India.

E-mail: sumanjeetsingh@gmail.com

ABSTRACT

The emergence of e-commerce has created new financial needs that in many cases cannot be effectively fulfilled by the traditional payment systems. Recognizing this, virtually all interested parties are exploring various types of electronic payment system and issues surrounding electronic payment system and digital currency. Broadly electronic payment systems can be classified into four categories: Online Credit Card Payment System, Online Electronic Cash System, Electronic Cheque System and Smart Cards based Electronic Payment System. Each payment system has its advantages and disadvantages for the customers and merchants. These payment systems have numbers of requirements: e.g. security, acceptability, convenience, cost, anonymity, control, and traceability. Therefore, instead of focusing on the technological specifications of various electronic payment systems, the researcher have distinguished electronic payment systems based on what is being transmitted over the network; and analyze the difference of each electronic payment system by evaluating their requirements, characteristics and assess the applicability of each system.

Key Words: E-Commerce, Payment, Debit Cards, Credit Cards, Internet

JEL Codes: E41; L21; O30, O33

1. INTRODUCTION

As payment² is an integral part of mercantile process, electronic payment system is an integral part of e-commerce. The emergence of e-commerce (table 1) has created new financial needs that in many cases cannot be effectively fulfilled by traditional payment systems. For instance, new types of purchasing relationships-such as auction between individuals online-have resulted in the

¹ Dr. Sumanjeet is an Assistant Professor, Department of Commerce, Ramjas College, University of Delhi, North Campus, Delhi-7, INDIA

² Payment represents both cash and non-cash financial transactions, which take place between two or more parties. But, in a strict sense of word 'payment' represents only non-financial transaction. It is more common for two parties exchanging value to hold accounts with alternative banks, in which both banks become the parties of payment.

need for peer-to-peer³ payment methods that allows individuals to e-mail payments to the other individual. Recognizing this, virtually all interested parties (i.e. academicians, government, business community and financial service providers) are exploring various types of electronic payment system and issues surrounding electronic payment system and digital currency. Some proposed electronic payment systems are simply electronic version of existing payment systems such as cheques and credit cards, while, others are based on the digital currency technology and have the potential for definitive impact on today's financial and monetary system. While popular developers of electronic payment system predict fundamental changes in the financial sector because of the innovations in electronic payment system (Kalakota & Ravi, 1996). Therefore, electronic payment systems and in particular, methods of payment being developed to support electronic commerce cannot be studied in an isolation. A failure to take place these developments into the proper context is likely to result in undue focus on the various experimental initiatives to develop electronic forms of payment without a proper reflection on the broader implications for the existing payment system.

Table 1: B2C E-Commerce Sales* in the Select Countries (US Billion)
(Asia Pacific Region, 2006-2011)

Countries	2006	2007	2008	2009	2010	2011
Australia	9.5	13.6	20.4	26.4	28.7	31.1
China**	2.4	3.8	6.4	11.1	16.9	24.1
India	0.8	1.2	1.9	2.8	4.1	5.6
Japan	36.8	43.7	56.6	69.9	80.0	90.0
South Korea	9.6	10.9	12.4	14.0	15.9	17.9
Asia-Pacific	59.1	73.3	97.7	124.1	145.5	168.7

Note: Converted at average annual exchange rates (projected for future year): Total B2C sales include all purchase made on a retail website, regardless of device used to complete the transaction;

*Includes online travel, event tickets and digital download sales; **excludes Hong Kong

Source: eMarketer, January 2008

A. Concept and Size of Electronic Payment

Payment systems that use electronic distribution networks constitute a frequent practice in the banking and business sector since 1960s⁴, especially for the transfer of big amounts of money. In the four decades that have passed since

³ Peer-to-peer refers to the design of a service that does not rely on centralized networking services such as D.N.S. (Domain Name System-a unique name of collections of computers connected to networks such as Internet) to connect and users' computers and accounts for the unpredictable accessibility of these end nodes in making connections between the users. Participants in the peer-to-peer network, whether individual or companies, exchange information directly with one another, bypassing central exchanges. In short, peer-to-peer is more of a bazaar what customers will find until he/she get there.

⁴ BankAmerica, in Fresno, California, executes the first mass mailing of credit cards in (1960); Westminster Bank installs first automated teller machine (ATM) at Victoria, London Branch in 1967.

their appearance, important technological developments⁵ have taken place, which on the one hand have expanded the possibilities of electronic payment systems and on the other hand they have created new business and social practice, which make the use of these systems necessary. These changes, naturally, have affected the definition of electronic payments⁶, which is evolving depending on the needs of each period. In its, most general form, the term electronic payment includes any payment to businesses, bank or public services from citizens or businesses, which are executed through a telecommunications or electronic networks using modern technology. It is obvious that based on this definition, the electronic payments that will be the objects of present result, are the payment that are executed by the payer himself, whether the latter is a consumer or a business, without the intervention of the another natural person. Furthermore, the payment is made from distance, without the physical presence of the payer and naturally it does not include cash. By providing such definition for the electronic payment system, researcher include the transfer of information concerning the accounts of the parties involved in the e-commerce transactions, as well as the technological means of distribution channels through which the transactions is executed.

Size of Electronic Payments: Electronic payment system is conducted in different e-commerce categories such as Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Business (C2B) and Consumer-to-Consumer (C2C). Each of which has special characteristics that depend on the value of order. Danial, (2002) classified electronic payment systems as follows:

- Micro Payment (less than \$ 10) that is mainly conducted in C2C and B2C e-commerce.
- Consumer Payment that has a value between \$ 10 and \$ 500. It is conducted mainly in B2C transactions.

⁵ In the year, 1967, the New York Clearing House launched CHIPS (Clearing House Interbank Payment System) which provides US Dollar funds –transfer and transactions settlements online and in real time. In the late 1970s, Chemical Bank launched its Pronto system providing 3,000 computer terminals to customers' home linked to its central computers by telephone. It offers a range of facilities: balance inquiries, money transfer between Chemical Bank accounts, and bill payments to selected local stores. The stumbling blocks for the first generation home building system in general was who is to pay for terminals at home. In the year 1985, EDI (Electronic Data Interchange) extensively used in bank-to-bank payment systems. In 1994, digital cash trails by DigiCash of Holland conducted online. And in the year 1995, Mondex electronic currency trails begin in Sweden, England.

⁶ A real revolution in the meaning of electronic payment system came with the development of EFT (Electronic Fund Transfer) technology. EFT is a technology (one of the electronic commerce technologies) that allows the transfer of funds from the bank account of the one person or organization to that another. EFT is also used to refer to the action of using this technology. It is an important addition in organization that implements EDI in their organization. Consequently, the online remittance of funds appeared to be the next logical step in a progressive move towards the electronic funds transfer and banking, a process that had begun long before the Internet itself. There is, however, a crucial distinction between the pre-Internet electronic fund transfer system and the online payment system being used and developed in the conjunction with e-commerce. The former took place almost exclusively over proprietary networks, which the latter occur over a publicly accessible electronic medium.

- Business Payment that has the value more than \$ 500. It is conducted mainly in B2B e-commerce.

B2B transactions account about 95% of e-commerce transactions, while others account about 5% (Turban et al, 2004). P2P, which is related to the C2C category transactions, is relatively small due to its stiff usability. Further, Cavarretta and de Silva (1995), identify three classes of typical electronic transactions:

- Tiny value transactions: below \$1.
- Medium value transactions: between \$ 1 and \$ 1,000
- Large value transactions: above \$ 1,000.

Systems that can support tiny value transactions have to trade-off between conveniences of transactions (the major part of a cost in an extremely cheap transaction) vs. the security or durability of transactions. On the other side of the amount range, large value transactions will require highly secure protocols whose implementations are costly: be on-line and/or carry traceability information. Finally, nearly all the system can perform medium value transactions.

B. Conventional vs. Electronic Payment System

To get into the depth of electronic payment process, it is better to understand the processing of conventional or traditional payment system. A conventional process of payment and settlement involves a buyer-to-seller transfer of cash or payment information (i.e., cheque and credit cards). The actual settlement of payment takes place in the financial processing network. A cash payment requires a buyer's withdrawals from his/her bank account, a transfer of cash to the seller, and the seller's deposit of payment to his/her account. Non-cash payment⁷ mechanisms are settled by adjusting i.e. crediting and debiting the appropriate accounts between banks based on payment information conveyed via cheque or credit cards.

⁷ Non-cash payment requires three separate elements. The buyer must have an agreed means of payment authorization and instructing its bank to affect a transfer of funds. The seller's bank and buyer's bank need an agreed method of exchange payment instructions. This is referred to as payment clearing.

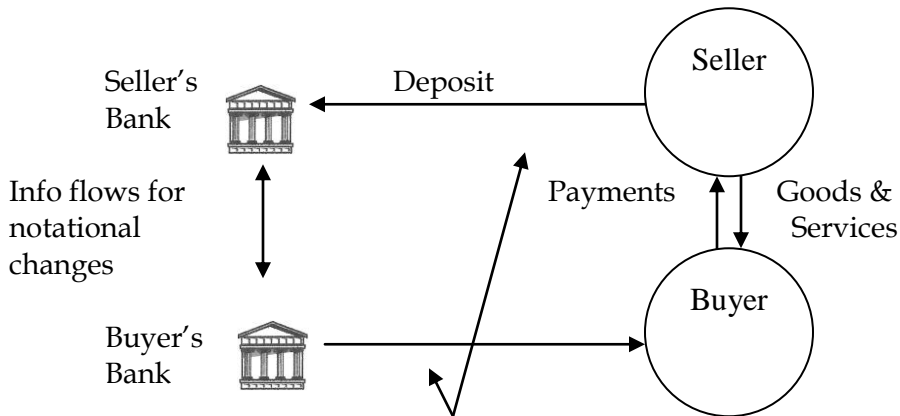
Figure 1: Conventional/Traditional Payment System

Figure 1 is simplified diagram for both cash and non-cash transactions. Cash moves from the buyers' bank to sellers' bank through face-to-face exchange in the market. If a buyer uses a non-cash method of payment, payment information instead of cash flows from the buyer to the seller, and ultimate payments are settled between affected banks, who notationally adjust accounts based on payment information⁸.

C. Process of Electronic Payment System

Electronic payment systems have been in operations since 1960s and have been expanding rapidly as well as growing in complexity. After the development of conventional payment system, EFT (Electronic Fund Transfer) based payment system came into existence. It was first electronic based payment system, which does not depend on a central processing intermediary⁹. An electronic fund transfer is a financial application of EDI (Electronic Data Interchange), which sends credit card numbers or electronic cheques via secured private networks between banks and major corporations. To use EFT to clear payments and settle accounts, an online payment service will need to add capabilities to process orders, accounts and receipts. But a landmark came in this direction with the development of digital currency¹⁰. The nature of digital currency or electronic money mirrors that of paper money as a means of payment. As such, digital

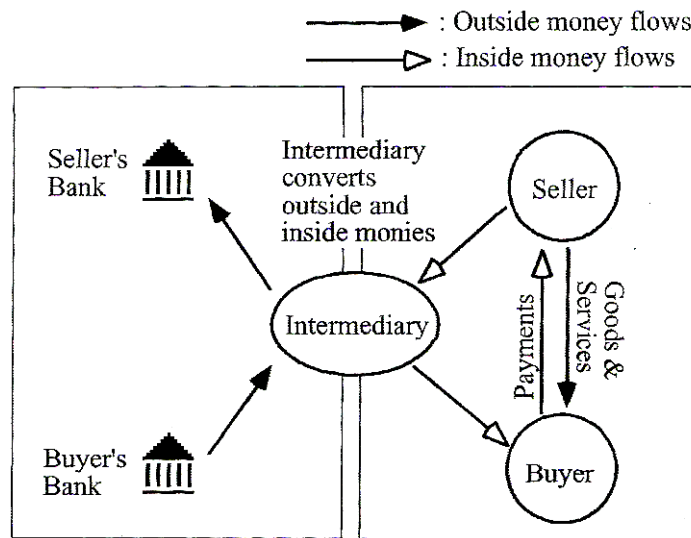
⁸ In real markets, this clearing process involves some type of intermediaries such as credit card services or cheque processing clearing companies. Schematically most payment systems are based on similar process.

⁹ In this case, intermediary acts as a centralized commerce enabler maintaining membership and payment information for both sellers and buyers. A buyer need only send the seller his identification number assigned by the intermediary.

¹⁰ Development in cryptography (science of disguising message to only the writer and the intended receivers are able to read them) has brought a new kind of money: the digital currency (e.g. DigiCash System {Chaum, (1992)}, the CAFÉ Project {Boly *et al.*, (1994)} and Mondex. The digital currency, encoded strings of digits, can be carried on a smart card or stored on a computer disk. Like a travelers' cheque, a digital coin is a floating claim on a bank or other financial institution that is not linked to any particular account..

currency payment systems have the same advantages as paper currency payment, namely anonymity and convenience. As in other electronic payment systems (i.e. EFT based and intermediary based) here too security during the transaction and storage is a concern, although from the different perspective, for digital currency systems double spending, counterfeiting, and storage become critical issues whereas eavesdropping and the issue of liability (when charges are made without authorizations) is important for the notational funds transfer. Figure 2 shows digital currency based payment system.

Figure 2: Electronic Payment System



In this figure, it is shown that intermediary acts as an electronic bank, which converts outside money (e.g. Rupees or US \$), into inside money (e.g. tokens or e-cash), which is circulated within online markets. However, as a private monetary system, digital currency has wide ranging impact¹¹ on money and monetary system with implications extending far beyond more transactional efficiency.

II. TYPES OF ELECTRONIC PAYMENT SYSTEMS

With the growing complexities in the e-commerce transactions, different electronic payment systems have appeared in the last few years. At least dozens of electronic payment systems proposed or already in practice are found (Murthy, 2002). The grouping can be made on the basis of what information is being transferred online. Murthy (2002) explained six types of electronic payment systems: (1) PC-Banking (2) Credit Cards (3) Electronic Cheques (i-

¹¹ Already digital currency has spawned many types of new businesses: software vendors for currency server system; hardware vendor for the smart cards and other interface devices; technology firms for security, encryption and authentication and new banking services interfacing accounts in digital currency and conventional currency.

cheques) (4) Micro payment (5) Smart Cards and (6) E-Cash. Kalakota and Whinston (1996) identified three types of electronic payment systems: (1) Digital Token based electronic payment systems¹², (2) Smart Card based electronic payment system¹³ and (3) Credit based electronic payment systems¹⁴. Dennis (2001) classified electronic payment system into two categories: (1) Electronic Cash and (2) Electronic Debit-Credit Card Systems. Thus, electronic payment system can be broadly divided into four general types (Anderson, 1998):

- Online Credit Card Payment System
- Electronic Cheque System
- Electronic Cash System and
- Smart Card based Electronic Payment System

Online Credit Card Payment System

It seeks to extend the functionality of existing credit cards¹⁵ for use as online shopping payment tools. This payment system has been widely accepted by consumers and merchants throughout the world, and by far the most popular methods of payments especially in the retail markets (Laudon and Traver, 2002). This form of payment system has several advantages, which were never available through the traditional modes of payment. Some of the most important are: privacy, integrity, compatibility, good transaction efficiency, acceptability, convenience, mobility, low financial risk and anonymity. Added to all these, to avoid the complexity associated with the digital cash or electronic-cheques, consumers and vendors are also looking at credit card payments on the internet as one of possible time-tested alternative. But, this payment system has raised several problems before the consumers and merchants. Online credit card payment seeks to address several limitations of online credit card payments for merchant including lack of authentication, repudiation of charges and credit card frauds. It also seeks to address consumer fears about using credit card such as having to reveal credit information at multiple sites and repeatedly having to communicate sensitive information over the Internet.

Basic process of Online Credit Card Payment System is very simple. If consumers want to purchase a product or service, they simply send their credit card details

¹² It includes: (1) Electronic Tokens, Electronic Cash and Electronic Cheques.

¹³ It includes: (1) Relationship based Smarts Cards (2) Electronic Purses and Debit Cards and Smart Cards Readers and Smart Phones.

¹⁴ It includes: Encryption and Credit Cards and third party processors and Credit Cards.

¹⁵ Credit card is made of plastic whose holder has been granted a revolving credit lines. This enables the holder to make purchase and/ or cash advances upto a pre arranged limits. The credit granted can be settled in full by the end of a specific period or in part, with the balance taken as extended credit. Interest may be charged on the transaction amounts from the date of each transaction or only the extended credit where the credit granted has not been settled in full. (http://www.rba.gov.in/Glossary/text_only.asp). The card normally contains the cardholders name and account number and many other information encoded on the magnetic strip. Some credit cards may be used in ATM (<http://www.treas.gov/glossar/gloss-c.htm>). Credit cards began in the late 40's when banks began giving out paper certificates that could be used like cash in local stores. Frankline National Bank of New York used the first real credit card in 1951.

to the service provider involved and the credit card organization will handle this payment like any other. This can be understood very easily with the format (Figure 3) of Credit Card Payment Form.

Figure 3: Credit Card Payment Form (Sample)

The form includes the following elements:

- Credit Card Type:** A selection area with logos for VISA (green), MASTERCARD (red), DISCOVER (cyan), and AMERICAN EXPRESS (magenta). There is also a 'Fraud Protection Guaranteed Click Here' link and an 'AMERICAN EXPRESS' logo.
- Expiration date:** A text input field.
- Card number:** A text input field.
- Card holder's name (on card):** A text input field.
- Full billing address of credit card:** A text input field.
- Your email address:** A text input field.
- Comment/Description:** A text input field.
- ...** An ellipsis indicating further options.
- Instructions:** A paragraph stating: "In the comment field please enter the service you are ordering, the domain or username this information should be applied to, or further information to help up speed and assist your order."

CHARGE AUTHORIZATION:

Do you authorize us to charge your credit card? By clicking "Yes" or signing below (type in your name if submitting online) you hereby authorize (*any particular company*) to use the above credit card to bill you for products ordered or services rendered (which includes setup fees, normal monthly fees and any future services you request) until such time as you cancel such services, and you hereby state that you have the legal authority to use this credit card:

Yes No | SIGNATURE:

Kalakota Whinston (1996), break credit card payment on online networks into three basic categories: (1) payment using clean credit card details (2) payment using encrypted credit card details and (3) payment using third party verification.

Electronic Cheque Payment System

Electronic cheques¹⁶ address the electronic needs of millions of businesses, which today exchange traditional paper cheques with the other vendors, consumers and government. The e-cheque method¹⁷ was deliberately created to work in much the same way as conventional paper cheque. An account holder will issue an electronic document that contains the name of the financial institution, the payer's account number, the name of payee and amount of cheque. Most of the information is in uncoded form. Like a paper cheques e-cheques also bear the digital equivalent of signature: a computed number that authenticates the cheque from the owner of the account. Digital chequing payment system seeks to extend the functionality of existing chequing accounts for use as online shopping payment tools. Electronic cheque system has many advantages: (1) they do not require consumers to reveal account information to other individuals when setting an auction (2) they do not require consumers to continually send sensitive financial information over the web (3) they are less expensive than credit cards and (4) they are much faster than paper based traditional cheque. But, this system of payment also has several disadvantages. The disadvantage of electronic cheque system includes their relatively high fixed costs, their limited use only in virtual world and the fact that they can protect the users' anonymity. Therefore, it is not very suitable for the retail transactions by consumers, although useful for the government and B2B operations because the latter transactions do not require anonymity, and the amount of transactions is generally large enough to cover fixed processing cost. The process¹⁸ of electronic chequing system can be described using (figure 4) the following steps. .

Step 1: a purchaser fills a purchase order form, attaches a payment advice (electronic cheque), signs it with his private key (using his signature hardware), attaches his public key certificate, encrypts it using his private key and sends it to the vendor.

Step 2: the vendor decrypts the information using his private key, checks the purchaser's certificates, signature and cheque, attaches his deposit slip, and

¹⁶ Electronic cheque also known as e-cheque and I-cheque are used to make electronic payment between two parties through an intermediary and not very much different from the traditional or current cheque processing system. Electronic cheques are generated and exchanged online. The intermediary will debit the customer account and credit the merchant account.

¹⁷ Electronic cheque is different from the electronic fund transfer (EFT) in several ways. For electronic chequing, electronic versions of cheques are issued, received and processed. So, the payee issues an electronic cheque for each payment. For EFT, automatic withdrawals are made for monthly bills or other fixed payments; no charges are issues.

¹⁸ Thus, a complete electronic cheque transaction may consist of several basic steps and these steps are executed in three distinct and optionally separate phases. In the first phase, the consumer makes a purchase; in the second phase, the merchant sends the electronic cheques to its bank for the redemption. In the third phase, the merchant's bank approaches the clearinghouse or consumer's bank to cash the electronic cheques.

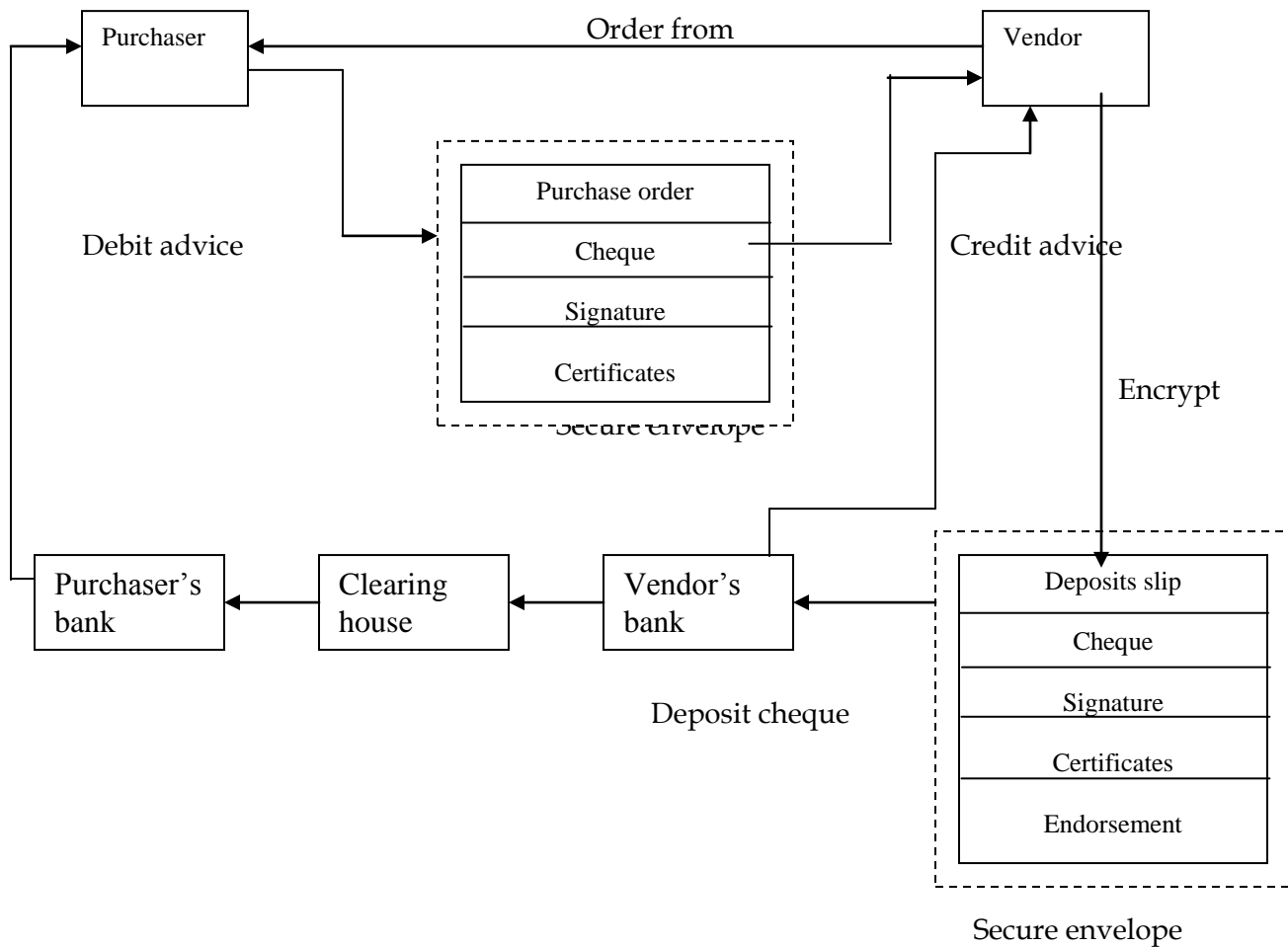
endorses the deposit attaching his public key certificates. This is encrypted and sent to his bank.

Step 3: the vendor's bank checks the signatures and certificates and sends the cheque for clearance. The banks and clearing houses normally have a private secure data network.

Step 4: when the cheque is cleared, the amount is credited to the vendor's account and a credit advice is sent to him.

Step 5: the purchaser gets a consolidated debit advice periodically.

Figure 4: Clearing Cheque payment electronically



E-cheque provide a security rich Internet payment option for businesses and offer an easy entry into electronic commerce without a significant investment in new technologies or legal systems.

Electronic Cash Payment System: Electronic cash (e-cash)¹⁹ is a new concept in online payment system because it combines computerized convenience with security and privacy that improve on paper cash. Its versatility opens up a host of new markets and applications. E-cash is an electronic or digital form of value storage and value exchange that have limited convertibility into other forms of value and require intermediaries to convert. E-cash presents some characteristics like monetary value²⁰, storability and irretrievability²¹, interoperability²² and security²³. All these characteristics make it more attractive payment system over the Internet. Added to these, this payment system offers numerous advantages like authority, privacy²⁴, good acceptability, low transactions cost, convenience and good anonymity²⁵. But, this system of payment also has many limitations like poor mobility²⁶, poor transaction efficiency²⁷ and high financial risk, as people are solely responsible for the lost or stolen. Gary and Perry (2002), just like real world currency counterpart, electronic cash is susceptible to forgery. It is possible, though increasingly difficult, to create and spend forged e-cash.

E-Cash Structure: e-cash structure could be identified as a string of bits that represents certain values such as reference number and digital signature, which could be used for the security purpose to prevent forgery and criminal use (Wright, 2002). But, the structure proposed by Wright (2002) needs some extension to make e-cash more secure. Therefore, the present model (Figure 3.5) adds a digital watermark to e-cash structure to protect it from the illegal copy and forgery activities further, the model modified the structure of the reference number to support tractability as shown in the figure 5.

¹⁹ E-cash portability means that it must be freely transferable between any two parties in all forms of e-commerce transactions. In contrast, credit cards do not possess this property of portability or transferability between every combination of two parties. In credit card transactions, the credit card payment recipient must already have a merchant account established with a bank- a condition that is not required with electronic cash.

²⁰ e-cash must have monetary value; it must be backed by either cash (currency),. Bank authorized credit, or a bank's certified cashier cheque.

²¹ E-cash must be storable and retrievable. Remote storage and retrieval (e.g., from a telephone or personal communication device) would allow users to exchange e-cash from home, office or while traveling. The cash could be stored on a remote computer's memory in smart cards, or in other easily transported standard or special purpose devices.

²² It must be interoperable-that is, exchangeable as payment for other e-cash, paper cash; goods or services, lines of credit, deposits in banking accounts, bank notes or obligations etc.

²³ E-cash should not be easy to copy or tamper with during exchange; this includes preventing and detecting duplication and double spending.

²⁴ The store or third parties online have no way of attaining the consumer's bank account information.

²⁵ Companies have no way of finding out the consumer's account information, and the distributors of e-cash have no way of finding out how e-consumers spend the e-cash.

²⁶ Consumers can only use computers that have the e-cash purse system.

²⁷ Needs to enter a large database to make comparison.

Figure 5: E-Cash Structure

Currency²⁸	Value²⁹	Reference³⁰	Digital Signature³¹	Digital Watermark³²
------------------------------	---------------------------	-------------------------------	---	---

The proposed e-cash structure is comparatively better than suggested by Wright (2002), because security issue is given importance of top most priority in the present model. But, still there are certain concerns to be addressed for an electronic cash system³³. For example, who has the right to issue electronic cash? Can every bank issue its own money? If so how do you prevent fraud? And who will monitor the banking operations to protect consumers? Many of these concepts relate to the legal and banking regulatory aspects. However all these issues are beyond the scope of the study and therefore, cannot be included here. But, these issues must be addressed before establishing a complete e-cash based payment system.

Smart Cards based Electronic Payment System

'Smart cards' are receiving renewed attention as a mode of online payment. They are essentially credit card sized plastic cards with the memory chips and in some cases, with microprocessors embedded in them so as to serve as storage devices for much greater information than credit cards³⁴ with inbuilt transaction processing capability (Chakrabarti and Kardile, (2002).

²⁸ Currency that defines the issued currency to sport multi currencies e-cash.

²⁹ Value that determines the value of e-cash.

³⁰ Reference number that allows the issuer or any other authorized party to trace e-cash movement. It has the following four sub types

- a. Issuer part, which is used as a reference to the issuer.
- b. Client part, which is used as a reference to the customer who orders the e-cash for the first time.
- c. Owner part, which is used to represent the ID of the new owner of the e-cash each time.
- d. Final part, which is used to check the generated digit each time.

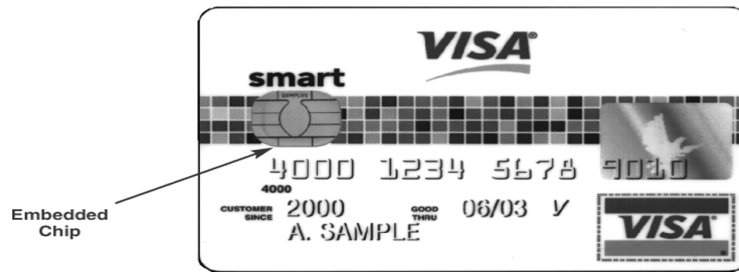
³¹ Digital signature is used to authenticate the identity of the issuer as an authorized party.

³² Digital watermark is used for copyright protection. It inserts invisible data into the digital file. In the present model, e-cash structure uses the digital watermark to prevent forgery or illegal copy of the e-cash.

³³ Processing of electronic payment system: a consumer first had to establish an account at a bank that was using e-cash system. Once the account is established, the consumer then downloaded the e-wallet software onto his/her computer's hard drive. Then consumer could request a transfer of digital cash. Once the digital wallet had cash, the consumer could spend that cash at merchants who were willing to accept it. The software would deduct the cash from digital wallet and transfer it to the merchant. The merchant could then transfer the cash back to the bank to confirm that it had not been double spent. The bank would cancel the e-coins or credit the merchant account at bank.

³⁴ Credit cards store a single charge account number in the magnetic strip on the back, smart cards can hold 100 times more data, including multiple credit card numbers and information regarding health insurance, transportation, personal identification, bank accounts and loyalty programs, such as frequent flyer accounts. This capacity makes them attractive alternatives to carrying a dozen or so credit and ID cards in a physical wallet.

Figure 6: Smart Card Image



This card also contains some kinds of an encrypted key that is compared to a secret key contained on the user's processor. Some smart cards have provision to allow users to enter a personal identification number (PIN) code. Smart cards have been in use for well over the two decades now and have been widespread mostly in Europe and Asian Countries. Owing to their considerable flexibility, they have been used for a wide range of functions like highway toll payment, as prepaid telephone cards and as stored value debit cards. However, with the recent emergence of e-commerce, these devices are increasingly being viewed as a particularly appropriate method to execute online payment system with considerably greater level of security than credit cards.

Compared with traditional electronic cash system, smart cards based electronic payment systems do not need to maintain a large real time database. They also have advantages, such as anonymity, transfer payment between individual parties, and low transactional handling cost of files. Smart cards are also better protected from misuse³⁵ than, say conventional credit cards, because the smart card information is encrypted. Currently, the two smart cards based electronic payment system- Mondex³⁶ and Visa Cash are incompatible in the smart cards and card reader specification. Not knowing which smart card system will become market leader; banks around the world are unwilling to adopt either system, let alone other smart card system. Therefore, establishing a standard smart card system, or making different system interoperable with one another is critical success factors for smart card based payment system.

Kalakota and Whinston (1996), classified smart cards based electronic payment system as (1) relationship based smart cards and electronic purses. Electronic

³⁵ For example conventional credit cards clearly show your account number on the face of the card. The card number along with a forged signature is all that a thief needs to purchase items and charge them against your card. With smart card, credit theft is practically impossible because a key to unlock the encrypted information is required, and there is no external number that a thief can identify and no physical signature that a thief can forge. In addition, smart cards provide the advantages of portability and convenience.

³⁶ Multifunctionary is one of the most exceptional features of the Mondex, a system that intends become "an *electronic equivalent of cash*". It is based on a smart card that can hold money and transfer it in both ways. The Mondex card is a debit card in the sense that can only be used to spend as long as it holds previously loaded money. The Mondex technology, in the development since 1990s, is exclusively runs by Mondex International, a London based firms in which Master cards holds 51% of share since the end of 1996.

purses, which may replace money, are also known as debit card³⁷. Further Diwan and Singh (2000) and Sharma and Diwan (2000), classified³⁸ smart cards into four categories. These are: (1) memory cards: this card can be used to store password or pin number. Many telephone cards use these memory cards (2) shared key cards: it can store a private key such as those used in the public key cryptosystems. In this way, the user can plug in the card to a workstation and workstation can read the private key for encryption or decryption (3) signature carrying card: this card contains a set of pregenerated random numbers. These numbers can be used to generate electronic cash (4) signature carrying cards: these cards carry a co-processor that can be used to generate large random numbers. These random numbers can then be used for the assignment as serial numbers for the electronic cash.

III. USAGE OF ELECTRONIC PAYMENT SYSTEMS

It is observed that different countries prefer the different forms of electronic payment system. The market has been from the start dominated by traditional financial intermediaries offering conventional electronic payment services augmented with minor innovations to adapt to the Internet. In 2003, 94.1 percent of all worldwide e-commerce transactions were conducted using credit cards (Pago, 2003). Even today, Credits cards are dominant form of online payment all over the world. This is especially true about the developed and fastest developing countries. This fact can be supported by the Research conducted by Jupiter Media Matrix (2000). The research revealed that credits cards are the most dominant methods of online payment in US. In the year 2000, credit cards accounted 95 % of online payments and accounted \$47 billion of credit cards transactions in the US. This figure rose to \$25 trillion in the year 2004 (Federal Reserve Payment Study, 2004). However, according to Jupiter Media Matrix Research Survey, some consumers would prefer to other payment system, such as e-cash, debit cards and e-chequing. Only 50 % of consumers outside the US use credit cards for online purchase (Landon and Traver, 2002). According to the "Banking on the Internet Report", Australia has a strong platform for e-payment growth, with 37.7 per cent of the population willing to engage in online payment.

In Europe (especially in UK) and other countries of developed world like Canada, New Zealand, and in some of the Asian Developing Countries like

³⁷ Wallet sized smart cards embedded with programmable microchips that store sums of money for people to use instead of cash for everything from buying food, to making photocopies, to paying subways fares. The electronic purse works in the following manners. After the purse is loaded with money, at an ATM or through the use of an inexpensive special telephone, it can be used to pay for, say, candy in a vending machine equipped with the card reader. The vending machine needs only to verify that a card is authentic and there is enough money available for the chocolate bar. In one second, the value of purchase is deducted from the balance on the card and added to e-cash box in the vending machine. The remaining balance on the card is displayed by the vending machine or can be checked at an ATM or with a balance ready device.

³⁸ Broadly these classifications are based on the technologies used in the smart cards based payment system.

China, Thailand, Japan and Singapore, smart cards based electronic payment system is popular. Most of the developing countries like India rely much more on electronic funds transfer and smart cards based electronic payment system. Very few percent of people have credit cards and use of e-cheque is in vogue. But according to Sumanjeet (2008) credit card is most popular method of payments in India (Table 2)

Table 2: E-Commerce Payments in India

E-Commerce Payment Systems	Percentage	Rank
Credit Card	35	1
Debit Card (Smart Card)	26.5	2
Cash on Delivery	23.5	3
Bank Transfer	9	4
Money Transfer	5	5
Postal Transfer	1	6
Prepaid Card	0	0
Payment Through Convenience Store	0	0
Total	100	0

Source: Sumanjeet (2008)

Interestingly, this fact is supported by a recent study of Nielsen. According to a global online survey conducted by leading research firm Nielsen, at 84%. Indian netizens have emerged as the third biggest credit card users globally for online purchasing, next only to the Turkish (91%) and Irish e-shoppers (86%). The survey found that credit cards are by far the most common method of payment for online purchases with 60 per cent of global online consumers having used their credit card for a recent online purchase. Among the various credit cards, more than half or about 53 per cent used a Visa card. Poor countries still rely on traditional cash and cheque system; they are not very much familiar with the electronic payment system because of poor infrastructure, poor economic conditions, lack of education etc. rate of adoption of e-payment system is not very encouraging in these country. The data from National payments System survey and CBK Annual report (2007) revealed that, Kenya had less than 1,000 ATMs in the country. However, the trend is increasing rapidly.

Table 3: E-Banking Statistics in Kenya

Type	2000	2001	2002	2003	2004	2005	2006
------	------	------	------	------	------	------	------

ATM	239000	262100	248247	266811	332015	426110	829962
Credit	16531	18522	18215	57146	59164	69478	750085
Debit	62256	159498	202018	330007	356989	496647	73238
Smart	2784	3068	3301	3693	3371	3142	3769
Total	320571	443188	471781	657657	751539	995377	1657054

Source: CBK Annual Report (2007)

Outside the US, electronic payment system is heavily influenced by the host country's financial infrastructure (Lawrence, 2000). Added to these, legal regimes, IT Infrastructure, economic and social conditions, are the strong determinants of the methods of online payment and all these vary from country to country and even within the country.

But, overall Credit card is the most popular methods of payment over Internet. Internet buyers seem to prefer credit cards to other electronic payment system that have been made available to them. One reason may be the simple familiarity with the credit card, as it is the oldest form of electronic payment system. E-commerce is still new and intimidating to many. It is easier for the buyers to make purchase on the Internet when they can use the familiar payment method, like credit card. However, this payment system suffered from many limitations like security³⁹, merchant risk⁴⁰, high costs⁴¹ and affordability⁴². For sellers' side, credit card has strategic disadvantages like: (1) credit cards are subject to percentage fees and these charges erode the profits margin, particularly on the inexpensive goods and services; (2) a buyers who uses a credit card may refuse to pay the issuer on the grounds that he/she has a claim or defense arising out of the underlying transactions. When this happens, the issuer may pass the loss back to the seller. Above all, credit cards have highest possibilities of frauds. Therefore, both buyers and sellers are shifting from credit cards to other innovative payment products, such as smart cards and electronic money. But, still it is expected that the buyers may continue to prefer credit card system, particularly when making expensive purchase.

IV. CRITICAL SUCCESS FACTORS OF E-COMMERCE PAYMENT SYSTEM

³⁹ Neither the merchant nor the consumer is authenticated. The existing system offers very poor security. The merchant could be a criminal organization designed to collect credit cards numbers, and the consumers could be using stolen or fraudulent cards.

⁴⁰ The risk facing merchant is high- consumers can repudiate charges even through the goods have been shipped or the product downloaded.

⁴¹ Costs for merchants are also very significant- roughly 3.5 % of the purchase plus a transaction fees of 20 to 30 % per transactions, plus other set up costs. The high costs make it undesirable to sell on the web for less than \$ 10 (Laudon and Traver, 2002)

⁴² Not everyone has the access to credit cards. Millions of people between the ages of 10 to 25 do not have the capacity to have credit cards. Even in America about 70 to 100 million adult cannot afford credit cards because of low incomes.

Success of e-commerce businesses, including both the largest of corporations and small retailers, rely on electronic payment system. Therefore, understanding the various critical success factors of e-commerce payment system is important. There are various factors, which should be considered by an e-commerce, firm before introducing and implementing e-commerce payment system. From the business perspective, new payment products are notoriously difficult to introduce as the barriers to entry (Lee, 1989; Yin, 1994), acceptance, and ubiquity are high (Abrazhevich, 2002).

Table 4: Factors Discouraging Consumer for Online Payments

Factors	Percentage
Concern about security	70
Difficulties to enter information	9
Do not have credit cards/smart cards etc.	7
Do not like interest charge	6
Purchase value too small	4
Exceeded personal limit	4

Source: PaymentOne, April 2003

Table 4 shows some factors, which are obstacles in the online payment systems. A good payment system should also consider these factors. Added to this, new payment products must be low margin to compete, high volume to build critical mass and be profitable, receive favorable press treatment, be well branded to gain customer confidence, achieve rapid uptake, and be differentiated from check and credit card so that consumers and merchants find reason to prefer and use them. Studies also revealed that simplicity (Schwartz, 2001; Truman et. al, 2003), trust (Herzberg, 2003; Juang, 2006), security and mutuality (Peha and Khamitow, 2004; Baddeley, 2004; Oh et al, 2006) of stakeholder benefits are all of importance to the adoption of e-commerce payment system. Thus the factors which are critical for the success of e-commerce payment systems are multifaceted. These include *integrity, non-repudiation, authentication, authorization, confidentiality and reliability*, which are discussed below:

- Integrity: transaction data are transmitted and received unchanged and as intended.
- Non-repudiation: transactions have the quality of non deniable proof or receipts.
- Authentication: identities and attributes of parties engaged in commerce are established at some tolerable level of risk.
- Authorization: individuals are established and recognized as entitled to receive, send or view transactions.
- Confidentiality: transactions can be protected from view except by those who are authorized.

- Reliability: probability of failure in the transaction-send, receive, acknowledge-is low.

Functionally, money technologies also need to achieve these operating characteristics: privacy, scalability, ease of use, personalize-able, seamlessness, interoperability, write one-apply anywhere and cost effective.

V. COMPARISON OF ELECTRONIC PAYMENT SYSTEMS

The electronic payment system- the ability to pay electronically for goods and services purchased online- are an integral part of e-commerce and an essential infrastructure for e-commerce models. One of the major reasons for the widespread of e-commerce transactions is perhaps the rapid development and growth of various electronic payment systems. In the developed countries, credit cards have been used even before the advent of Internet. The present part of the study revealed many electronic payment systems and broadly these electronic payment system can be grouped or classified into four categories: (1) Online Credit Card Payment System (2) Online Electronic Cash System (3) Electronic Cheque System and (4) Smart Cards based Electronic Payment System. These payment systems have numbers of requirements: e.g. security, acceptability, convenience, cost, anonymity, control, and traceability. Therefore, instead of focusing on the technological specifications of various electronic payment systems, the researcher have distinguished electronic payment systems based on what is being transmitted over the network; and analyze the difference of each electronic payment system by evaluating their requirements, characteristics and assess the applicability of each system. Table 5 presents the comparison of various electronic payment systems.

Table 5. Comparison of electronic payment systems

Features	Online Credit Card Payment	Electronic Cash	Electronic Cheque	Smart Cards
<i>Actual Payment Time</i>	Paid later	Prepaid	Paid later	Prepaid
<i>Transaction information transfer</i>	The store and bank checks the status of the credit card	Free transfer. No need to leave the name of parties involved	Electronic checks or payment indication must be endorsed	The smart card of both parties make the transfer
<i>Online and offline transactions</i>	Online transactions	Online transactions	Offline transfers are allowed	Offline transfers are allowed Table 5 contd.
<i>Bank account</i>	Credit card account	No	The bank	The smart card

<i>involvement</i>	makes the payment	involvement	account makes the payment	account makes the payment
<i>Users</i>	Any legitimate credit card users	Anyone	Anyone with a bank account	Anyone with a bank or credit card account
<i>Party to which payment is made out</i>	Distributing Bank	Store	Store	Store
<i>Consumer's transaction risk</i>	Most of the risk is borne by the distributing bank, consumers only have to bear part of the risk	Consumer is at risk of the electronic cash getting stolen, lost, or misused	Consumer bears most of the risk, but the consumer can stop check payments at any time	Consumer is at risk of the smart card getting stolen, lost or misused
<i>Current degree of popularity</i>	Credit card organizations check for certification then total the purchases. Therefore, it can be used internationally, and is the most popular payment type	Unable to meet financial internet standards in the areas of expansion potential and internationalism.	Can not meet international standards, therefore its not very popular	Credit card organizations check for certification then total the purchases. Therefore it can be used internationally, and is becoming more widely used.
<i>Anonymity</i>	Partially or entirely anonymous	Entirely anonymous	No anonymity	Entirely anonymous, but if needed, the central processing agency can ask stores to provide information about a consumer
<i>Small</i>	Transaction costs	Transaction	Allows stores	Transaction

Table 5 contd.

<i>payments</i>	are high. Not suitable for small payments	costs are low, suitable for small payments	to accumulate debts until it reaches a limit before paying for it. Suitable for small payments	costs are low. Allows stores to accumulate debts until it reaches a limit before paying for it. Therefore, it is suitable for small payments
<i>Database safeguarding</i>	Safeguards regular credit card account information	Needs to safeguard a large database, and maintain records of the serial numbers of used electronic cash.	Safeguards regular account information	Safeguards regular account information
<i>Transaction information face value</i>	Can be signed and issued freely in compliance with the limit	Face value is often set, and cannot be changed	Can be signed and issued freely in compliance with the limit	Can be deducted freely in compliance with the limit
<i>Real/Virtual world</i>	Can be partially used in real world	Can only be used in the virtual world	Limited to virtual world, but can share a checking account in the real world.	Can be used in real or virtual worlds.
<i>Limit on transfer</i>	Depends on the limit of the credit card	Depends on how much is prepaid	No limit	Depends on how much money is saved.
<i>Mobility</i>	Yes	No	No	Yes

After analysis and comparison of various modes of electronic payment systems, it is revealed that it is quite difficult, if not impossible, to suggest that which payment system is best. Some systems are quite similar, and differ only in some minor details. Further, all these systems have ability or potential to displace cash. Added to this, widely different technical specifications make it difficult to choose an appropriate payment system. On the basis of above analysis it is concluded that, smart cards based electronic payment system is best. It has numerous advantages over the other electronic payment systems. Therefore, establishing a standard smart card based system, or making different

system interoperable with one another is critical success factor for the smart cards based payment system. Smart card organizations around the world must establish a smart card interface standard and a conformance testing organization to make all smart card system compatible; otherwise smart card related products will not develop fully.

VI. CONCLUDING REMARKS

Technology has inarguably made our lives easier. It has cut across distance, space and even time. One of the technological innovations in banking, finance and commerce is the Electronic Payments. Electronic Payments (e-payments) refers to the technological breakthrough that enables us to perform financial transactions electronically, thus avoiding long lines and other hassles. Electronic Payments provides greater freedom to individuals in paying their taxes, licenses, fees, fines and purchases at unconventional locations and at whichever time of the day, 365 days of the year. On the basis of present study, first remark is that despite the existence of variety of e-commerce payment systems, credit cards are the most dominant payment system. This is consequences of advantageous characteristics, most importantly the long established networks and very wide users' base. Second, alternative e-commerce payment systems are some countries are debit cards. In fact, like many other studies, present study also reveals that the smart card based e-commerce payment system is best and it is expected that in the future smart cards will eventually replace the other electronic payment systems. Third, given the limited users bases, e-cash is not a feasible payment option. Thus, there are number of factors which affect the usage of e-commerce payment systems. Among all these user base is most important. Added to this, success of e-commerce payment systems also depends on consumer preferences, ease of use, cost, industry agreement, authorization, security, authentication, non-refutability, accessibility and reliability and anonymity and public policy.

Acknowledgment

While bearing full responsibility for any remaining mistakes, I wish to thank to my supervisor Prof. L. N. Dahiya for reading the earlier versions of this paper and making a number of helpful comments and constructive criticisms.

REFERENCES

1. Abrazhevich, D. (2002) '*Diary on Internet Payment Systems*', Proceedings of the British Conference on Human Computer Interaction, London, England.
2. Anderson, M.M. (1998), "*Electronic Cheque Architecture, Version 1.0.2*", Financial Services Technology Consortium, September

3. Baddeley, M. (2004) "Using E-Cash in the New Economy: An Electronic Analysis of Micropayment Systems", *Journal of Electronic Commerce Research*, Vol. 5, No. 4, pp 239-253.
4. Bhatia, Varinder (2000), *E-Commerce (Includes E-Business)*, New Delhi: Khanna Book Publishing Co.
5. Boly, J. P. et al., (1994), "The ESPRIT Project CAFÉ-High Security Digital Payment System", ESORICS 94, Third European Symposium on Research in Computer Security, Brighton, LNCS 875, Springer-Verlage, Berlin, pp 217-230. accessed on http://www.zurich.ibm.ch/technology/Security/Sirene/Publ/BBCM1_94cafeEsorics.ps.gz.
6. Cavarretta, F. and de Silva, J. (1995), "Market Overview of the Payments Mechanisms for the Internet Commerce", accessed on <http://www.mba96.hbs.edu/fcavarretta/money.html>.
7. Chakrabarti, Rajesh and Kardile, Vikas (2002), *E-Commerce: The Asian Manager's Handbook*, New Delhi: Tata McGraw Hill.
8. Charkrabarthi, Rajesh et al (2002), *The Asian Manager's Handbook of E-Commerce*, New Delhi: Tata McGraw Hill.)
9. Chaum, D. (1992), "Achieving Electronic Privacy", *Scientific American*, August, pp 96-101 accessed on <http://www.digicash.support.nl/publish/sciam.html>.
10. Danial, Amor (2002), *E-Business (R) evolution*, New York: Prentice Hall.
11. Dennis, Abrazhevich (2001), "Classifications and Characteristics of Electronic Payment Systems", *Lecture Notes in Computer Science*, Vol. 21, No. 5, pp. 81-90.
12. Diwan, Parag and Sharma, Sunil (2001), *E-Commerce: A Managerial's Guide to E-Business*, New Delhi: Excel Books.
13. Diwan, Parag and Singh, Dharmvir (2000), *Computer Networks Driven E-Commerce Technologies*, New Delhi: Amexcel Publisher Pvt. Ltd.
14. Erikson, J. (2003), *Dictionary of E-Commerce*, New Delhi: Anmol Publications Pvt. Ltd., p.151.
15. Herzberg, A. (2003) "Payments and banking with mobile personal devices", *Communications of the ACM*, Vol. 46, No. 5, pp 53-58.
16. Juang, W.S. (2006) 'D-cash: A flexible pre-paid e-cash scheme for date-attachment', Accepted for *Electronic Commerce Research and Applications*.
17. Kalakota, Ravi and Whinston, B. Andrew (1996), *Frontiers of Electronic Commerce*, Singapore: Pearson Education, p. 295.
18. Laudon, C. Kenneth and Traver, Carol (2002), *E-Commerce*, New Delhi: Pearson Education.
19. Lawrence, Stacy (2000), "Study Peeks into Worldwide Wallets", *The Industry Standard*, April. pp 34-54.
20. Lee, A.S. (1989) "A Scientific Methodology for MIS Case Studies", *MIS Quarterly*, 13, pp 33-50.
21. Murthy, C.S.V. (2002), *E-Commerce: Concepts, Models and Strategies*, New Delhi: Himalaya Publishing House, p. 626.
22. Oh, S., Kurnia, S., Johnston, R.B., Lee H. and Lim, B. (2006) "A Stakeholder Perspective on Successful Electronic Payment Systems Diffusion", *Hawaii International Conference on Systems Sciences (HICSS-39)*, Hawaii.
23. Pago, (2003), *Pago Survey 2003: Credit Card Payment, Pago e-Transaction Services*

24. Peha, J.M. and Khamitov, I. M. (2004) "*PayCash: a secure and efficient internet Payment System*", *Electronic Commerce Research and Applications*, Vol 3, No. 4, pp 381-388.
25. Schwartz, E.I. (2001) "*Digital cash payoff*", *Technology Review*, Vol. 104, No. 10, pp 62-68.
26. Sharma, Sunil and Diwan Parag (2000), *E-Commerce: A Manager's Guide to E-Business*, New Delhi: Excel Books.
27. Sumanjeet (2008), "*Factors Affecting the Online Shoppers' Satisfaction: A Study of Indian Online Customers*", *The South East Asian Journal of Management*, Vol. 11, No. 1, pp 3-11.
28. Sumanjeet (2008), "*Securing Payment Systems in the Age of Electronic Commerce*", *International Journal of Management Research and Technology*, vol. 2, No. 1, pp 19-32.
29. Truman G. E., Sandoe, K. and Rifkin, T. (2003) "*An empirical study of smart card technology*", *Information and Management*, Vol. 40, No. 6, pp 591-606.
30. Turban, E.; King, D. and D. Viehland (2004), *Electronic Commerce: A Managerial Perspective*: Prearson Education.
31. Wright, David (2002), *Comparative Evaluation of Electronic Payment System*, INFO 2002.
32. Yin, R.K. (1994) *Case Study Research: Design and Methods*. 2nd edn. Sage Publications, Thousand Oaks.